



# THE JOURNAL OF EGE UNIVERSITY FACULTY OF AGRICULTURE

Special Issue

Volume I



EGE ÜNİVERSİTESİ ZİRAAT FAKÜLTESİ DERGİSİ ÖZEL SAYISI



ISSN: 1018 - 8851

*The Journal of Ege University Faculty of Agriculture*  
*Special Issue*

ISSN 1018-8851

**23<sup>rd</sup> INTERNATIONAL SCIENTIFIC-EXPERTS CONGRESS ON  
AGRICULTURE AND FOOD INDUSTRY**

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**VOLUME - I**  
**2013**

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**The Journal of Ege University Faculty of Agriculture**

ISSN 1018-8851

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CAB Abstracts, FAO AGRIS, NAL Catalog (AGRICOLA), TUBİTAK/ULAKBİM,  
THOMSON REUTERS Master Journal List, Zoological Record.

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**Press:** Ege University Press, Bornova –İZMİR

TC Kültür ve Turizm Bakanlığı Sertifika No: 18679

**Baskı Tarihi:** 20.09.2013

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# INFLUENCE OF ROOTSTOCK AND CLIMATE CONDITIONS ON QUALITY OF PLANTING MATERIAL OF THE ŽILAVKA VARIETY

Agan KOJIĆ<sup>1</sup> Vide ŠUTALO<sup>1</sup> Senaid MEMIĆ<sup>1</sup> Mersija DELIĆ<sup>1</sup>

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## ABSTRACT

Growing vine plantations ensuring high yield and good grape quality is mostly dependent on vine planting material. In order to produce good quality planting material, it is necessary to ensure healthy and good quality vine-cutting of the rootstock and scion of the domestic vine. The following four rootstocks are mostly used in the area of Herzegovina: *Kober 5 BB*, *Paulsen 1103*, *Richter 99* and *Chasselas x Berlandieri 41 B*. The experiment was randomly conducted with four rootstocks in four repetitions. Grafting and stratification of grafts was performed in the Dominant nursery at Gabela vine district. Studied years were 2002 and 2003. The parameters that most significantly influence the quality of the vine planting material were also studied. These include the following: number of grafts of class I and II, number of developed basic roots, length of basic roots, thickness of basic roots and thickness of shoots. The study showed enormous variation among vine rootstocks being the factor mostly influencing the quality of planting material. However, no major statistical variation was observed concerning the studied years. Based on obtained results, grafts of the *Žilavka* variety on vine rootstock *Kober 5 BB* were reported to have the greatest length of roots and greatest thickness of shoots.

Key Words: Rootstock, graft, *Žilavka* variety, planting material

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## INTRODUCTION

Vine growing is an important branch of agriculture in the territory of Bosnia and Herzegovina. Its importance lies in the high productivity. This branch is especially important in the territory of Herzegovina dominated by skeletal soil that can be taken advantage of only in vine growing.

Climate conditions in Herzegovina favour the development of vine growing. As temperature in Herzegovina is high during the period of vegetation, temperature sums in excess of 4.800°C, and in winter is mild, minimum temperature being - 15°C, vine growing in Herzegovina of almost all vine varieties is successful. Also, during the vegetation period, the amount of water residue is enormous, often being above 1.350 mm, of which about 45% during the vegetation period, which is an important factor for successful vine growing.

The growing of vineyard ensuring high yield and good grape quality is mostly dependent on vine planting material. The development of buds, their fertility, longevity and grape quality in a vineyard are directly dependent on planting material. For that reason, the production of planting material must be taken care of in order that it can later have desired effects in the conditions of vine growing. Planting material needs to have good quality in order that grafts formed root. Healthy and good quality cuttings of rootstock as well as scions of domestic vine are necessary for good quality planting material. *Žilavka* is the most present white vine variety in Herzegovina. The most obvious reason for it is presence lies in the fact that it has best results in agro-ecological conditions of Herzegovina. The growing of this variety largely depends on root system as seen from the aspect of depth of penetration and adaptation to skeletal soil. Also, different vine rootstocks have different affinities towards varieties. Thus it is of great importance to determine how behave different vine rootstocks towards *Žilavka* variety in terms of achieve a perfect weld between the two partners and penetration root system into deeper layers of soil. Therefore, this paper aims to examine influence of different rootstocks and *Žilavka* variety on quality of vine grafts, that is, to determine the percentage of I class grafts. For the purpose of this research, vine rootstocks, mostly used in Herzegovina for grafting most of the varieties being grown, have been used. The results obtained in the research will be used by scientists and vine growers in order to provide clear instructions to present and future vine growers as to which vine rootstock should be used to grow the *Žilavka* variety.

For successful production of vine planting material, it is necessary to locate a vine nursery in favourable climate and soil conditions. Sufficient amount of water is necessary for watering certain parts of the nursery Burić (1995).

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According to Suružiy (1965) fertilizing of mother vine rootstocks is an effective agro-technical measure for specific growing in certain soil conditions influencing yield and quality of cuttings as well as properties of production grafts.

According to Vuksanović (1974) taking of vine rootstocks from mother rootstocks and scions from the mother vineyard can be done in the period when leaves start falling in autumn and until spring before vegetation.

## ECOLOGICAL CONDITIONS

Ecological conditions are the key factor influencing successful vine growing. Thus it is essential to be aware of climate and soil when growing vine and producing vine planting material. A part of the process of production of planting material is an outdoor activity; therefore outside conditions considerably influence the quality of vine grafts. In the studied years, temperature conditions were favourable for the development of grafts in the vine nursery; they were as follows:

Table 1. Basic meteorological factors in the Čapljina - Nerezi

Parameter	Year		
	2002	2003	2000-2010
Annual average air temperature (°C)	15,3	15,7	15,6
Average vegetation air temperature (°C)	19,5	21,2	20,8
Absolute minimum air temperature (°C)	4,3	6,4	5,6
Absolute maximum air temperature (°C)	41,0	40,0	40,3
Temperature sum (°C)	4.175,4	4.250,6	4.176,0

Data presented in Table 1 show that annual average air temperature in 2002 was 15.3 °C and in 2003 it was 15.7 °C. Average vegetation temperature in 2002 was 19.5 °C, and in 2003, it was 21.2 °C. The temperature parameters indicate favourable conditions for graft development during the vegetation period. Maximum temperature during the vegetation period in 2002 was 41 °C, and in 2003, it was 40.0 °C. Such high temperatures did not have detrimental effect on the grafts in vine nursery because it was placed under the irrigation system.

Annual rainfall sum during the vegetation period in 2002 was 790.3 mm of water residue, and in 2003, it was 451.7 mm. Thus, rainfall sum in 2003 was quite smaller than one in 2002. However, vine nursery was placed under the irrigation system, so the rainfall sum did not have major influence on the development of grafts during the vegetation.

The soil that was used for vine nursery during the two studied years is located in the vicinity of the Neretva River where the soil is alluvial. In most of the cases, alluvial soil has favourable physical properties and stable micro-aggregates.

## MATERIALS AND METHODS

The research was conducted on the original variety of *Žilavka* that is the most present variety in Herzegovina. Grape bunches of this variety are of medium size and grape yield is regular and good. It successfully grows on skeletal soil found across Herzegovina.

From the point of production - technological characteristics, this variety has high sugar content, varying from 21 to 24 %, and total acid content, varying from 5 to 8 g/l. Grapes of this variety are used for wine production and other purposes.

The following rootstocks were used for grafting: *Kobber 5BB*, *Richter 99*, *Paulsen 1103*, and *Chasselas x Berlandieri 41B*. These rootstocks are most commonly present in the region of Herzegovina because their root system is well developed and they penetrate deep into the soil. Since the region of Herzegovina is dominated by skeletal soil, these rootstocks may ensure good supply of water and minerals to vine plants even in dry season.

The research was conducted in the area of Nerezi, where the vine nursery is located. The experiment was randomly conducted with four variants repeating four times. In each repeating, 50 grafts were taken, which makes 200 grafts per variant. The entire experiment included 800 grafts.

Preparation for grafting was conducted during autumn in a way that from the mother vineyard of rootstocks canes were taken and placed in cold storage. At the same time, canes of *Žilavka* variety were harvested from mother plantation of graft canes and left in storage until the moment to be used. In the beginning of March, the preparation of vine canes for grafting started. Rootstock canes were taken into barrels and left there for three days, while canes of local *Žilavka* were soaked only for one day, because buds would have been damaged if they had been soaked longer.

## RESULTS AND DISCUSSION

Successful production of the vine planting material depends on many factors as follows: canes of local vine and rootstocks, material used for stratification, grafting techniques, methods of maintenance of grafts in vine nursery, etc. From the aspect of quality of grafts, the most relevant indicators of graft quality were observed in the course of their production and the results are hereby provided.

### Number of I Class Grafts

Data in Table 2 indicate that the average number of I class grafts of *Žilavka* variety with rootstocks *Kobber 5BB*, *Richter 99*, *Paulsen 1103* and *Chasselas x Berlandieri 41B* produced in 2002 and 2003 varied between 16.00 (*Kobber 5BB* in 2002) and 20.25 (*Richter 99* in 2002). The authors Avramov and Briza (1986) indicate that with rootstock *Chasselas x Berlandieri 41B* 30-50% of I class grafts can be supplied. Our results vary within the limits provided by these authors.

The results of the variability analysis provided in Table 2 indicate that the presented differences of average number of I class grafts of *Žilavka* variety with rootstock *Kobber 5BB*, *Richter 99*, *Paulsen 1103* and *Chasselas x Berlandieri 41B* produced in 2002 and 2003 was statistically significantly influenced by rootstock, while they were not significantly influenced by conditions of the production years. The testing of differences indicate that the average number of I class grafts of *Žilavka* variety with rootstock *Richter 99* in 2002 was statistically quite higher compared to those with rootstock *Kobber 5BB* in 2002 and rootstock *Paulsen 1103* in 2003. No statistical difference was observed between other rootstocks in the studied years.

Table 2. Average values of the most relevant indicators of graft quality of *Žilavka* variety with rootstocks *Kobber 5BB*, *Richter 99*, *Paulsen 1103* and *Chasselas x Berlandieri 41B*

Indicator	Rootstock	Year		Average
		2002	2003	
No. of grafts of class I $W_{0,05} = 4,23$	<i>Kober 5 BB</i>	16,00 <sup>b</sup>	16,75 <sup>a</sup>	16,38
	<i>Richter 99</i>	20,25 <sup>a</sup>	19,25 <sup>a</sup>	19,75
	<i>Paulsen 1103</i>	17,75 <sup>a</sup>	16,00 <sup>b</sup>	16,88
	<i>Chasselas x Berlandieri 41 B</i>	19,00 <sup>a</sup>	18,75 <sup>a</sup>	18,88
No. of grafts of class II $W_{0,05} = 7,75$	<i>Kober 5 BB</i>	9,00 <sup>ab</sup>	8,75 <sup>ab</sup>	8,88
	<i>Richter 99</i>	12,75 <sup>ab</sup>	14,25 <sup>ab</sup>	13,50
	<i>Paulsen 1103</i>	7,75 <sup>b</sup>	9,50 <sup>ab</sup>	8,62
	<i>Chasselas x Berlandieri 41 B</i>	16,50 <sup>a</sup>	16,00 <sup>a</sup>	16,25
Length of basic roots $W_{0,05} = 10,01$	<i>Kober 5 BB</i>	74,86 <sup>a</sup>	77,19 <sup>a</sup>	76,02
	<i>Richter 99</i>	41,24 <sup>e</sup>	41,24 <sup>e</sup>	41,24
	<i>Paulsen 1103</i>	51,67 <sup>cd</sup>	46,25 <sup>de</sup>	48,96
	<i>Chasselas x Berlandieri 41 B</i>	56,74 <sup>bc</sup>	61,81 <sup>b</sup>	59,28
Thickness of basic roots $W_{0,05} = 0,44$	<i>Kober 5 BB</i>	3,44 <sup>a</sup>	3,49 <sup>a</sup>	3,46
	<i>Richter 99</i>	2,57 <sup>cd</sup>	2,40 <sup>d</sup>	2,48
	<i>Paulsen 1103</i>	3,28 <sup>ab</sup>	3,40 <sup>a</sup>	3,34
	<i>Chasselas x Berlandieri 41 B</i>	3,29 <sup>ab</sup>	2,91 <sup>bc</sup>	3,10
Thickness of shoots $W_{0,05} = 0,92$	<i>Kober 5 BB</i>	9,40 <sup>a</sup>	10,19 <sup>a</sup>	9,80
	<i>Richter 99</i>	8,26 <sup>b</sup>	8,01 <sup>b</sup>	8,14
	<i>Paulsen 1103</i>	9,71 <sup>a</sup>	9,46 <sup>a</sup>	9,58
	<i>Chasselas x Berlandieri 41 B</i>	9,61 <sup>a</sup>	9,41 <sup>a</sup>	9,51



### Number of II Class Grafts

Average number of II class grafts of *Žilavka* variety on examined vine rootstocks produced in 2002 and 2003 varied from 8.75 (*Kobber 5BB* in 2003) to 14.25 (*Richter 99* in 2003).

The results of the variability analysis provided in Table 2 indicate that the presented differences of average number of II class grafts of *Žilavka* variety with rootstocks *Kobber 5BB*, *Richter 99*, *Paulsen 1103* and *Chasselas x Berlandieri 41B* produced in 2002 and 2003 was statistically significantly influenced by rootstock, while they were not significantly influenced by conditions of the production years.

### Length of Basic Roots

Average length of basic roots (cm) of the grafts of *Žilavka* variety on rootstocks *Kobber 5 BB*, *Richter 99*, *Paulsen 1103* and *Chasselas X Berlandieri 41B* produced in 2002 and 2003 varied between 41.24 cm (*Richter 99* in both studied years) and 77.19 cm (*Kobber 5 BB* in 2003). Average length of basic roots of rootstocks for both studied years varied from minimum on rootstock *Richter 99* (41.24 cm) to maximum with grafting on rootstock *Kobber 5 BB* (76.02 cm).

The results of the variability analysis provided in Table 2 indicate that the presented differences of average length of basic roots of grafts of the *Žilavka* variety on rootstocks *Kobber 5 BB*, *Richter 99*, *Paulsen 1103* and *Chasselas X Berlandieri 41B* produced in 2002 and 2003, was statistically significantly influenced by rootstock, while they were not significantly influenced by conditions of the production years.

### Thickness of Basic Roots

Average thickness of basic roots of the grafts of *Žilavka* variety on rootstocks *Kobber 5 BB*, *Richter 99*, *Paulsen 1103* and *Chasselas X Berlandieri 41B* produced in 2002 and 2003 varied from minimum 2.40 mm (*Richter 99* in 2003) to maximum 3.49 (*Kobber 5 BB* in 2003).

The results of the variability analysis provided in Table 2 indicate that the presented differences of average thickness of basic roots of grafts of the *Žilavka* variety on examined rootstock produced in 2002 and 2003, was statistically significantly influenced by rootstock, while they were not significantly influenced by conditions of the production years.

### Thickness of Shoots

Average thickness of shoots of the grafts of *Žilavka* variety on rootstocks *Kobber 5 BB*, *Richter 99*, *Paulsen 1103* and *Chasselas X Berlandieri 41B* produced in 2002 and 2003 varied between minimum 8.01 mm (*Richter 99* in 2003) and maximum 10.19 mm (*Kobber 5 BB* in 2003).

The results of the variability analysis provided in Table 2 indicate that the presented differences of average thickness of shoots of grafts of the *Žilavka* variety on examined rootstock produced in 2002 and 2003, was statistically significantly influenced by rootstock, while they were not significantly influenced by conditions of the production years. Shoots of the grafts of *Žilavka* variety on rootstocks *Kobber 5 BB*, *Paulsen 1103* and *Chasselas X Berlandieri 41B* in both studied years were significantly thicker than those on rootstock *Richter 99*. Examining the influence of rootstocks of 14 vine varieties, Mamarov et al., 1970 found out that in six years on average, for all varieties the vegetation potential was the highest with the rootstock *Kobber 5BB*. The second highest potential was with the rootstock *R du Lot*, and the lowest potential was with the rootstock *Ch X B 41B*. In our research, the rootstock *Kobber 5BB* had the thickest shoots; however, it was not *Ch X B 41B* that had the lowest vegetation potential but *Richter 99*.

## CONCLUSIONS

At *Nerezi* vine district, where vine nursery *Dijamant d.o.o.* is located, an experimental research concerning the influence of four rootstocks grafted on the *Žilavka* variety was being conducted in the period of two years. The purpose of the research was to find out which vine rootstock produces the highest number of I class grafts.

The obtained results, concerning the influence of vine rootstocks on the number and quality of grafts of *Žilavka* in the given production and ecological conditions, have led to the following conclusions:

1. Climatic conditions in the studied years were favourable as there was a lot of sunshine favouring the development of roots and shoots, as well as timely maturing of grafts.
2. Average number of I class grafts was the highest with grafts on the vine rootstock *Richter 99* (19.75), and the lowest on the vine rootstock *Kobber 5BB* (16.38). It is indicative that *Chasselas X Berlandieri 41B* had considerably higher number of I class grafts than expected. Most probably, aids used for better rooting of vine rootstocks facilitated growth of this rootstock the rooting of which is known to be difficult. No major difference was observed in the studied years concerning the number of grafts of class I.
3. Average length of basic roots was maximum with the rootstock *Kobber 5BB* (76.02), and minimum with the rootstock *Richter 99* (41.24). Therefore, there is a statistical difference between grafts on the *Žilavka* variety at various rootstocks. No major difference was observed between the studied years when it comes to *Žilavka* variety.
4. Average thickness of basic roots was maximum with the rootstock *Kobber 5BB* (3.46), and minimum with the rootstock *Richter 99* (2.48). There is a statistical difference between grafts on the *Žilavka* variety at various rootstocks, while no major difference was observed between the studied years.
5. Average thickness of shoots of the grafts of *Žilavka* variety on various rootstocks varied between the maximum with the rootstock *Kobber 5BB* (9.80) and the minimum with the rootstock *Richter 99* (8.14). No major difference was observed between the studied years when it comes to average thickness of shoots on various rootstocks.

Finally, it has been concluded that the grafts of the *Žilavka* variety on various vine rootstocks demonstrated high degree of variability taking into account the most relevant factors of their quality. Based on obtained results, the grafts of the *Žilavka* variety on vine rootstock *Kobber 5BB* had the longest and thickest roots, and also the thickest shoots. Despite the lower number of I class grafts compared to other rootstocks, it is considered to be the best as it has the satisfactory length and thickness of roots taking into account the fact that it was grown on skeletal soil of Herzegovina where vine is usually grown. The grafts of the *Žilavka* variety on vine rootstock *Chasselas X Berlandieri 41B* also had good results taking into account class I and II and the number of developed roots. Therefore, it is recommended for growing on limestone soil since this rootstock tolerates two or three times higher content of CaCO<sub>3</sub> compared to other three vine rootstocks.

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# COMPARATIVE VALUE OF WHITE CLOVER (*TRIFOLIUM REPENS L.*), PERENNIAL RYEGRASS (*LOLIUM PERENNE L.*) AND THEIR MIXTURES

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## ABSTRACT

Forage yield and quality are key factors in sustainable meat and milk production. To fulfill this, the most important is to grow such forage plants that can give high forage yield of high quality. Between perennial legumes and grasses, forage legumes are of superior feeding value due to both nutritive value and voluntary intake compared to grasses. Among perennial legumes, white clover (*Trifolium repens L.*) is one of the most valuable ones due to its high protein content, even though it is not the most productive one. The aim of this work was to compare dry matter and protein yield of white clover, perennial ryegrass and their mixtures. In a two-year experiment (2004-2005), the highest dry matter yield was obtained through a mixture containing 50% white clover and 50% perennial ryegrass (in total 25.29 t/ha), and the lowest pure perennial ryegrass (19.58 t/ha). The differences were significant. On the other hand, the highest protein yield gave white clover (in total 4278.80 kg/ha) and the lowest (2418.59 kg/ha) pure perennial ryegrass. Mixtures with high percent of white clover were both high yielded, including dry matter and protein yield.<sup>1</sup>

Key Words: Dry matter and protein yield

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## INTRODUCTION

Forage legumes are of superior feeding value due to both their nutritive value and their voluntary intake in comparison with grasses. They also contribute to nitrogen (N) economy of grassland, especially in extensive low-input, low cost systems of animal production and of subsequent crops from N<sub>2</sub> fixation. White clover (*Trifolium repens L.*) is, around the world, the most important true clover species for grazed swards within the genus *Trifolium*. In developed countries, especially those with mild climate, white clover mixtures with grasses dominate within temporary grassland. It is not the most productive, but it is of high feeding value having up to 30% of protein in dry matter (DM). Frame and Newbould (1984) and Wolfhardt and Luftensteiner (1983) reported that when sown in pure stand, DM yield of white clover could achieve 12 to 13 t ha<sup>-1</sup>. Perennial grasses are also very productive if grown with legumes due to transferred nitrogen from legumes, or if they are fertilized with high nitrogen rate. Perennial ryegrass (*Lolium perenne L.*) is very suitable to be sown with white clover, as they are similar in many ways, especially for environmental conditions. White clover grown in mixture with perennial ryegrass in New Zealand produced annual yield of 22 to 28 t ha<sup>-1</sup> DM (Frame *et al.*, 1998). Perennial ryegrass, sown in pure stands, produce 12 to 15 t ha<sup>-1</sup> DM, which contains 16 to 18% protein and 23 % cellulose with 78 to 82% of digestibility, if not cut too late (Alibegovic-Grbic, 1992). White clover and perennial ryegrass are grown either in pure stands or together in a binary mixture. Both of them are usually a part, in small rations, in grass-legume mixtures containing many species (alfalfa, red clover, bird's foot trefoil, tall oat grass, meadow fescue, timothy, orchard grass, red fescue, etc.).

The aim of this study was to compare dry matter and protein yield of white clover, perennial ryegrass and their mixtures.

## MATERIALS AND METHODS

The field experiment was established in Butmir near Sarajevo (518 m a s l.) with an average annual precipitation of 902 mm and an average annual temperature of 9,5°C. Soil of the experimental field is loamy-clay, characterized by the pH-5,6 (in H<sub>2</sub>O), P-11 mg, K-14,6 mg and 160 mg N in 100 g of soil. We used a randomized complete blocks design with four replications and plot size of 5 m<sup>2</sup>. The experiment was set up in spring 2004 with following variants: white clover 100%; white clover 75% + perennial ryegrass 25% (S1); white clover 50% + perennial ryegrass 50% (S2); white clover 25% + perennial

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ryegrass 75% (S3) and perennial ryegrass 100%. The sward was harvested at the beginning of white clover flowering. In 2004 we achieved three, and in 2005 four cuts. Protein yield was calculated on the basis of dry matter (DM) yield and protein content ( $N \times 6.25$ ). Total N was determined using the Kjeldahl method. Results were subjected to ANOVA and compared by LSD test.

## RESULTS

Favorable weather conditions had a positive influence on both the dry matter (DM) and the protein yield.

### Dry matter yield

In the seeding year three cuts were obtained. DM yield ranged from 7,11(perennial ryegrass) to 9,17 t ha<sup>-1</sup> (S 2 -white clover 50% and perennial ryegrass 50%), tab 1. The differences were not significant. In the year of full harvest (tab1), due to a longer growing season four cuts were obtained, and DM yield was considerably higher. The most productive was S2 (15,52 t ha<sup>-1</sup>) and once again, perennial ryegrass (12,47 t ha<sup>-1</sup>), but without significant differences. Total DM yield (tab.1) for both years ranged from 19.58 t ha<sup>-1</sup> to 25.29 t ha<sup>-1</sup>, for perennial ryegrass and white clover, respectively. The differences were significant. The mixture 50% white clover and 50% perennial ryegrass gave significantly higher DM yield in comparison to perennial ryegrass in pure stands. Total DM yield of white clover (23,79 t ha<sup>-1</sup>) in pure stand was also significantly higher than DM yield of perennial ryegrass (19.58 t ha<sup>-1</sup>).

Dry matter yield and its distribution per cuttings in 2004 (tab.2) indicate that the first cut is the most productive and its portion in the total yield is the highest, ranging from 46.93% (S1) to 59.63% (perennial ryegrass). The contribution of the second cut was considerably lower in total annual yield ranging from 23.77% (perennial ryegrass) to 38.07% (white clover). The contribution of the third cut is rather small, from 13.41% (S2) to 20.99% (S3).

Table.1. Dry matter yield (t ha<sup>-1</sup>)

Variants	Year		Total
	2004	2005	
White Clover 100%	8.8	13.99	22.79*
S1	8.46	15.52	23.98**
S2	9.17	16.12	25.29***
S3	7.91	12.76	20.67
English ryegrass 100% (control)	7.11	12.47	19.58
LSD 0.05			2.87
0.01			3.92
0.001			5.31

Table 2. Dry matter yield distribution in 2004

Variant	Dry matter yield t/ha <sup>-1</sup>				Dry matter yield distribution (%)			
	1 <sup>st</sup> Cut	2 <sup>nd</sup> Cut	3 <sup>rd</sup> Cut	Total	1 <sup>st</sup> Cut	2 <sup>nd</sup> Cut	3 <sup>rd</sup> Cut	Total
White Clover 100%	4.25	3.35	1.20	8.80	48.30	38.07	13.64	100
S1	3.97	3.09	1.40	8.46	46.93	36.52	16.55	100
S2	5.20	2.74	1.23	9.17	56.71	29.88	13.41	100
S3	3.90	2.35	1.66	7.91	49.30	29.71	20.99	100
English ryegrass 100%	4.24	1.69	1.18	7.11	59.63	23.77	16.60	100

Yield distribution during 2005 (tab.3) was rather similar to 2004 for the first cut. However contribution of the second cut was considerably less. That year, the third cut contributed more than the previous one (16.12% to 20.62 %). The contribution of the fourth cut in total yield was slightly above 10% ranging from 10.24% to 15.99%.

Table 3. Dry matter yield distribution in 2005

Variant	Dry matter yield t/ha <sup>-1</sup>					Dry matter yield distribution (%)				
	1 <sup>st</sup> Cut	2 <sup>nd</sup> Cut	3 <sup>rd</sup> Cut	4 <sup>th</sup> Cut	Total	1 <sup>st</sup> Cut	2 <sup>nd</sup> Cut	3 <sup>rd</sup> Cut	4 <sup>th</sup> Cut	Total
White Clover 100%	6.02	3.40	2.60	1.97	13.99	43.03	24.30	18.58	14.08	100
S1	7.88	2.85	3.20	1.59	15.52	50.77	18.36	20.62	10.24	100
S2	7.87	3.34	2.76	2.15	16.12	48.82	20.72	17.12	13.34	100
S3	5.42	2.40	2.90	2.04	12.76	42.48	18.81	22.73	15.99	100
English ryegrass 100%	7.64	1.36	2.01	1.46	12.47	61.27	10.91	16.12	11.71	100

### Protein yield

In comparison to DM yield, the differences in protein yield were significant (tab. 4) both per year and in total. In the seeding year, the highest protein yield (1647.84 kg ha<sup>-1</sup>) was reached by white clover and the least (889.5 kg ha<sup>-1</sup>) by perennial ryegrass. The highest protein yield in 2005 had white clover in pure stand and S1 (2630.97 kg ha<sup>-1</sup>). The protein yield of perennial ryegrass was only 1529.09 kg ha<sup>-1</sup>. In total, regarding the protein yield, white clover was the most productive (4278.80 kg ha<sup>-1</sup>) while perennial ryegrass was least productive with 2418.59 kg ha<sup>-1</sup>.

Protein yield distribution in 2004 (seeding year) is characterized by a very high participation of the first cut (62.54%) of perennial ryegrass in total annual protein yield (tab.5). White clover had the highest portion of protein yield in the second cut (41.24%), while mixture S3 showed the most participation of protein yield (20.01) in the third cut.

Table 4. Protein yield (kg ha<sup>-1</sup>)

Variants	Year		Total
	2004	2005	
White clover 100%	1647.84**	2630.97**	4278.80***
S1	1483.54*	2630.97**	4114.51***
S2	1441.7*	2571.75**	4013.45***
S3	1144.76	1953.56	3098.32**
Perennial ryegrass 100% (control)	889.5	1529.09	2418.59
LSD 0.05	479.62	592.09	395.33
0.01	663.28	818.82	539.18
0.001	916.71	1131.68	729.65

Protein yield distribution in 2005 (tab.6) was slightly different. However, the highest portion of total annual protein yield was recorded in the first cut and by perennial ryegrass (41.95%). The second and the third cut had a similar portion in total protein yield ranging from 16.35% (perennial ryegrass) to 26.61% (white clover) in the second and from 20.39% (white clover) to 28.10% in the third cut (S3).

Table 5. Protein yield distribution through growing season (cuts) in 2004

Variants	Protein yield kg/ha <sup>-1</sup>				Protein yield distribution (%)			
	1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	Total	1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	Total
White Clover 100%	725.05	679.55	243.24	1647.84	44.00	41.24	14.76	100
S1	664.98	563.44	255.12	1483.54	44.82	37.98	17.20	100
S2	808.08	437.68	195.94	1483.54	56.05	30.36	13.59	100
S3	543.11	372.55	229.10	1144.76	47.44	32.54	20.01	100
English ryegrass 100%	556.29	195.87	137.34	889.50	62.54	22.02	15.44	100

Table 6. Protein yield distribution through growing season (cuts) in 2005

Variants	Protein yield kg/ha <sup>-1</sup>					Protein yield distribution (%)				
	1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	4 <sup>th</sup> cut	Total	1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	4 <sup>th</sup> cut	Total
White Clover 100%	987.88	700.06	536.37	406,65	2630.96	37.55	26.61	20.39	15.46	100
S1	1136.20	570.85	604.90	318,97	2630.94	43.19	21.70	22.99	12.12	100
S2	962.55	651.76	538.34	419,09	2571.74	37.43	25.34	20.93	16.30	100
S3	563.68	454.78	548.86	386,23	1953.55	28.85	23.28	28.10	19.77	100
English ryegrass 100%	641.40	250.02	369.75	267,91	1529.08	41.95	16.35	24.18	17.52	100

## DISCUSSION

White clover grown both in pure stand and in a mixture with perennial ryegrass without fertilization can produce high DM and protein yield per unit area, which was also suggested by Reid (1983) and Skuodiene *et al* (2000). However, dry matter and protein yield of white clover were higher than those of perennial ryegrass for both the seeding year, as well as the second year of growth. But, in total, the differences were significantly higher. On the other hand, perennial ryegrass could not compete with white clover, neither in the dry matter, nor in protein yield. In general, all mixtures were more productive than perennial ryegrass. Due to nitrogen transfer that was fixed by white clover, mixture with high portion of white clover was even more productive than white clover in pure stands. Carlson *et al*(2008)noted that the amount of fixed nitrogen was the highest when white clover was grown with small number of grass species, which could explain the obtained results. However, the best results with regard to DM yield were obtained with mixtures containing up to 50% perennial ryegrass. Higher portion of perennial ryegrass in a mixture had a negative effect on both DM and protein yield. White clover, in whole, was the best when it comes to protein yield. Soegaard (2010) suggested that it is hard to optimize both the dry matter and the protein yield. It seems therefore necessary to choose between maximizing either the protein yield or dry matter yield.

## CONCLUSION

Results showed that white clover grown in pure stand, as well as in a mixture with perennial ryegrass without fertilizing, can produce high DM and protein yield per unit area in Bosnia and Herzegovina. Perennial ryegrass could not compete with white clover in either dry matter or protein yield. The highest dry matter yield was achieved with mixtures containing 75% or 50% of white clover. Pure white clover stand delivered the highest protein yield. Having all previous in mind, it seems necessary to choose between maximizing either the protein yield or the dry matter yield.

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# RESEARCH RESULTS ON THE SPECIES PREFERENCES FOR ROTATION PASTURES UNDER MEDITERRANEAN CLIMATIC CONDITIONS OF AEGEAN REGION

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## ABSTRACT

Grasslands have traditionally been used all around the world for grazing and livestock production generating products such as milk, meat, fiber and others, while grazing is a land use covering approximately 3300 million ha (more than 25%) of the global land surface which makes it the largest and most extensive land use of the planet (Asner et al., 2004). In the Mediterranean regions of the world, the climate is characteristics by mild and wet winters and particularly, long summer droughts, which impose nutritional constraints toward the end of summer. High annual inter-and-intra variability of rains is along with prolonged summer droughts a characteristic of Mediterranean regions (Sánchez-Díaz, 2001). As a Mediterranean country a deficiency of animal protein is highly evident in human diet in rural areas of Turkey and other developing Mediterranean countries. An increase in animal production is necessary to raise the level of living of the rural population and the export-import situation (Tan et al., 2002). Pasture degradation is the most significant factor reducing productivity in farm animals due to the fewer incentive for individuals to reduce grazing pressure. Despite Turkey and neighboring Mediterranean countries faces many problems on productivity of grasslands and forage crop cultivation, there is also great potential for developing forage sources and improving feed resources for farm animals to reduce the grazing pressure on pastures, ensuring their sustainability (Karagoz, 2006). Overseeding on natural pastures and artificial pasture establishments particularly rotation pastures in arable lands are also an effective way of increasing forage sources of Turkey and the developing Mediterranean countries (Kir et al, 2010). In an experiment to test proper techniques to improve forest pastures; fertilizer applications and fertilizer+weed control+overseeding practices were found to be highly effective (Avcioglu et al., 1996). In another study (Gençkan, 1972), weed control, fencing, overseeding and controlled grazing were tested and the results revealed that all treatments increased yield and other properties of pastures. The investigation searching long term performances of an artificial pasture vegetation under Mediterranean conditions displayed that *M.sativa*, *L.corniculatus*, *F.arundinacea*, *A.elatius* were promising pasture crops (Geren et al. 2010). Results of the other field experiment comparing sowing techniques and harvest treatments proved that *M.sativa*+*F.arundinacea* mixture seeded in alternate rows and harvested by grazing provided the best performance (Kir et al., 2010).

Key words: Mediterranean ecology, grasses and legumes, overseeding, rotation pasture.

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## INTRODUCTION

Grazing is a land use covering approximately 3300 million ha (more than 25%) of the global land surface which makes it the largest and most extensive land use of the planet (Asner et al., 2004). Grasslands have traditionally been used all around the world for grazing and livestock production generating products such as milk, meat, fiber and others (Bugalho and Abreu, 2003). The countries with most land area in grazing systems are Australia, 440 million ha; China, 400 million ha; United States, 204 million ha; Brazil, 170 million ha; and Argentina, 140 million ha. Mongolia, Botswana and Uruguay are the countries with the highest proportion of land allocated to grazing (80%, 76% and 76%, respectively). Countries with the highest stocking rates are Malaysia, 3.2 Animal Units (A.U.) ha<sup>-1</sup>; India, 2.7 AU ha<sup>-1</sup>; N.Korea, 2.1 AU ha<sup>-1</sup>; and Vietnam, 1.8 AU ha<sup>-1</sup>; with others with relatively high stocking rates to be found in central Europe and the Middle East. Usually those countries with large areas of dryland grazing system (e.g. Australia, Argentina, and the United States) have relatively lower stocking rates (Asner et al., 2004). In Europe, grasslands represent the dominant land use covering approximately 80 million ha, or 22% of the land area of the European Union (EU25) (EEA 2005), and sustain 150 million cows and 150 million sheep, which is nearly 15% of the global animal population. Extensive areas of permanent grasslands characterize the countries dominated by a Mediterranean climate, including Portugal, Spain, Italy, Greece, most of southern France and southern and western of Turkey. In the Mediterranean regions of the world, the climate is characterized by mild and wet winters and, particularly, long summer droughts, which impose nutritional constraints toward the end of summer. High annual inter-and intra- variability of rains are, along with prolonged summer droughts, a characteristic of Mediterranean regions. Wide variations in amount of herbage biomass from one year to the next are common and a direct result of fluctuations in precipitation and temperature (Geren et al. 2010). Such variability imposes limitations not only on herbage production but also influences the botanical composition of grasslands (e.g. ratio of grasses and legumes) from year to year (Levassor et al, 1993). The nutritional characteristics of the herbage layer can thus be summarized as: low availability and quality towards the end of summer, high availability and relatively high quality in spring, high availability but low quality in summer, and a period of nutritional constraint from summer towards autumn

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and occurrence of first autumn rains (Seligman, 1996). A deficiency of animal protein is highly evident in human diet in rural areas of Turkey and other developing Mediterranean countries. An increase in animal production is necessary to raise the level of living of the rural population and the export-import situation (Tan et al., 2002). Pasture degradation is the most significant factor reducing productivity in animal husbandry due to the fewer incentive for individuals to reduce grazing pressure. Despite Turkey and neighboring Mediterranean countries faces many problems on productivity of grasslands and forage crop cultivation, there is also great potential for developing forage sources and improving feed resources for farm animals to reduce the grazing pressure on pastures, ensuring their sustainability (Karagoz, 2006). Overseeding on natural pastures and artificial rotation pasture establishments, in arable lands are also an effective way of increasing forage sources of Turkey and the developing Mediterranean countries (Kir et al, 2010).

## MATERIALS AND METHODS

**Experiment 1:** Proper improvement techniques for natural forest pastures. In an attempt to find out the proper techniques to improve the natural forest pastures of west coast of Anatolia, fertilization (NPK), weed control (hoeing) and overseeding (lucerne, sainfoin, burnet, orchardgrass, intermediate wheatgrass) techniques were imposed separately or in combination on the vegetations of 4 different experimental sites for 3 years (1989-1991) in Izmir-Turkey (Avcıoğlu et al. 1996). Experimental design was a randomized complete block with 4 replications, plot size being 10 m<sup>2</sup>.

**Experiment 2:** Effect of different practices to improve a lowland pasture. Weed control (hoeing), fencing, resting (no grazing), reseeding (birdsfoot trefoil, smooth brom, crested wheatgrass) and fertilizer (manure 50 t ha<sup>-1</sup> + P 60 kg ha<sup>-1</sup>) were applied on sandy soils of a lowland pasture in Menemen/Izmir (Gençkan, 1972). Experimental design was a randomized complete block with 4 replications, plot size being 100 m<sup>2</sup>.

**Experiment 3:** Long term performance of an artificial pasture vegetation under Mediterranean conditions in Aydın/Turkey. The experiment was carried out for 7 years on a silty-sand loam soil with 7.1 pH in the area (35 m a.s.l., lat. 37°45'N, long. 27°24'E). After conventional seed bed preparation, a mixture of *M.sativa* (10%, 3 kg ha<sup>-1</sup>, *L. corniculatus* (15%, 2.5 kg ha<sup>-1</sup>, *T.resupinatum* (5%, 2 kg ha<sup>-1</sup>) and grasses (*B.inermis* (15%, 5 kg ha<sup>-1</sup>, *F.arundinacea* (25%, 5 kg ha<sup>-1</sup>, *D.glomerata* (10%, 5 kg ha<sup>-1</sup>, *A.elatius* (15%, 6.5 kg ha<sup>-1</sup>) and *S.minor* (5%, 1 kg ha<sup>-1</sup>) were sown on a 7 ha lowland field in 15 cm row spacing on November, 21<sup>st</sup> 2002. A total of 200 kg ha<sup>-1</sup> NPK fertilizer was applied prior to sowing in early spring of each year. The experimental design was randomized plots (100x100m) with 4 reps. Data indicating overall performances of material were statistically analyzed and summarized in Table 3 and 4. In variation analysis the least significant difference (LSD) test was performed.

**Experiment 4:** Effect of sowing techniques and harvesting treatments on the performances of some rotation pasture mixtures. The rotation pasture trial was performed in the experimental area (38°27.236 N, 27°13.576 E at about 2 m a.s.l) of the Field Crop Department of Agriculture Faculty in Ege University, Bornova, Izmir, Turkey under Mediterranean climatic conditions in 2004 - 2005. The soil was heavy textured with 30.2% sand, 32.5% silt, 37.3% clay, 1.1% organic matter and pH of 7.8. Two grasses (*Festuca arundinacea*, Fa and *Cynodon dactylon*, Cd ) and three legumes (*Medicago sativa*, Ms; *Trifolium repens*, Tr and *Lotus corniculatus*, Lc) were seeded in different rate of mixture (Fa 75% +Ms 25%, Fa 75% + Tr 25%, Fa 70% + Lc 30%, Cd 65% + Tr 35%, Cd 35% + Tr 30% + Fa 35%) in same or alternate rows. Individual plot size was 2 x 5 m = 10 m<sup>2</sup>. Sowing was done in 20 cm row spacing, in same or alternate rows by hand, on October 18th, 2003. Grazing plots were separated from cutting plots by fencing. Sampling cages (50 x 50 x 80 cm<sup>3</sup>) in all plots were also employed for observations and measurements. The total average results of the two years study were statistically analyzed using ANOVA (analysis of variance) with the statistical analysis system (SAS, 1990) and differences between treatment means were compared using the least significant difference (LSD) test at 5% probability.

## RESULTS AND DISCUSSION

**Experiment 1:** Results of the first experiment, as an average of different locations and years (Table 1), showed that fertilizer application and fertilizer+weed control+overseeding methods imposed on the vegetation affected positively. Effect of fertilizer application was obvious and it increased the rate of legumes in botanical composition and the combination of techniques gave the best result in terms of green and hay yields. Since none of the seeds used in overseeding could germinate and form a new crop, there was no any noticeable result of this technique. It

was concluded that almost 200% increase in hay yield of pasture vegetations in the area could be achieved through the weed control and fertilizing techniques (Avcioglu et al., 1996).

Table 1: Effect of different improving techniques applied in 4 different sites (Doğanbey, Payamlı, Çift Kalesi-I and Çift Kalesi-II) of Izmir during 1989-1991

Treatments	Botanical Composition (%)			Yield (kg.ha <sup>-1</sup> )	
	Legumes	Grasses	Others	Green Herbage	Hay
Control	6	33	61	2163	514
Fertiliser Application (100 kg.ha <sup>-1</sup> NPK)	9	28	63	3175	724
Weed control	8	25	67	2345	514
Overseeding+Weed control	8	34	58	2129	475
Fertiliser+Weed control+Overseeding	6	44	50	3462	806

Experiment 2: Results of the second experiment indicated that hay yield and legume rate in botanical composition were higher by applying all of these improving techniques together (Table 2).

Table 2: Effect of some pasture improving techniques (weed control, fencing, overseeding, controlled grazing) on the hay yield and botanical composition of a marginal lowland pasture in Izmir-Turkey (Gençkan, 1972).

	Control			Improved with cultural methods		
	Hay yield (kg.ha <sup>-1</sup> )	Bot.comp. (%)	Number of species	Hay yield (kg.ha <sup>-1</sup> )	Bot.comp. (%)	Number of species
Grasses	903	69	11	1705	53	15
Legumes	356	27	12	1262	39	15
Other family	53	4	2	263	8	4
Invaders			17			3
Total	1312	100	42	3230	100	37

Experiment 3: Botanical composition data obtained from the swards were highly variable in terms of percentage of legume, grass and weed components (Table 3). Long term (7 yrs) performance of experimental crops indicated the increased rates of *Ms* and *Fa* in the swards, but decreasing rates of *Tr* and *Dg* which is a grass well-known for its competitive ability (Lacefield et al, 2003). Another striking point among the results was that of a steady increase of weed infestation throughout the experimental years. There were significant differences among total dry matter (DM) yield of experimental years (Table 4). Sward total DM yields increased until 2006 and decreased in the following years (2007-2009). DM yield data also confirmed that *Ms* and *Fa* performed far better than other crops in the sward. Further, *Lc* and *Ae*, with satisfactory and sustainable DM yields in the course of experimental years, also performed better than *Tr* and *Dg*. The latter species are known as being susceptible to high atmospheric heat, light intensity and low air moisture which are the essential characteristics of Mediterranean environments (Hall et al, 2009). Our results confirmed related information given by Lacefield et al. (2003) and Deak et al. (2007). Existing as an indigenous species in the region, *Sm* cultivar maintained a reasonable performance in sward whereas weeds invaded the gaps left by disappearing individuals of *Tr*, *Bi* and *Dg* (Søegaard, 2002). The results of the long-term cover tests in the experiment supported the approach pointing out the promising performances of the sward through the contributions provided particularly by *Fa*, *Ms*, *Ae* and *Lc* in the mixture. Overall cover rates in succeeding years decreased mainly because of weed infestation (Table 4). In addition to Mediterranean ecological impacts, it is obvious that grazing has to some extent adverse effect on pasture crops, and thinning in the swards is expected.

Table 3: Botanical compositions (%) in different years

Crops	2003	2004	2005	2006	2007	2008	2009	Mean
<i>M. sativa</i> (Ms)	12.2	13.8	15.7	17.2	23.7	18.4	18.6	17.1
<i>L. corniculatus</i> (Lc)	8.6	11.0	9.6	13.3	8.7	9.2	11.8	10.3
<i>T. resupinatum</i> (Tr)	14.2	10.8	4.3	1.1	0.0	0.0	0.0	4.3
<i>B. inermis</i> (Bi)	8.1	7.6	9.2	8.8	6.9	10.1	5.6	8.0
<i>D. glomerata</i> (Dg)	18.3	13.9	11.4	7.6	5.1	3.8	1.1	8.7
<i>A. elatius</i> (Ae)	12.3	11.5	9.7	11.1	9.4	11.2	11.1	10.9
<i>F. arundinaceae</i> (Fa)	16.7	21.1	23.8	24.4	26.6	28.7	30.7	24.6
<i>S. minor</i> (Sm)	7.1	6.6	8.4	5.3	6.4	6.2	6.7	6.7
Natives-weed (W)	2.5	3.7	7.9	11.2	13.2	12.4	14.4	9.3
LSD (0.05)	Year : ns, Crops : 0.7, Year x Crops : 1.9							

Table 4: Dry matter yield and cover traits of mixture crops in succeeding years

	DM yield (kg ha <sup>-1</sup> )								Total cover (%)							
	2003	2004	2005	2006	2007	2008	2009	Mean	2003	2004	2005	2006	2007	2008	2009	Mean
Ms	875	1190	2210	2470	3005	2490	2145	2055	17.1	19.0	14.1	16.9	19.8	16.7	15.4	17.0
Lc	645	950	1325	1665	1165	1200	1430	1197	6.3	10.6	7.4	13.2	8.4	9.1	10.6	9.4
Tr	100	640	350	45	0	0	0	291	14.5	7.8	3.4	2.0	0.0	0.0	0.0	4.0
Bi	415	395	970	860	635	955	385	659	6.4	5.1	9.6	6.8	5.3	6.4	3.6	6.2
Dg	960	1080	1255	810	510	370	85	724	14.6	10.4	8.5	5.7	3.2	2.7	1.1	6.6
Ae	680	995	1040	1410	940	1305	965	1048	10.8	8.5	9.6	9.5	6.9	8.5	10.4	9.2
Fa	119	1534	3888	4119	3698	4272	3746	3208	17.1	19.4	21.4	22.6	22.2	23.8	25.4	21.7
Sm	351	615	915	505	875	568	82	559	5.8	4.7	8.8	3.8	6.4	3.6	4.4	5.4
W	219	390	835	1380	1305	1230	1610	996	3.5	2.2	7.2	12.2	11.3	8.6	11.9	8.1
Σ	634	7789	12788	13264	12133	12390	10448		96.1	87.7	90.1	92.7	83.5	79.4	82.8	
	LSD (.05) Year : 36 Crops : 41 Year x Crops : 108								LSD (.05) Year : 0.6 Crops : 0.7 Year x Crops : 1.9							

Experiment 4: Cover and other data were summarized in Table 5.

**Cover:** Highest cover rate (82.1%) was obtained from Fa + Tr mixture plots (Table 5). Significant effect of sowing methods on the cover rate was also recorded and average cover rate in same-rows was better than that of alternate-rows. Harvesting methods were also significantly effective on average cover rate. Also grazing treatment provided better covers (83.1%) than cutting (73.5%).

**Vegetation height:** The highest vegetation was obtained in Fa and Ms mixture as a result of the morphological structure of these forage crops which had erect growing habit with intensive tillers. Previous researchers confirmed that Ms and Fa have many morphological advantages such as vigorous growth with erect stems and rich tillering (Hubard and Nicholson, 1964). Cd and Tr mixture had lower vegetation heights. This was due to the prostrated growing habits of this grass and legume crops (Avcioglu et al., 2009), although Cd was a fast growing warm season grass. It is a fact that cutting versus grazing or vice versa has been discussed by scientist for many years (Bubar, 1964). Some researchers pointed out the advantages of grazing over cutting (Sawnhey and Anderson, 1963), although others indicated controversial results.

**Botanical composition:** Botanical composition data also indicated significant differences among the mixtures mainly in terms of rate of legume component. Higher average legume rates were recorded in Fa + Ms and Cd + Fa + Tr mixtures. There was no significant difference between same or alternate-row sowings with regards to the legume component but average legume rates in grazing were higher than in cutting. In an attempt to compare the effect of defoliation techniques (cutting and grazing treatments) on rye grass persistency and tillering, Evans et al. (1998) revealed that grazing was more favorable than cutting and contrasting impacts of cutting and grazing management on sward components were obvious. Since Tr is a cold season leguminous forage crop, it was concluded that Mediterranean hot climatic conditions were harmful to this component and a limiting factor for its regeneration. In addition, Tr is replaced mostly by weeds particularly during hot periods (Kadziuliene, 2003).

Table 5: Effect of sowing techniques and harvesting treatments on cover, vegetation height, botanical composition (legume, grass and other family), fresh biomass and hay yield traits of some rotation pasture mixtures.

Mixtures	Cover (%)	Vegetation Height (cm)	Botanical Composition (%)			Fresh Biomass Yield (kg ha <sup>-1</sup> )	Hay Yield (kg ha <sup>-1</sup> )
			Legume	Gramineae	Other Family		
Fa + Ms	79.8	66.02	32.79	65.00	2.21	51870	13504
Fa + Tr	82.1	38.25	16.04	80.44	3.52	43790	11170
Fa + Lc	75.7	40.74	11.48	84.63	3.89	42570	11076
Cd + Tr	79.2	31.22	20.63	62.57	16.80	35960	9353
Cd+Fa+Tr	74.9	37.66	32.63	43.94	23.43	37440	9748
LSD	2.6	0.66	0.95	0.89	1.00	780	588
F-test	**	**	*	*	*	**	**
<b>Sowing Techniques</b>							
Same-rows	79.5	44.32	22.78	67.63	9.36	41775	10567
Alternate-rows	77.2	41.19	22.64	67.00	10.41	42865	11373
LSD	1.6	0.40	ns	ns	0.87	280	372
F-test	**	**	ns	ns	*	**	**
<b>Harvest Techniques</b>							
Grazing	83.1	44.92	24.72	66.20	8.84	43400	11336
Cutting	73.5	40.60	20.70	68.43	10.93	41250	10604
LSD	1.2	0.11	0.61	0.24	0.80	430	234
F-test	**	**	*	*	*	**	**

**Fresh biomass yield (kg ha<sup>-1</sup>):** The total fresh biomass yield particularly increased in Fa containing mixtures and the mixture with Ms had also the highest fresh biomass yield (51870 kg ha<sup>-1</sup>). Due to the aggressive and competitive growth habits of Fa and Ms, higher yield values were recorded in these mixtures. Demiroglu and Avcioglu (2006) also reported that Fa and Ms are generally dominating legume and grass components in pasture mixtures. There was also significant difference between sowing techniques and alternate-rows having highest average fresh biomass yield (42865 kg ha<sup>-1</sup>). This finding suggested that alternate row spacing was in favour of mixture crops in terms of competition for nutrients and water. Effect of harvest treatments on fresh biomass yield was also significant and average fresh biomass yield in grazing (43400 kg ha<sup>-1</sup>) was higher than the average yield of cutting treatment (41250 kg ha<sup>-1</sup>). Previous studies are consistent with the results of our study (Miles, 1960). Frame and Hunt (2006) also investigated the effects of cutting and grazing systems of herbage production in a perennial rye grass-dominant sward.

**Hay yield (kg ha<sup>-1</sup>):** Hay yield differences among the mixtures were significant and Fa + Ms mixture had the highest average values (13504 kg ha<sup>-1</sup>). Average hay yield of alternate-rows was also higher than those of same-rows. There were also significant differences among the harvest treatments in terms of hay yield, and the average yield of grazing treatment (11336 kg ha<sup>-1</sup>) was found to be higher than cutting treatment (10604 kg ha<sup>-1</sup>).

## CONCLUSION

In accordance with the results of the first and second experiments, it can be concluded that fertilization and weed control which significantly increased grass portion appeared to be effective techniques for pasture improvement in the west coast of Turkey. Any introduction and contribution to the local vegetations through drilling, overseeding or reseeding seemed to be very difficult under dryland conditions of Mediterranean ecology. The results of third experiment suggested that Ms and Fa were the permanent and most successful legume and grass crops in the mixture, with respect to botanical composition throughout the experimental years. With respect to DM yield and cover characteristics, same components of the mixture also performed well and have been evaluated as recommendable for all resembling Mediterranean environments. It was also suggested that Lc and Ae, both exhibiting stable and sustainable DM yield and cover contribution to overall performances of the sward, should be included in this type of Mediterranean pasture mixture. General performances of Tr, Bi and Dg in the mixture proved that more attention should be paid to consider these forage crops in mixtures and indicated the necessity for further investigations. Overall results of fourth experiment revealed that, when a rotation pasture establishment under Mediterranean climatic conditions is targeted, Fa + Ms mixture should be preferably seeded in alternate rows and harvested by grazing.

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# TEA GROWTH AND YIELD IN RELATION TO MIXED CULTURES OF N<sub>2</sub>-FIXING AND PHOSPHATE SOLUBILIZING BACTERIA

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## ABSTRACT

This study was conducted in order to investigate the effects of different potential PGPR strains from a pool obtained from the tea (*Camellia sinensis* L.) rhizosphere on growth and yield of tea plants under natural soil conditions by conducting pot experiments in three years. The isolates were identified based on whole-cell fatty acid methyl ester (FAMES) analysis using the MIDI system and BIOLOG assays. The experiment included 7 different combinations of PGPR and applications of mineral nitrogen, and NPK-fertilizer as well as a control treatment without inoculation and fertilizer application. The experiments were conducted in a completely randomized block design with four replicates (each having twelve rooted cutting sapling). Bacterial combination efficiencies were variable and depended on the inoculants strain, harvest time and growth parameters evaluated. Trial results showed that mixed inoculation of I (*Bacillus simplex* 6/4+*Brevibacillus centrosporus* 66/4+*Burkholderia cepacia* 65/6), IV (*Paenibacillus lentimorbus* 47/8+ *Bacillus subtilis* 39/3+*Pseudomonas fluorescens* 58/3), VII (*Bacillus subtilis* 6/3+*Bacillus atrophaeus* 55/6+*Pseudomonas fluorescens* 4/9), VI (*Bacillus sphaericus* 57/3+*Alcaligenes faecalis* 47/11+*Brevibacillus reuszeri* 10/5) and V (*Bacillus megaterium* 66/5+*Pseudomonas putida* 29/2+*Citrobacter freundii* 3/7) stimulated overall plant growth, including shoot development and leaf yield of Turkish registered tea clone Fener 3. It was concluded that PGPR had a potential to be used as a bio-fertilizer in sustainable and organic tea production.

**Key Words:** Plant-growth-promoting bacteria, nitrogen fixation, phosphate solubilization, mixed inoculation, biofertilizers

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## INTRODUCTION

Nitrogen and phosphorus are essential nutrients for plant growth and development. Intensive agriculture entails the risk of excessive fertilization. Microorganisms are important in agriculture in order to promote the circulation of plant nutrients and reduce the need for chemical fertilizers as much as possible. Therefore, use as biofertilizers for sustainable agriculture is important. Microorganisms colonizing the rhizosphere can affect plant growth both positively and negatively, the term plant growth promoting rhizobacteria (PGPR) often describes beneficial rhizobacteria that stimulate plant growth (Asghar et al. 2002). PGPR in turn having a great impact on root biology, influence plant growth, nutrition and development are important for long-term sustainability. N<sub>2</sub>-fixing and P-solubilizing bacteria are important in plant nutrition increasing N and P uptake by the plants. Plant-associated N<sub>2</sub>-fixing and P-solubilizing bacteria are regarded as a possible alternative for inorganic nitrogen fertilizers, and PGPR strains have previously been attracted the attention of agriculturists as soil inoculums to improve the plant growth and yield (Çakmakçı et al., 2001, 2006, 2007a,b; Şahin et al., 2004, Park et al., 2005; Chen et al., 2006; Hariprasad and Niranjana, 2009). Tea (*Camellia sinensis*) the most important plant of Turkey is used in the traditional preparation of its national food and is planted widely on acidic soils. Turkey's tea growing area is only located at the very mountainous eastern end of the Black Sea coast, centered on the town of Rize and Trabzon. In this area, the soils are classified as acid. However, no information is available on the occurrence of PGPR tolerant to soil acidity and its interactions with acid tolerant crops generally grown on acidic soils of the tea gardens of Turkey. We conducted a survey of PGPR naturally colonizing a mild climate with high precipitation and acidic soil in tea growing region (Çakmakçı et al., 2010). Information about the composition and diversity of the bacterial community characteristics in tea garden soil ecosystems is scarce. Therefore, the objective of this study was to isolate and identify plant growth promoting rhizobacteria from the rhizosphere of tea and characterize them for nitrogen fixation, phosphate solubilization and plant growth promotion. The aim of this work was to evaluate effects of

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co-inoculation with phosphate-solubilizing bacteria (PSB) and nitrogen-fixing bacteria (NFB) on growth and yield in tea seedlings.

## MATERIALS AND METHODS

The field of rhizosphere microbiology of tea garden soil ecosystems unexplored and in this work, we have isolated the bacterial population in 413 acidic soils samples from the rhizosphere of tea production zones. Bacterial strains were initially isolated from the rhizosphere of tea rhizosphere soil based on whole-cell fatty acid methyl ester (FAMES) analysis using the MIDI system (Sherlock Microbial Identification System version 4.5, MIDI, Inc., Newark, DE). The identified bacterial strains were maintained in nutrient broth (NB) with 30% glycerol at -86°C for further tests. These bacteria were also tested for N<sub>2</sub>-fixing ability, as described by Döbereiner (1988) and phosphate solubilisation capacity on National Botanical Research Institute's phosphate growth medium (NBRIP-BPB). Ability of rhizobacterial isolates to grow on Döbereiner nitrogen-free culture medium indicated their non-symbiotic N<sub>2</sub>-fixation ability (Rau et al., 2009; Han et al., 2005). Among the 460 bacterial strains, 394 strains exhibited N<sub>2</sub>-fixing activity and 305 were efficient in phosphate solubilization; 265 strains were efficient in N<sub>2</sub>-fixation and P-solubilization.

We selected twenty-one different potential PGPR from a pool of 460 rhizobacterial isolates obtained from the tea rhizosphere on the basis of their SIM value, N<sub>2</sub>-fixing and P-solubilizing ability. The selected 21 strains (Table 1) were tested for their three strains combinations on growth and yield increasing potential under natural soil conditions by conducting pot experiments in three years at the Atatürk Tea and Horticultural Research Institute of Rize.

Table 1. Biochemical characteristics of the bacterial strains tested

Bacterial strain	Oxidase	Catalase	Sucrose	N <sub>2</sub> -fixation	P-solubili-zation
<i>Bacillus simplex</i> 6/4	+	S+	-	S+	W+
<i>Brevibacillus centrosporus</i> 66/4	-	+	W+	S+	W+
<i>Burkholderia cepacia</i> 65/6	-	+	-	+	S+
<i>Paenibacillus polymyxa</i> 28/3	-	+	+	S+	W+
<i>Chryseobacterium indologenes</i> 21/5	S+	S+	-	W+	+
<i>Burkholderia pyrrocinia</i> 64/4	+	W+	W+	S+	S+
<i>Brevibacillus choshinensis</i> 2/5	W+	+	W+	S+	W+
<i>Rhizobium radiobacter</i> 2/7	S+	+	-	-	+
<i>Achrb. xylosoxidans denitrificans</i> 16/4	+	S+	-	W+	-
<i>Paenibacillus lentimorbus</i> 47/8	-	S+	-	S+	W+
<i>Bacillus subtilis</i> 39/3	W+	S+	+	S+	W+
<i>Pseudomonas fluorescens</i> 58/3	S+	+	+	+	W+
<i>Bacillus megaterium</i> 66/5	-	+	W+	S+	W+
<i>Pseudomonas putida</i> 29/2	+	+	-	S+	W+
<i>Citrobacter freundii</i> 3/7	-	+	-	+	S+
<i>Bacillus sphaericus</i> 57/3	W+	S+	-	+	+
<i>Alcaligenes faecalis</i> 47/11	+	-	+	-	-
<i>Brevibacillus reuszeri</i> 10/5	S+	+	W+	S+	-
<i>Bacillus subtilis</i> 6/3	+	S+	-	S+	W+
<i>Bacillus atrophaeus</i> 55/6	-	+	+	S+	+
<i>Pseudomonas fluorescens</i> 4/9	S+	+	+	+	W+

"S": strong positive reaction, "+": positive reaction, "W": weak positive reaction.

The experiments were conducted in a completely randomized block design with four replicates (each having twelve rooted cutting sapling). The treatments included: (1) Control ((without bacteria inoculation or mineral fertilizers), (2) N fertilizer (158 mg N rooted cutting in the form of ammonium nitrate 33%), (3) NPK fertilizer (240 mg N + 76 mg P + 48 mg K rooted cutting in the compound fertilizer); (4) *Bacillus simplex* 6/4+ *Brevibacillus centrosporus* 66/4+ *Burkholderia cepacia* 65/6; (5) *Paenibacillus polymyxa* 28/3 + *Chryseobacterium indologenes* 21/5+ *Burkholderia pyrrocinia* 64/4, (6) *Brevibacillus choshinensis* 2/5+ *Rhizobium radiobacter* 2/7+ *Achromobacter xylosoxidans denitrificans* (*Alcaligenes*) 16/4, (7) *Paenibacillus lentimorbus* 47/8+ *Bacillus subtilis* 39/3+ *Pseudomonas fluorescens* 58/3, (8)

*Bacillus megaterium* 66/5+ *Pseudomonas putida* btype B 29/2+ *Citrobacter freundii* 3/7, (9) *Bacillus sphaericus* 57/3+ *Alcaligenes faecalis* 47/11+ *Brevibacillus reuszeri* 10/5, (10) *Bacillus subtilis* 6/3+ *Bacillus atrophaeus* 55/6+ *Pseudomonas fluorescens* 4/9. Saplings were the rooted cuttings, used as planting material. There were ten treatments and four replicates (each having twelve rooted cutting sapling) totalling 480 pots.

For this experiment, pure cultures were grown in 50% strength tryptic soy broth (TSB) on a rotary shaker (120 rpm; 25 °C) for 3 days. Bacteria were then harvested by centrifugation (ca. 3000 x g for 10 in), washed and re-suspended in 10 mM sterile phosphate buffer, pH 7 (SPB) to a density of 10<sup>9</sup> cfu ml<sup>-1</sup> for the bacterial strains. For triple inoculation, equal volume (10<sup>9</sup> cfu ml<sup>-1</sup> of each inoculant) of three cultures were mixed and then used for tea seedlings. Rooted cutting were surface-sterilized prior to inoculation by soaking in 25% commercial-grade bleach for 5 min, followed by thorough washing under running tap water and air-drying aseptically overnight at room temperature. Uniform height young rooted cutting were inoculated with each of the PGPR strains. The bacterial inoculation involved dipping the root system of the saplings into a suspension of each PGPR strains for 60 min, prior to planting. Fresh and dry leaf weight, shoot weight, average and total shoot length, shoot and trunk diameter and plant height were collected for all tea rooted cuttings. An analysis of variance (ANOVA) and Duncan's multiple range test (at  $p < 0.05$ ) were performed to analyse statistical differences and to discriminate between means (Stat Soft Inc, 1998).

## RESULT AND DISCUSSION

Inoculation of mixed bioinoculants of N<sub>2</sub>-fixing and P-solubilizing bacteria promoted growth and yield of tea under natural soil conditions by conducting pot experiments at the Ataturk Tea and Horticultural Research Institute of Rize. Triple inoculation with phosphate-solubilizing bacteria (PSB) and nitrogen-fixing bacteria (NFB) resulted in higher plant height, shoot and leaf weight than uninoculated control. The best effects were obtained in plants grown in soils with mixed combination of the fourth (*Paenibacillus lentimorbus* 47/8, *Bacillus subtilis* 39/3 and *Pseudomonas fluorescens* 58/3) and the first (*Bacillus simplex* 6/4+ *Brevibacillus centrosporus* 66/4+ *Burkholderia cepacia* 65/6) combinations. The maximum trunk diameter in tea seedling was found after mixed inoculation with P-solubilizing strain *B. cepacia* 65/6 and N<sub>2</sub>-fixing strains *B. simplex* 6/4 and *B. centrosporus* 66/4, followed by combination of the fourth and fifth. The highest plant height was observed after co-inoculation with N<sub>2</sub>-fixing and P-solubilizing strains *Bacillus subtilis* 6/3, *Bacillus atrophaeus* 55/6, and *Pseudomonas fluorescens* 4/9, followed by N<sub>2</sub>-fixing *Brevibacillus reuszeri* 10/5 and P-solubilizing *Bacillus sphaericus* 57/3 inoculations. On the other hand, the effect of strong N<sub>2</sub>-fixing strains application was essentially associated with improvement of a nitrogenous nutrition of tea seedlings. Therefore, the better effect of combined inoculation with strong P-solubilizing strain *B. cepacia* 65/6 and nitrogen fixing strains *B. simplex* 6/4 and *B. centrosporus* 66/4, and N<sub>2</sub>-fixing and P-solubilizing combination of the fourth (*P. lentimorbus* 47/8+ *B. subtilis* 39/3+ *P. fluorescens* 58/3) and seventh (*B. subtilis* 6/3+ *B. atrophaeus* 55/6+ *P. fluorescens* 4/9) could be explained by corresponding N<sub>2</sub>-fixing ability and phosphate-solubilizing ability, which provided a more balance nutrition for tea plants. These combinations showed an improvement in plant height, trunk diameter dry weight, Shoot+leaf weight and leaf yield of tea seedlings as compared with either the uninoculated control, indicating that inocula could act synergistically with each other. In contrast, co-inoculation with P solubilizer (*Rhizobium radiobacter* 2/7) and N<sub>2</sub> fixer (*Brevibacillus choshinensis* 2/5 and *Achromobacter xylosoxidans denitrificans* 16/4) recorded no significant difference in shoot and leaf weight of tea seedlings. It may be due to differential survival or activity of these strains to the chemical, physical and biological differences under *in vitro* conditions and environmental conditions. On the other hand, combination of *R. radiobacter* 2/7 and *B. choshinensis* 2/5 and/or *A. xylosoxidans denitrificans* 16/4 in trails might cause antagonistic effects and competition for energy sources such as organic matter, root exudates.

Mixed inoculants provide better nutritional balance for plants and improvements in N and P uptake were the main mechanisms involved (Rodríguez and Fraga, 1999). Our results clearly indicate the beneficial effect of co-culturing the N<sub>2</sub>-fixer and P-solubilizer in inoculants production. Combined inoculations with PSB and NFB have been reported to be more effective than single inoculation on



promoting plant growth and providing a more balanced nutrition for various crops (Şahin et al., 2004; Valverde et al., 2006; Madhaiyan et al., 2010; Yu et al., 2012). The interaction of NFB with other bacteria can inhibit or promote their diazotrophic activity (Rojas et al., 2001). In agricultural and forestry inoculation practices, mixing of two or more microbial species often has a more positive effect on plant growth than the use of a single bacterium (Belimov et al., 1995; Şahin et al., 2004). Co-inoculation, frequently, increased growth and yield, compared to single inoculation, provided the plants with more balanced nutrition, and improved absorption of nitrogen, phosphorus, and mineral nutrients (Bashan and Holguin, 1997; Bashan, 1998). Also, the few studies in the literature comparing the efficacy of combinations of beneficial rhizobacteria to single strain inoculation showed that mixed inocula can lead to a competitive process by which plant growth may be reduced (Chiarini et al., 1998; Probanza et al., 2002). Plant growth promoting activity was partially independent of bacterial population size on roots (Chiarini et al., 1998). The nutrient competition between plant and high bacteria population probably limited plant growth (Oliveira et al., 2002). The mechanisms explaining the synergistic interaction should be further investigated to elucidate the biochemical basis of these interactions (Şahin et al., 2004).

Application of NPK in the first harvest, while the highest values of shoot and leaf weight, but less than the efficiency of different combinations of bacteria were obtained in the second harvest. In this case, the mineral fertilizer efficiency decreases with time, whereas the bacterial activity shows that longer and more persistent. Greater attention should be paid to new combinations of N<sub>2</sub>-fixing and P-solubilizing bacteria for improvement of biofertilizers efficiency. The identification and the isolation of PGP bacteria from acidic and P-deficient soils, which combine the ability to solubilize phosphate with the fixation nitrogen capable of promoting plant growth, could also significantly increase the productivity of crops in acidic soil.

**Table 2.** The effect of different combinations of bacteria and fertilizer applications on the measured parameters of yield and vegetative growth components of Turkish tea clone Fener 3

Treatment	Trunk diameter (cm)	Plant height (cm)	First harvest		Second harvest		Total	
			Shoot+leaf weight (g/sapling)	Fresh leaf weight (g/sapling)	Shoot+leaf weight (g/sapling)	Fresh leaf weight (g/sapling)	Shoot+leaf weight (g/sapling)	Fresh leaf weight (g/sapling)
Control*	4,0 b	52,4 c	8,8 d	6,4 e	11,2 e	8,3 d	19,9 d	14,7 f
N	4,5 ab	56,9 bc	12,1 bc	9,6 bc	14,9 cd	12,1 bc	27,0 bc	21,6 bc
NPK	4,4 ab	59,2 abc	14,4 a	11,0 a	14,8 cd	11,3 bc	29,2 a	22,4 abc
I	5,0 a	61,5 abc	13,3 ab	10,8 a	16,1 bc	13,1 ab	29,4 a	23,9 ab
II	4,5 ab	62,5 abc	11,2 c	8,2 d	13,9 d	10,3 c	25,2 c	18,5 de
III	4,6 ab	64,3 abc	11,5 c	9,0 cd	9,9 e	7,8 d	21,4 d	16,8 ef
IV	4,8 a	65,4 ab	12,3 bc	10,3 ab	17,2 ab	14,4 a	29,5 a	24,7 a
V	4,9 a	65,3 ab	11,7 c	9,3 bcd	15,3 c	12,6 ab	27,1 bc	21,9 bc
VI	4,5 ab	66,9 ab	9,7 d	6,8 e	17,8 a	13,1 ab	27,6 ab	19,9 cd
VII	4,6 ab	70,2 a	13,8 a	10,4 ab	15,4 c	11,6 bc	29,3 a	22,0 bc

\*control: without bacteria inoculation or mineral fertilizers; N fertilizer (158 mg N rooted cutting in the form of ammonium nitrate 33%); NPK fertilizer (240 mg N + 76 mg P + 48 mg K rooted cutting in the compound fertilizer); I: *Bacillus simplex* 6/4+ *Brevibacillus centrosporus* 66/4+ *Burkholderia cepacia* 65/6; II: *Paenibacillus polymyxa* 28/3 + *Chryseobacterium indologenes* 21/5+ *Burkholderia pyrrocinia* 64/4, III: *Brevibacillus choshinensis* 2/5+ *Rhizobium radiobacter* 2/7+ *Achromobacter xylooxidans denitrificans* (*Alcaligenes*) 16/4, IV: *Paenibacillus lentimorbus* 47/8+ *Bacillus subtilis* 39/3+ *Pseudomonas fluorescens* 58/3, V: *Bacillus megaterium* 66/5+ *Pseudomonas putida* 29/2+ *Citrobacter freundii* 3/7, VI: *Bacillus sphaericus* 57/3+ *Alcaligenes faecalis* 47/11+ *Brevibacillus reuszeri* 10/5, VII: *Bacillus subtilis* 6/3+ *Bacillus atrophaeus* 55/6+ *Pseudomonas fluorescens* 4/9

\*\* Different letters within the same column indicate significant differences according to Duncan's Multiple Range Test ( $P < 0.05$ )

#### Acknowledgements

This study was supported financially by a grant (TOVAG; 107 O 360) from the Scientific and Technological Research Council of Turkey (TUBİTAK)

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# CROP PRODUCTION IN NON-GRAVITY AND MICROGRAVITY CONDITIONS (SPACE AGRICULTURE)

Murat ÇIÇEKLI<sup>1</sup>

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## ABSTRACT

Our planet earth is becoming a place which is impossible to live in day by day due to climate changes. As a result people will have difficulty in living on earth surface and big immigration waves will occur. Due to possibility of such dangers in future, many scientists create and announce theories about living in space and establishing human colonies. In NASA and space research centers of other countries, researches regarding these types of theories are made. In these researches, human, animal and plant physiologies are being studied and the effect of non-gravity or microgravity conditions on living things is being researched. In this study, the studies made about crop production in non-gravity or microgravity conditions will be examined and the physiological response of plants under these conditions will be evaluated. Various studies about the possibility of crop production in non-gravity or microgravity conditions will take place. The applicability of crop production in case we have to leave our planet and have to live in space or other planets or with the purpose of feeding astronauts and people during space travel to planets like Mars and space agriculture will be emphasized. The necessary conditions for the space agriculture to be made will be mentioned.

Key Words: Space agriculture, clinostat, hydroponic, microgravity

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## INTRODUCTION

With the consideration of the possibility of living in space, in recent years, humankind has been developing space programs and worked on projects particularly concerning space travel and living in space or on other planets. The National Aeronautics and Space Administration (NASA) plans to establish a human colony on Mars by the year 2032 (Wheeler, 2006). The colonization of space will depend on our ability to routinely provide for the metabolic needs (oxygen, water and food) of a crew with minimal re-supply from Earth. A key variable in space is gravity; planets (e.g. Mars, 1/3 g) and moons (e.g. Earth's moon, 1/6 g) differ from spacecraft orbiting the Earth (e.g. Space stations, near 0 g) or orbital transfer vehicles that are subject to microgravity. The movement of heat, water vapor, CO<sub>2</sub> and O<sub>2</sub> between plant surfaces and their environment is also affected by gravity (Monje et al., 2003). Therefore it is necessary to know thoroughly the conditions required to grow plants in a zero-gravity environment. As they are factors affecting plant production in space, growing conditions such as plant species, irrigation, fertilization, conditioning, artificial lighting and CO<sub>2</sub> – O<sub>2</sub> exchange and surface conditions such as micro and non-gravity, radiation, Electromagnetic Field and atmospheric pressure (high temperature, storm, frost, gradient etc.) have to be analyzed in depth and the systems (constructions, greenhouses, buildings, machines, equipments, etc.) have to be designed according to such analyses and plant production planning suitable to such systems has to be designed.




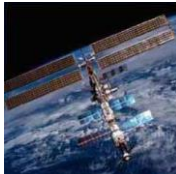
## SYSTEMS THAT MAY BE INCLUDED IN SPACE AGRICULTURE

In the future, humankind will live in vehicles he constructed in space, as well as living on the surfaces of other planets. It is known that, when these environments are compared, Mars is the most livable known planet having the most gravity after Earth (Table 1). For instance, solar radiation on Mars is about 44% of that on Earth (Wheeler, 2004). Solar radiation on Mars is 0.63 kW m<sup>-2</sup> outside the atmosphere (Table 1). However, on the surface it is 0.37 kW m<sup>-2</sup> in absence of dust. Minimum solar radiation must be 0.30 kW m<sup>-2</sup> for correct vegetative growth (Pirolli, 2006). Due to this reason, vegetative production is deemed to be possible with artificial lighting consisting of red light supporting photosynthesis and blue light supporting fotomorfogenesis. The pH in the regoliths in Mars is 7.2. Furthermore, most of the required plant nutrients are available on Mars. Phosphorus is contained in the minerals of the Martian regolith, and may be released by weathering in a similar way to other nutrients. However, the released phosphate is considered to be unavailable for plant roots, due to its strong adsorption (phosphate-fixation) on CaSO<sub>4</sub>, CaCO<sub>3</sub> and iron oxides (Yamashita et al., 2009).

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**Table 1. Conditions in Different Space Environments (Maggi and Pallud, 2010; Pirolli, 2006)**

	Earth	Moon	Mars	ISS
				
Atm. Pressure	101.3 KPa	$3.10^{-3}$ KPa	0.7 – 0.9 KPa	101.3 KPa
Gravity ( $g = 9.806 \text{ m s}^{-2}$ )	1 g	0.16 g	0.38 g	0 g
Atmospheric components	0.035% CO <sub>2</sub> 78% Nitrogen 21% Oxygen 1% Argon 0-4% H <sub>2</sub> O	25% Helium 25% Neon 23% Hydrogen	95% CO <sub>2</sub> 3% Nitrogen 0.13% Oxygen 1.6% Argon 0-0.021% H <sub>2</sub> O	21% Oxygen 0.6% CO <sub>2</sub>
Mean of Temp.	286 K (13 °C)	243 K (-30 °C)	216 K (-57 °C)	300 K (27 °C)
Irradiance	1370 W m <sup>-2</sup>	1370 W m <sup>-2</sup>	630 W m <sup>-2</sup>	960 W m <sup>-2</sup>

### NUTRITION IN SPACE AGRICULTURE

When planning vegetative production in a weightless environment, the nutrients and vitamins needed by human have to be considered. Starting with human requirements, the vegetative portion of the daily ration should contain: 45– 50 g of protein; 20–25 g of fats, of which 3– 6 g are essential fatty acids; 400– 500 g of carbohydrates, of which about 80% are in the form of starchy polysaccharides; the required quantity of vitamins and mineral components; a sufficiently and subjectively determined collection of components that can guarantee gustatory variety (Tikhomirov et.al., 2004). Due to this reason, the products to be grown have to embody such nourishment properties, be easy to be grown in space, have short vegetation periods, and their root and the cultivation system to be used have to be suitable for hydroponic (soilless) systems. According to this, humans can survive on a selection of only three crops: wheat, rice, and beans since they provide almost all of the 50 basic nutrients humans need. While wheat, dwarf rice, potatoes, pinto bean, strawberries, lettuce, tomatoes, broccoli, spinach, amaranthus and arabidopsis thaliana are among the products that are to be cultivated in the first place, herbs (parsley, basil, thyme, garlic, oregano) and microorganisms (algae, cyanobacteris) take the second place. A model diet consisting of rice, soybean, sweet potato, green–yellow vegetable, silkworm pupa, and loach fish was found to meet human nutritional requirements. (Katayama et al., 2007)

### CROP PRODUCTION IN SPACE AGRICULTURE

The world record for potato yield is about 100 tons per ha (fresh weight). A 132-day test in a large controlled environment room produced a yield of 197 tons ha<sup>-1</sup>. How did NASA achieve this? Lighting was increased by extending the photoperiod and plants were given elevated CO<sub>2</sub> and watered with nutrient solution to speed growth. The world record for wheat in the field is 15400 kg ha<sup>-1</sup>. NASA's highest wheat yield, published in 1988. At a 120 day life cycle in controlled environments, NASA's ratio to the field record is almost 5 times higher ~ at about 72200 kg ha<sup>-1</sup>. NASA used much higher light levels and CO<sub>2</sub> (Wheeler, 2006).

In a study of MIR Space Station, there is a serious imbalance in the major minerals in plants grown in microgravity (Table 2). This is manifested by an acute increase in phosphorus and decrease in calcium levels in wheat. Other mineral elements also undergo changes. A decrease in the level of manganese, most of which functions in the second photosystem, might also be related to a lesion of the photosynthetic system in the test plants (Table 2). It is likely that the transport of calcium, like that of other ions, involves peroxidation processes, resulting in a decrease in calcium levels in the plant. Peroxidation of the plant membranes may be induced by calcium deficiency of an in-flight origin, with an eventual decline in the rates of plant biosynthesis (Mashinsky et al., 1994).

**Table 2. Effects of Spaceflight on the Mineral Status of Wheat Plants (mg kg<sup>-1</sup>)**

Applications	N	P	K	Ca	Mg	Fe	Zn	Mn
Control (Ground)	4.00	0.75	6.80	0.25	0.22	255	225	75
Test (MIR Space Station)	5.60	1.20	6.25	0.05	0.20	272	225	50

NASA has developed a zeolite-based synthetic substrate, termed zeoaponics. The zeoaponic substrate (consisting of  $\text{NH}_4^+$  and  $\text{K}^+$  exchanged clinoptilolite, synthetic apatite, and dolomite) provides all of the plant essential nutrients through mineral dissolution and ion exchange, with only the addition of water (Figure 1). Zeoaponic substrates are capable of providing the long-term productivity of radishes. Previous studies have shown high productivity of wheat in zeoaponic substrates (Gruener et al., 2007).

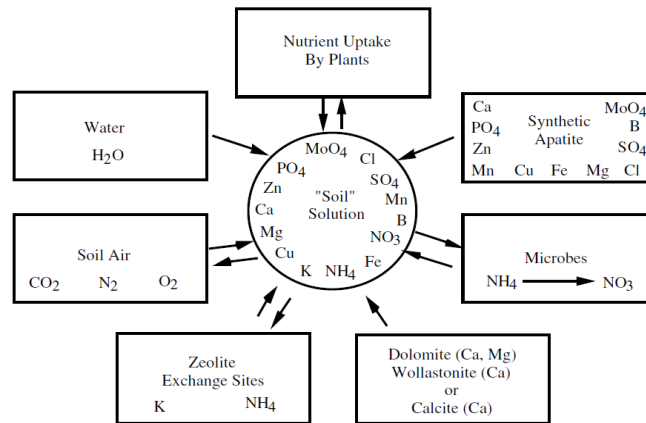


Figure 1. Dynamic equilibria for NASA's zeoaponic plant-growth system

Besides substrats and zeoaponic plant growth systems, there are also slow-release fertilizer and nutrient solutions, the use of which is easier in cylindrical hydroponic systems (Figure 3) and porous tube (Figure 2b) systems, can be used as the plant cultivation medium. In a porous tube study conducted by Steinberg et al. (2002), the effect of microgravity( $\mu\text{g}$ ) can be seen to produce the highest concentrations of water immediately adjacent to the centrally situated (in the root zone) water input tube, and decreasing wetness levels with increasing distances from the water input tube. In contrast, under gravity (1g) conditions, the effect of gravity was (not surprisingly) to pull the water down to the bottom of the chamber, resulting in an entirely different water distribution pattern. These patterns can be used to address the question of how to design the water delivery system for both spaceflight and ground control plant culture units (Figure 2a). The argument has been made that different placements of the water input tubes for microgravity ( $\mu\text{g}$ ) and gravity (1g) operation would be the best way to optimize system performance for both conditions (Steinberg et al., 2002). Additionally, in two studies conducted with porous tubes, clinostat and microgravity conditions were established for lettuce and tomato samples and the results were compared with gravity (Saccardo, 2006). While at the end of the studies, a 10% biomass loss was detected for tomato samples in clinostat, the leaf area of lettuce samples in clinostat (443,5  $\text{cm}^2$ ) was found to be smaller than that of the control samples (568,5  $\text{cm}^2$ ) (Figure 2b).

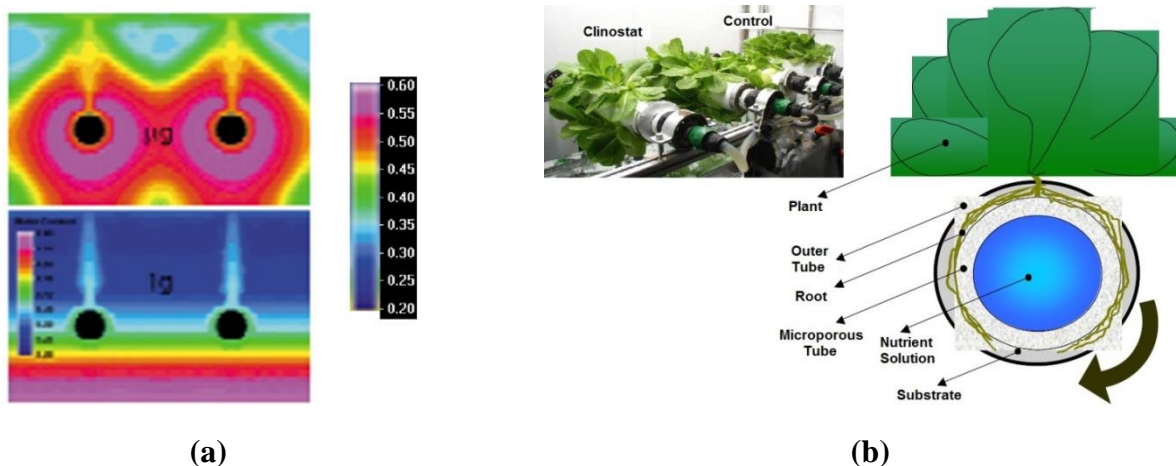
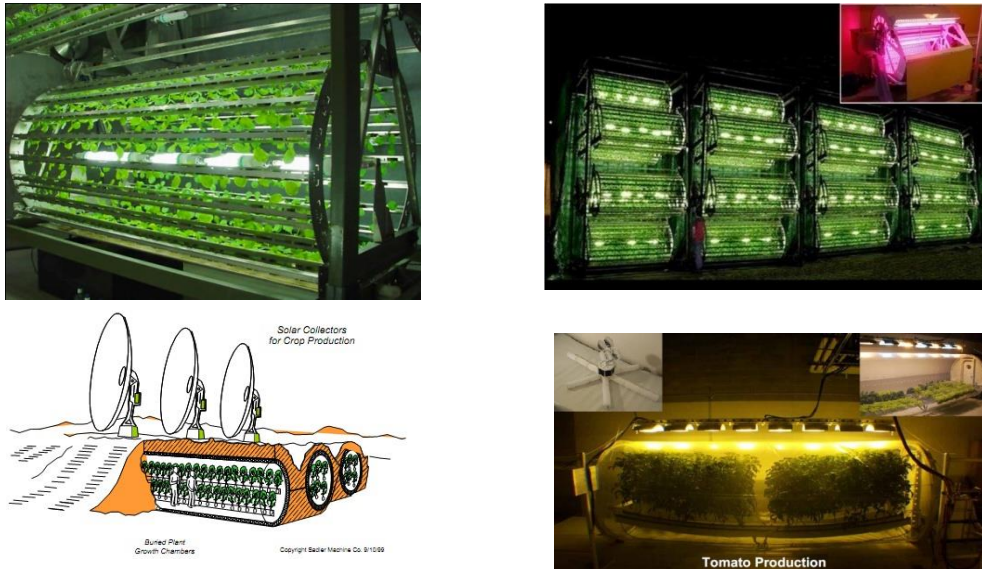


Figure 2. Dynamics of water delivery and distribution under both gravity (1g) and microgravity ( $\mu\text{g}$ ) conditions(a); Porous tube nutrient delivery system for microgravity(b)(Saccardo, 2006).



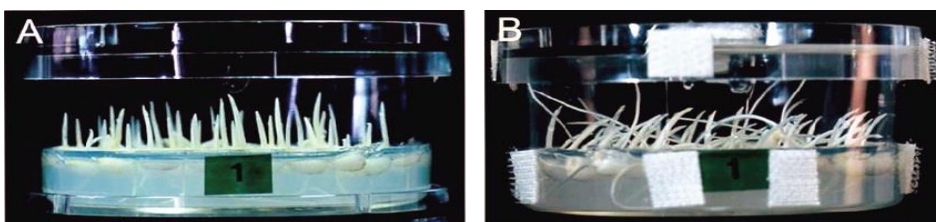
**Figure 3. Cylindrical Hydroponic Designs (top pictures) and Different Greenhouse Designs (below pictures) for Space Agriculture (Omega Garden, 2012; Fowler, 2004)**

In their study, Takahashi et al. (2000) conducted an experiment designed to observe the growth of cucumber seedlings. Cucumber seedlings were grown aeroponically in microgravity and on the ground. On the ground, primary roots showed positive orthogravitropism and grew downward when grown aeroponically. Lateral roots of the ground control grew perpendicular to the primary roots growing down (Figure 4A). Surprisingly, the lateral roots of cucumber seedlings grew toward the wet plastic foam in microgravity (Figure 4C). The deviated angle of the lateral root from the primary root was much smaller than  $90^\circ$ . In the stationary control, the angle between the primary root and lateral root was approx.  $90^\circ - 100^\circ$ , whereas in the clinorotated seedlings it was approx.  $40^\circ - 50^\circ$  (Figure 4B). It has been established that seedling roots show positive hydrotropism in response to a moisture gradient (Takahashi et al., 1996).



**Figure 4. Root Growth in Space and on Earth (A: Seedlings grown for 96 h in a stationary condition on the ground, B: Clinorotated seedlings for 96 h on the ground = 3-D Clinostat and rotated at 1 rpm, C: Seedlings grown for 70 h in microgravity; Arrowheads: Lateral roots)**

In a different study, Rice (cv. Koshihikari) seedlings were grown under 1 g (on Earth) and microgravity conditions (STS-95 Mission). Hoson and Soga (2003) showed that the thickness of cell wall of rice shoots decreased under microgravity conditions in space (Figure 5).



**Figure 5. The Morphology of Rice Seedlings (A: 1 g ; B: microgravity)**

There are also projects developed by the Stanford University focusing on the establishment of a colony of 10,000 people and the realization of vegetative production in that colony. The energy and lighting of the Stanford Torus, which measures 1.8 km in diameter, is generated via solar panels, and by rapidly rotating on its own axis with the energy obtained, the system creates a centrifugal force (Fig 6). This force creates artificial gravity between 0.9 and 1.0 g (NSS, 2011).

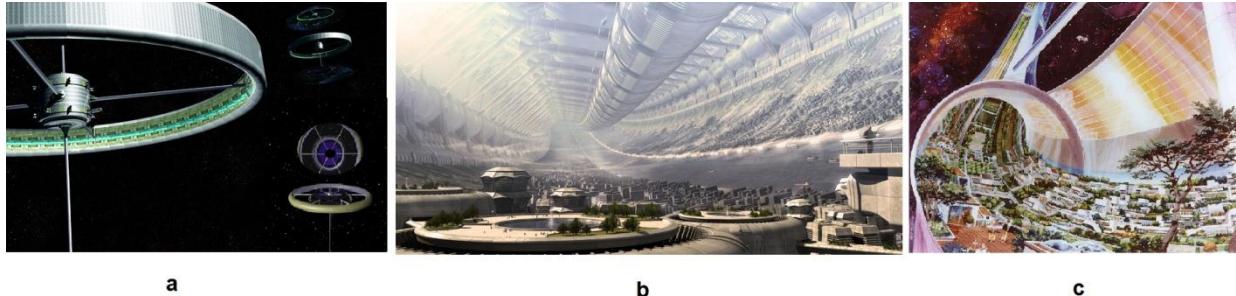


Figure 6. Different Torus Designs: a) Vademecum b) Abalakin c) Stanford (NSS, 2011)

## CONCLUSION

The studies conducted so far have shown that vegetative production is possible under artificially set conditions in systems and cultivation mediums and under non-gravity and microgravity conditions. However, vegetative production in space or on other planets will not be possible by itself without human interference.

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# MODEL IRRIGATION AND FERTILIZATION STRATEGIES IN GREENHOUSES WITH HIGH TECHNOLOGY IN TURKEY

Murat ÇİÇEKLİ<sup>1</sup>

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## ABSTRACT

The number of high technology greenhouses has been rapidly increasing in geothermal areas especially in Izmir, Aydın, Denizli, Manisa and Afyon. Although their installation costs are high, production costs are decreased in these greenhouses since yield and quality are increased. By virtue of automation systems, procedures like heating, ventilation, humidification, irrigation and fertilization are carried out by receiving commands from the program in the computer. By this means, the product grown in the greenhouse is not affected by human errors and the climate and root environment required by the product can be adjusted by precision. In this study, irrigation and fertilization strategies performed with the help of the computer program and used in the high-tech greenhouse companies in Turkey will be presented and recommendations about how yield and quality can be enhanced by these strategies.

**Key Words:** Greenhouse, radiation, blossom-end rot, automation, fertilization

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## INTRODUCTION

According to 2010 data, total greenhouse area in Turkey is 56.348 ha. The total greenhouse area is composed of 8.077 ha glasshouse, 23.052 ha plastic greenhouse, 8.122 ha high tunnel and 17.097 ha low tunnel (TurkStat, 2011). In the 99% of the greenhouse area, the production is carried out traditionally in the land. The soilless agriculture starting in 1995 is now 1% of the total area (Gül-Aydoğın et al., 2009).

By aiming to reduce the heating costs, the high-tech greenhouses doing soilless agriculture in Turkey are located in Izmir, Manisa, Aydın and Denizli, which have geothermal resources. Mainly tomato production is carried out in the enterprises. 86-95% of the product is exported (especially to Russia, Netherlands, Germany, England), and the rest is placed on the domestic market. Although the average productivity in tomato is reported to be 30 kg m<sup>-2</sup> (Gül-Aydoğın et al., 2009), the production is low in many greenhouse company due to the incorrect production. In this article, the irrigation and fertilization strategies for modern greenhouse cultivation are given according to tomato production in some substrates based on the greenhouses in the Aegean Region (Manisa, Aydın, Denizli).

## MATERIAL AND METHODS

In this study, the production, air-conditioning and irrigation strategies of four high-tech greenhouses are observed, which are similar in terms of system, do soilless agriculture have computerized air-conditioning and irrigation systems, and are located in Aegean Region (Manisa, Aydın, Denizli). The automation systems of the greenhouses are controlled with Priva Intégro 724 and 727 software. Rockwool, perlite and cocopeat are used as a growing media. Tomatoes are sowed with a 2.5-3.0 plant m<sup>-2</sup> density (Rorabaugh et al., 2010). In all of the four greenhouses, the plant(truss tomato) density is 2.5 plant m<sup>-2</sup> at the beginning, and increases to 3.0 plant m<sup>-2</sup> in the period when the light exposure rises (February in Aegean Region). Irrigation systems have the automatic dosage system designed according to this features, and the irrigation drippers are 3 liters per hour.

## RESULTS AND DISCUSSION

**Climate Strategies:** In general, the desired greenhouse interior heat is 12-26°C (Figure 1). The heat is set to be 18°C 1-2 hours before the sunrise. The greenhouse interior heat is kept at 18-20°C based on the joule amount if the weather is rainy or cloudy, and 20-26°C if the weather is clear and sunny. The greenhouse is cooled 1-2 hours before the sunset. After the sunset, the heat is kept at 12-17°C before the midnight, and 17-19°C after the midnight (Grotek, 2007).

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Figure 1. Model Climate Strategy (heating and ventilation) (Grotek, 2007)

The maximum heat of the heating pipes is 70 °C. In the heating strategies applied above this heat, the air-conditioning of the greenhouse is kept under observation and applications that meet the needs of the plants are applied (night irrigation, air-conditioning etc.). The sample values that are used by the greenhouses in the air-conditioning strategies are given in Figure 1.

High-pressured fogging (60-100 bars) is generally preferred in the modern greenhouses in the Aegean Region. The fogging is of great importance for cultivation in the Aegean Region, where the humidity is low in summer, and there is a great deal of product loss due to the calcium deficiency. Low humidity in the day is known to increase Blossom-End Rot (BER) and high night-time humidity to decrease it, but constant high (95%) relative humidity in growth chambers reduced calcium concentration and increased BER relative to constant moderate (55%) relative humidity (Banuelos et al., 1985). CO<sub>2</sub> is used in these greenhouses and the application dosage is between 400 and 800 ppm.

**Irrigation Strategies:** In the 4 greenhouses in the Aegean Region, regardless of the substrate in the irrigation strategy, irrigation programs are similar and the rule in the irrigation strategy is 3.0 ml j<sup>-1</sup> (1 joule = 3 ml water). The general rule of thumb is 3 ml j<sup>-1</sup>, 2 ml for transpiration and 1 ml for drain, assuming 30% drain over 24 hours (Lee, 2010). At 20°C, heat of vaporization ( $\lambda$ ) is about 2.45 MJ kg<sup>-1</sup>. In other words, 2.45 MJ are needed to vaporize 1 kg or 0.001 m<sup>3</sup> of water. Hence, an energy input of 2.45 MJ m<sup>-2</sup> is able to vaporize 0.001 m or 1 mm of water, and therefore 1 mm of water is equivalent to 2.45 MJ m<sup>-2</sup> (Allen et al., 2006). 0.408 ml water (~0.41 ml) vaporizes with 1 MJ energy. Light-dependent radiation in these greenhouses is measured outside the greenhouse. However, perspiration occurs inside the greenhouse. 20-30% of the radiation coming to the greenhouse does not reach the plants. The amount of the water vaporizing because of this reason is 0.3 ml. Consequently, 0.03 ml cm<sup>-2</sup> or 300 ml m<sup>-2</sup> vaporizing occurs with 100 j m<sup>-2</sup> incoming energy and this means 1 joule = 3 ml water.

When transpiration begins in the plants, water content curve changes in the substrate after sunrise (Lee, 2010). 1<sup>st</sup> period covers the area between the first irrigation and first drainage (Figure 2). 2<sup>nd</sup> period covers the area, in which the irrigation and substrate balance from the point of first drainage, and the substrate EC reduces (Figure 2). 3<sup>rd</sup> period is the period in which the water content of the substrate balances and EC value minimizes. Normally, this period exceeds the highest sun radiation point (Figure 2). Finally, the 4<sup>th</sup> period is the area between the last irrigation on the 1<sup>st</sup> day and the first irrigation on the 2<sup>nd</sup> day. In this period, the water content of the substrate reduces, and EC increases (Figure 2).

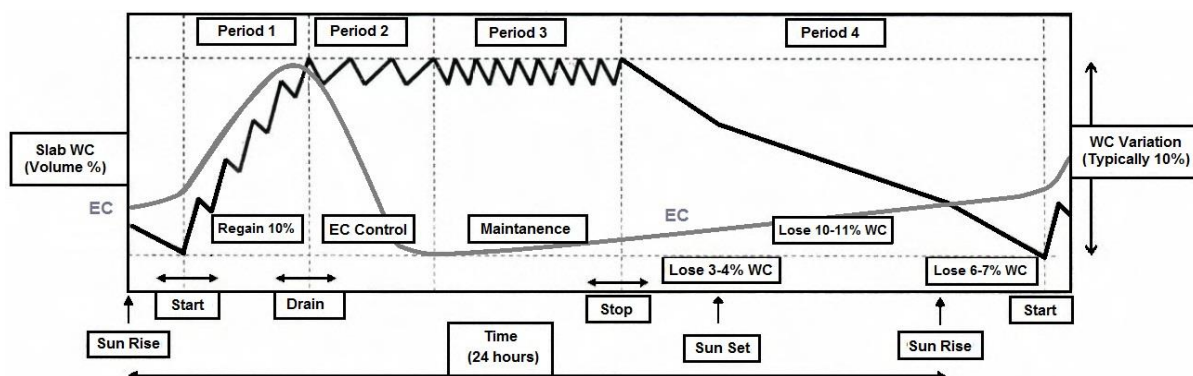


Figure 2. Steering Water Content (WC) and Electro-Conductivity (EC) in Media (Tomatoes) (Brandsema, 2007; Lee, 2010)

The golden rule in the choice of irrigation time is that transpiration should occur after the irrigation. This helps hindering the cracking and irregular ripening. The ideal is to start irrigation 1-2 hours after the sunrise. The irrigation should be stopped 1-2 after the sunset. The ideal drainage standard is that drainage should start 2-3 hours after the irrigation. This means that the drainage comes 400 j cm<sup>2</sup> or 600 j cm<sup>2</sup> (Lee, 2010). If the irrigation starts earlier and ends later than usual, the plan inclines to vegetative growth (Table 1). When examined in the light of these information, the irrigation strategies applied in all 4 greenhouses are similar to literature (Brandsema, 2007; Lee, 2010; Lee, 2011), sample graphic and irrigation strategies.

Table 1. Actions which will enable steering of the plant (Brandsema, 2007; Lee, 2010)

STEER	Vegatative Effect	Generative Effect	Limits of Normal Operations
<b>CLIMATE</b>			
Difference day-night temperature	smaller	bigger	0 – 7 °C
Cooling day to night	slowly (not)	quickly (evening cooling)	0 – 4 °C /hour
Pipe temperature	decrease	increase	0 – 80 °C
Ventilation (outside temp.>10 °C)	less	more	-
Humidity deficit (HD)	decrease	increase	2 – 8 g m <sup>3</sup>
CO <sub>2</sub> Concentration	less	more	350 – 1000 ppm
<b>IRRIGATION</b>			
EC Slab	lower (decrease)	higher (increase)	2.5 – 6 mS cm <sup>-1</sup>
EC Drip	lower (decrease)	higher (increase)	2 – 4 mS cm <sup>-1</sup>
WC (Slab)	higher (increase)	lower (decrease)	% 50 – 80
cycle length and frequency	short and more	long and less	75 – 150 cc
Start time irrigation	earlier	later	0 – 3 h after sunrise
Stop time irrigation	later	earlier	0 – 5 h before sunset

The water coming from the drainage after the irrigation passes through UV disinfection (UV dosage for all diseases is 250 mj cm<sup>-2</sup>), and is again mixed into the irrigation system between 0,5-1.2 EC values (Priva, 2012).

The irrigation strategy is applied according to Priva Groscale (Figure 4) in all 4 greenhouses and the irrigation data and strategies are entered into system as in Figure 3, and are followed graphically as in Figure 4. Thus, the irrigation strategy is completely applied.

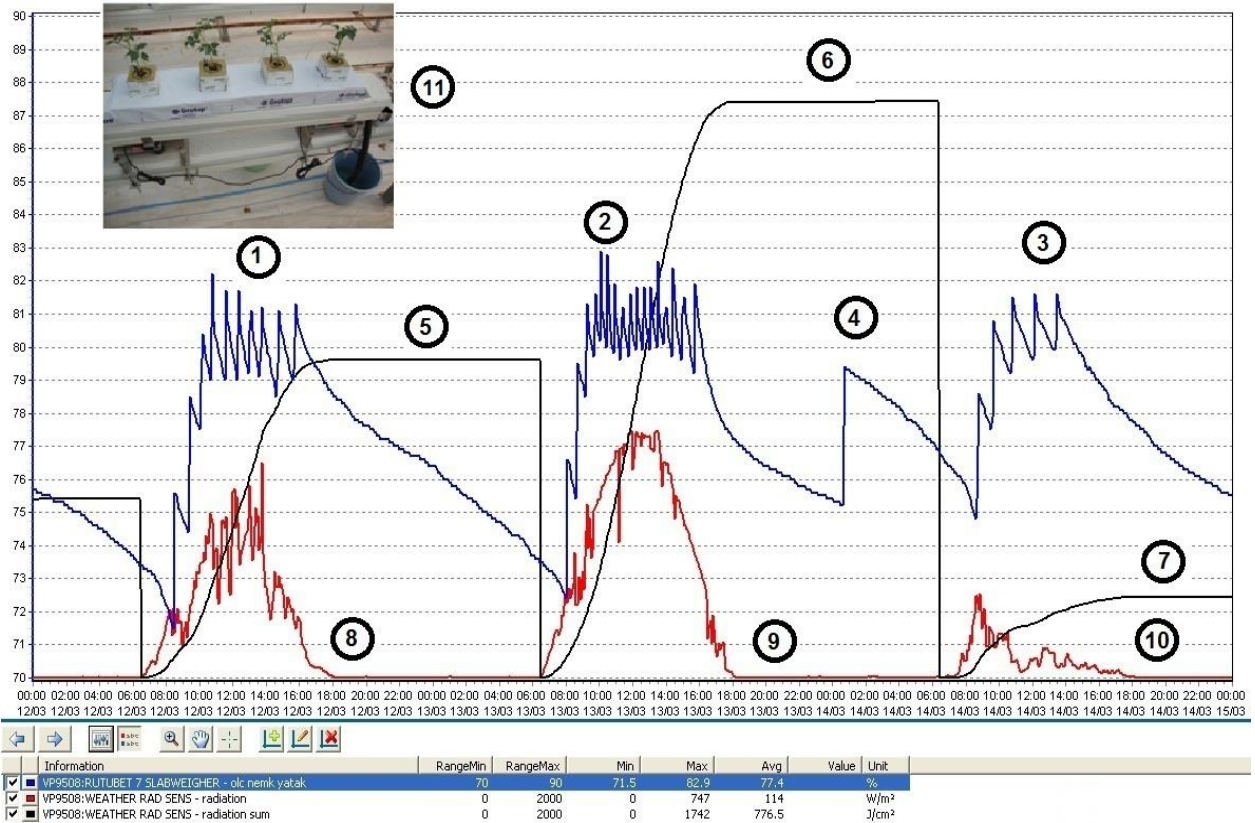
**Fertilization Strategies:** In all 4 greenhouses, the fertilization program, the nutrient solution and the solutions taken from the drainage or slabs every 15 days are sent to laboratory for analysis. The fertilization programs are made by the laboratory according to the reference sample values (Table 2-3) determined in respect to the number of blooms and to the results of the analysis (Figure 5).

	Per1	Per2	Per3	Per4	Per5	Per6
2						
3	Activated	NO	NO	YES	NO	NO
4	Period	ON	ON	ON	ON	ON
5	Start time	7:00	8:30	10:30	15:30	17:30
6	Start phase	PHASE 1	PHASE 2	PHASE 3	PHASE 3	PHASE 3
7	Minimum rest time	0:30	0:30	0:20	0:20	0:20
8	Maximum rest time	---	1:00	0:50	0:50	---
20	Radiation limit	---	---	---	---	200
21	Radiation sum start	100	100	90	95	95
22	Drain:infl rad sum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Phase1	Phase2	Phase3	Phase4	Phase5
1	Phase				
2	Time	3'00	3'00	3'00	0'30
3	Quantity	110,0	100,0	90,0	10,0
4	Recipe number	10	10	10	10
5	Nr of times phase	1	1	1	1

6	Unit of quantity	m1
7	Priority	NORM
8	Use quantity & time	YES
9	Radiation adj. quant & time	0
10	Use recipe number	YES

Figure3. Irrigation strategy samples from the greenhouses in the Aegean Region.



(\*: 1.2.3. The irrigation amounts and humidity content changes in the slabs in the different instantaneous radiations on different days; 4.Night irrigation; 5.6.7. Total radiation amounts on different days; 8.9.10. Instantaneous radiation changes and graphics on different days; 11. Groscale system)

Figure 4. The graphic of irrigation strategy sample in a greenhouse in Aegean Region

Table 2. Nutrient Solutions for Different Systems (Tomato in rockwool) (Sonneveld and Straver, 1994)

	EC (dS m <sup>-1</sup> )	mmol l <sup>-1</sup>							μmol l <sup>-1</sup>					
		NH <sub>4</sub>	K	Ca	Mg	NO <sub>3</sub>	SO <sub>4</sub>	H <sub>2</sub> PO <sub>4</sub>	Fe	Mn	Zn	B	Cu	Mo
<b>Addition free drain</b>	2.6	1.2	9.5	5.4	2.4	16.0	4.4	1.5	15	10	5	30	0.75	0.5
<b>Addition closed</b>	1.6	1.0	6.5	2.75	1.0	10.75	1.5	1.25	15	10	4	20	0.75	0.5
<b>Root Environment</b>	4.0	<0.5	8.0	10.0	4.5	23.0	6.8	1.0	25	7	7	50	0.70	0.5

Table 3. Guide values and limits for nutrients in the root zone for a tomato crop in rockwool (De Kreij et al., 1997)

	EC (dS m <sup>-1</sup> )	pH	mmol l <sup>-1</sup>							μmol l <sup>-1</sup>					
			NH <sub>4</sub>	K	Ca	Mg	NO <sub>3</sub>	SO <sub>4</sub>	H <sub>2</sub> PO <sub>4</sub>	Fe	Mn	Zn	B	Cu	Mo
<b>Guide Values</b>	4	5.5	<0.1	8	10	4.5	23	6.5	1.0	15	5	7	50	0.75	0.5
<b>Limits</b>	-	5.0- 6.0	0.0- 0.5	6.5- 10.0	8- 12	2.7- 6.5	17- 28	4- 9	0.7- 2.0	9- 25	3- 10	5- 10	35- 65	0.5- 1.5	0.3- 0.8

<b>Crop data</b>	Crop	tomato
	Growing stage	flowering over 15th truss
	System	drainage

**Explanation** DRIP EC : 2,6 / if the set DRIP EC

	analysis	at EC 3,70	target	low	normal	high
pH	5,5	5,5	5,5		I	
mS/cm	EC	3,8	3,8	4,0		
Cations mmol/l.	NH <sub>4</sub>	< 0,1	< 0,1	< 0,5		
	K	13,2	13,1	8,0		
	Na	0,8	0,8			
	Ca	9,1	9,1	10,0		
	Mg	5,4	5,4	4,5		
Anions mmol/l.	NO <sub>3</sub>	18,9	18,4	22,0		
	Cl	1,5	1,5	< 6,0		
	S	9,1	8,9	6,8		
	HCO <sub>3</sub>	< 0,1	< 0,1			
	P	1,92	1,87	1,00		
Micro-nutrients µmol/l.	Fe	55	55	35		
	Mn	12	12	5,0		
	Zn	11	11	7,0		
	B	127	127	50		
	Cu	1,8	1,8	0,7		
	Mo	1,7	1,7	0,5		
	Si	0,21	0,21			
mmol/l.	K/Ca	1,5	0,8			

Calcium nitrate	132,5	kg
KCl 52,4%	11,6	kg
Chelated iron DTPA 6% or	1750	g
Chelated iron 3% liq.	2,7	l
<b>A</b>		
1000 liter	100 * concentrated	

Potassium nitrate	18,6	kg
Mono potassium phosphate	20,4	kg
Sulphate of potash	21,9	kg
Magnesium sulphate	67,2	kg
Manganese sulphate 32%	125	g
Zinc sulphate 23%	115	g
Borax	145	g
Copper sulphate	14	g
Sodium molybdate	12	g
<b>B</b>		
1000 liter	100 * concentrated	

Figure 5. Sample analysis result and fertilization program in Aegean Region

The time-dependent changes are observed according to the results of the fertilization programs (Figure 6) and appropriate irrigation and fertilization program are prepared according to the sample reference values.

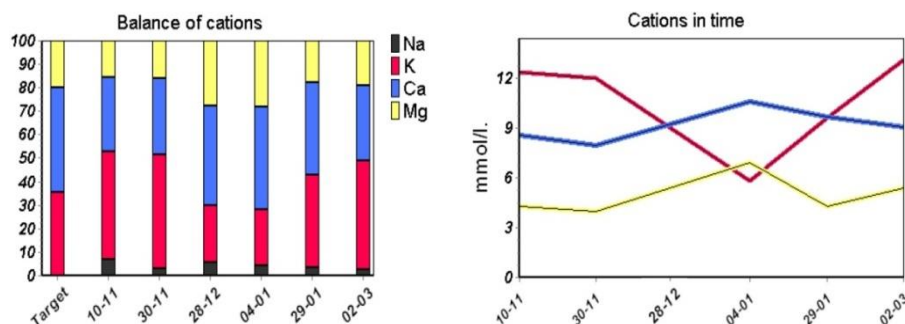


Figure 6. The time-dependent changes of the nutrient elements

## CONCLUSION

As a result of this study, when all the greenhouse data are analyzed and the all the production during the season are taken into consideration (1 September – 10 July), productivity values are determined as 26.8 – 35.8 kg m<sup>-2</sup> at the end of the season. These productivity values are above the average in Turkey. All the sample strategies change based on the skill of the person, who is responsible for the conditioning,

**product, cultivation system, construction, mechanization and production. However, when the production strategies are developed, all the data must be recorded and the strategies must be decided after analyzing all the data. Besides, making the necessary changes based on the conditioning and requirements in the automation system by taking instantaneous decision is a significant issue for the productivity and the quality of the product. Unfortunately, the number of the people that consciously use conditioning strategies and automation systems is rather low in Turkey. The false conditioning and irrigation strategies causes a great deal of products every year due to the reasons such as calcium deficiency and cracking, and the productivity level per unit area reduces. Hence, more researches must be carried out by increasing the university-greenhouse private sector cooperation and the results should be shared with the private sector.**

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# THE EFFECTS OF DIFFERENT IRRIGATION METHODS IN POTATO CULTIVATION ON SOIL SALT DISTRIBUTION AT KONYA REGION

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## ABSTRACT

In this study, the effects of furrow, sprinkler and drip irrigation methods on the distribution of salt in the soil profile were investigated. A 7-day irrigation interval was used in the study. The soil water content at plant root depth was monitored with Delta-T Profile-Probe moisture meter. As a results of the study, it was observed that maximum decrease between the initial and final electric conductivity (EC) occurred in furrow irrigation method at the soil depth of 0 – 30 cm and 30 – 60 cm with value 52.9% and 52.6% respectively, at the soil dept of 60 – 90 cm and 90 – 120 cm, maximum increase occurred in sprinkler irrigation method with values 58.8% and 54.6% respectively. The maximum salt accumulation was observed at the soil depth of 0 – 60 cm in drip irrigation method and at the soil depth of 60 – 120 cm in sprinkler irrigation.

**Key Words:** Soil salinity, irrigation, irrigation methods, potato.

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## INTRODUCTION

There is a parallelism between world population and food needs of people as both of them are growing, and this is a current matter concerning the whole world. It is essential to provide the sustainable use of available resources and get high quality and maximum yield from per unit area. Irrigation is the primary technological process to increase plant production in arid and semi-arid regions.

The climate in Turkey has arid and semi-arid features. It is not possible to get yields without irrigation because of climate. The average annual rainfall is 643 mm and this corresponds to 501 km<sup>3</sup>/year water. Available total water volume of the country is 112 km<sup>3</sup>/year under the current conditions. However, 44 km<sup>3</sup>/year of which is consumed currently. Arable agricultural land is about 28 million hectares, 16.5 million of which is irrigable land. Currently irrigated area is 5.5 million hectares. This rate is 65% (8.5 million hectares) of the economically irrigable land (Çiftçi et al., 2009).

Due to the characteristics of the climate and basin Konya Closed Basin is an ideal environment for the occurrence of salinity and aridity. The total area of Konya Closed Basin is 4 081 353 hectares. 2 247 857 hectares of which is arable land, 1 652 762 hectares is irrigable land but only 377 426 hectares is irrigated, 761 461 hectares is grassland and 540 189 hectares is forest land. In 531 846 hectares of basin area, there are salinity and sodium problems (Kara et al., 2008).

The aim of this study is to determine the distribution of salt in the soil profile in potato cultivation irrigated by sprinkling and furrow irrigation, which are the commonly applied methods, and drip irrigation method, which has just been started to be applied recently in Konya Plain.

## MATERIAL AND METHODS

The research was conducted in the experimental area which belongs to Konya Sugar Inc. in Alakova that is in south of Konya and located about 20 km far from the centre. The average temperature was 12.5°C and the total rainfall was 441.2 mm in 2009 in which the research was conducted. Approximately 28% of rain fell in growing period for plants (Yavuz, 2011).

In the research, Russet Burbank potato variety, which has a good adaptation in the Central Anatolia region, was used as a plant material. Russet Burbank is often used in industry as frozen french fries. Potato cultivation has an important place in the area because 220 895 tons of potatoes are cultivated in 7041 hectares.

Soil samples were taken in four different depths (0-30, 30-60, 60-90, 90-120), with 3 replications. Some of the physical analysis results related to soil samples taken from the research field before the experiment was carried out are given in Table 1.

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\*This study was abstracted from Master thesis of Nurcan Çivicioğlu and supported by the Selcuk University BAP Office (Coordinating Office of Scientific Research Projects, Project No: 09101041)



*Table 1. Some physical characteristics of experimental area soil*

Profile depth (cm)	Saturation (%)	Field Capacity (FC) (volumetric %)	Wilting Point (WP) (volumetric %)	Bulk density (g/cm <sup>3</sup> )	Soil Texture			
					Sand %	Clay %	Silt %	Class
0-30	58.7	30.6	15.4	1.26	54.75	30.57	14.68	SCL
30-60	57.3	34.2	20.0	1.31	50.75	28.45	20.8	SCL
60-90	66.9	36.0	21.3	1.32	42.99	34.45	22.56	CL
90-120	74.4	39.4	25.2	1.35	59.74	23.71	16.55	SCL

According to Table 1; in the fields of research with 0-30, 30-60 and 90-120 cm depths, soil layers have sandy-clay-loam textures; soil layers have clay-loam textures at 60-90 depths, and bulk density values vary from 1.26 to 1.35 g/cm<sup>3</sup>.

The groundwater was used to irrigate the plots in the experimental area. According to chemical analysis results of soil samples obtained at the beginning, middle and end of the vegetation period, the Electrical Conductivity (EC) values of irrigation water were determined as 568.14 µmhos/cm, and pH value was calculated 7.40. According to U.S. Salinity Laboratory Classification system, the irrigation water was classified as T<sub>2</sub>S<sub>1</sub> in terms of salinity and sodium.

A field experiment of research was conducted in growing season of 2009. Evaluation of the obtained data and laboratory studies were completed in 2010. Before experiment, in experimental area, the profile 120 cm depth has opened to determine the characteristics such as the structure of the test area soil, field capacity, wilting point and bulk density and, disturbed and undisturbed soil samples were taken from every 30 cm layer in this profile.

In this study, in order to determine the effects of irrigation methods on EC and pH values of soil profile, soil samples were collected before and after irrigation by one-skip method from certain points at 4 different depths (0-30, 30-60, 60-90, 90-120), in irrigated areas in which each irrigation method was applied, and EC and pH were determined. At the end of the experiment as well as at the beginning of the experiment, soil samples were taken from the same depths, and analyzed physically and chemically.

Soil samples were taken from furrow bottom in furrow irrigation; from furrow bottom of the two lateral lines in sprinkler irrigation; but in drip irrigation, from the centre of two emitters next to the lateral line. In sprinkler, drip and furrow irrigation methods, the application of irrigation programs was determined by Δt Profile Probe and gravimetric soil moisture measurement method. In all irrigation methods, irrigation interval was 7 days (Ünlü et al., 2006) and in this interval, the irrigation water was given until diminished soil moisture reached at field capacity. 90 cm soil layer was taken into account in determining the amount of irrigation water that would be given to plots. During the experiment, 522.09 mm irrigated water was given to the area irrigated by furrow irrigation method, 556.44 mm irrigated water was given to the area irrigated by sprinkler irrigation and 480.30 mm irrigated water was given to drip irrigated area.

## RESULTS AND DISCUSSION

### Chemical Characteristics of Experiment Area Soil

The results of chemical analysis of soils are given in Table 2. As it is seen in the table, pH value of soil changes between 7.83 and 8.08, EC value changes between 519 µmhos/cm and 1021 µmhos/cm before the experiment. CEC (Cation Exchange Capacity) values of soil change between 16.73 me/100 g and 18.74 me/100 g, and ESP values change between 1.02% and 1.85%. In terms of infiltration, experimental area soil has sandy-clay-loam characteristics (infiltration speed 26 mm/hr), these soils possess good drainage without salinity and sodium problem.

In this research, pH values of experimental area soils varied from 7.67 to 8.06 and EC values varied between 448 µmhos/cm (furrow irrigation method) and 997 µmhos/cm (sprinkler irrigation method). After irrigation season, ions, such as water-soluble salts, were leached down to the lower layers. In experimental area soil, CEC values varied between 8.84-19.84 me/100 g; ESP values varied between 0.93-2.55.

There is a decrease in EC values of experimental soil after irrigation season. However, reduction in soil salinity has been limited because flashing water wasn't given in addition to irrigation water and irrigation water was second class. In general, the research area is arable land and conditions of natural drainage are sufficient.

**Table 2. Some chemical characteristics of experimental area soil before and after experiment**

Soil		pH	ECx10 <sup>-6</sup> (µmhos/cm)	SOLUBLE IN WATER										CEC (Cation Exchange Capacity) (me/100g)	Exchangeable Cations (me/l)			ESP (Exchange Sodium Percent) %
Method	Depth (cm)			Cations (me/l)					Anions (me/l)						Na <sup>+</sup>	K <sup>+</sup>	Ca <sup>++</sup> +Mg <sup>++</sup>	
				25°C	Na <sup>+</sup>	K <sup>+</sup>	Ca <sup>++</sup>	Mg <sup>++</sup>	Total	CO <sub>3</sub> <sup>=</sup>	HCO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>=</sup>					
Before experiments	0-30	8.08	951	2.72	0.04	3.34	3.60	9.70	-	2.31	5.0	2.20	9.51	18.74	0.28	0.63	16.84	1.49
	30-60	8.07	1021	1.51	0.08	4.09	4.92	10.60	-	1.60	6.0	2.61	10.21	16.73	0.31	0.50	12.44	1.85
	60-90	7.83	519	0.66	0.02	2.13	2.41	5.22	-	1.10	3.0	1.09	5.19	18.55	0.19	0.51	17.42	1.02
	90-120	7.85	645	0.84	0.03	2.48	3.21	6.56	-	1.47	3.0	1.83	6.30	16.95	0.24	0.56	15.28	1.43
After the harvest in furrow irrigated plots	0-30	7.94	448	1.01	0.03	1.63	1.92	4.59	-	0.50	3.0	0.98	4.48	15.07	0.18	0.70	13.79	1.19
	30-60	7.91	484	1.13	0.04	1.58	1.88	4.63	-	1.10	2.0	1.74	4.84	13.97	0.30	0.47	12.93	2.14
	60-90	7.81	580	1.02	0.06	2.41	3.16	6.65	-	1.60	4.0	1.20	6.80	19.84	0.28	0.35	18.27	1.41
	90-120	7.73	670	0.94	0.03	2.08	3.80	6.85	-	1.25	3.0	2.20	6.45	17.04	0.16	0.38	16.20	0.93
After the harvest in sprinkler irrigated plots	0-30	7.89	563	0.87	0.06	2.24	2.55	5.72	-	0.80	3.0	1.83	5.63	14.79	0.24	0.56	13.68	1.62
	30-60	7.78	752	1.56	0.01	3.34	4.41	9.32	-	1.80	5.0	2.72	9.52	10.20	0.26	0.33	9.02	2.55
	60-90	7.72	825	1.41	0.02	4.39	5.61	11.43	-	1.30	7.0	2.95	11.25	10.0	0.18	0.33	8.97	1.8
	90-120	7.67	997	1.81	0.04	3.19	4.71	9.75	-	1.20	6.0	2.77	9.97	8.84	0.13	0.23	8.36	1.47
After the harvest in drip irrigated plots	0-30	8.06	671	1.68	0.04	2.10	2.54	6.36	-	1.0	3.0	2.71	6.71	14.72	0.27	0.51	13.58	1.83
	30-60	8.02	760	2.12	0.01	2.71	2.95	7.79	-	1.40	5.0	2.20	7.60	12.43	0.28	0.31	11.61	2.25
	60-90	7.68	810	1.02	0.04	3.72	5.27	10.05	-	1.25	6.0	2.67	9.92	11.93	0.15	0.26	11.39	1.25
	90-120	7.83	850	1.12	0.02	2.79	4.21	8.14	-	1.30	4.0	3.20	8.50	13.09	0.16	0.26	12.53	1.22

### Changes of Salt Distribution in Profile According to the Irrigation Methods

Moisture distribution in soil profile is different in each irrigation method. In furrow irrigation method, furrow base and slope; in sprinkler irrigation method, all soil surface; but in drip irrigation method, only close parts to the plant roots on row are wetted. Movement of salts in the soil profile depends on water movement. So irrigation method and the amount of irrigation water is very effective in the distribution of salinity.

In research results; although the amount of irrigation water given by sprinkler irrigation method is more than drip and furrow irrigation method, soil samples taken during the irrigation season showed that salinity values for all layers was the lowest in furrow irrigation method. When we compared sprinkler irrigation method and drip irrigation method, in the upper layers (0-60 cm), EC levels were higher in the drip irrigation plots but it varied in lower layers. Before and after research, salinity values and % changes are given in Table 3.

Table 3. The change in salinity before and after the irrigation season

	Depth (cm)	EC. Before irrigation season ( $\mu\text{mhos/cm}$ )	EC. After irrigation season. ( $\mu\text{mhos/cm}$ )	Salt concentration variation. (%)
Furrow system	0-30	951	448	- 52.9
	30-60	1021	484	- 52.6
	60-90	519	580	11.7
	90-120	645	670	3.9
Sprinkler system	0-30	951	563	- 40.8
	30-60	1021	752	- 26.3
	60-90	519	825	58.8
	90-120	645	997	54.6
Drip system	0-30	951	671	- 29.5
	30-60	1021	760	- 25.5
	60-90	519	810	56.2
	90-120	645	850	31.8

When the Table 3 is examined, in salt values at the beginning of the experiment and after the experiment, the largest decrease for 0-30 cm and 30-60 cm layers are observed in furrow irrigation method as 52.9% and 52.6% respectively; the largest increase for 60-90 cm and 90-120 cm layers are observed in sprinkler irrigation method as 58.8% and 54.6% respectively. As there was no in experimental land, there was decrease in salt levels as given irrigation water provided leaching in the upper layers, and there was increase in lower layers as salty water wasn't removed.

In layers having 0-60 cm depth in experimental field soil profile, there was a decrease from 25.5% to 52.9% in each irrigation method, and there was an increase from 3.9% to 58.8% in layers having 60-120 cm depth. Salt changes before and after the experiment is shown in Figure1.

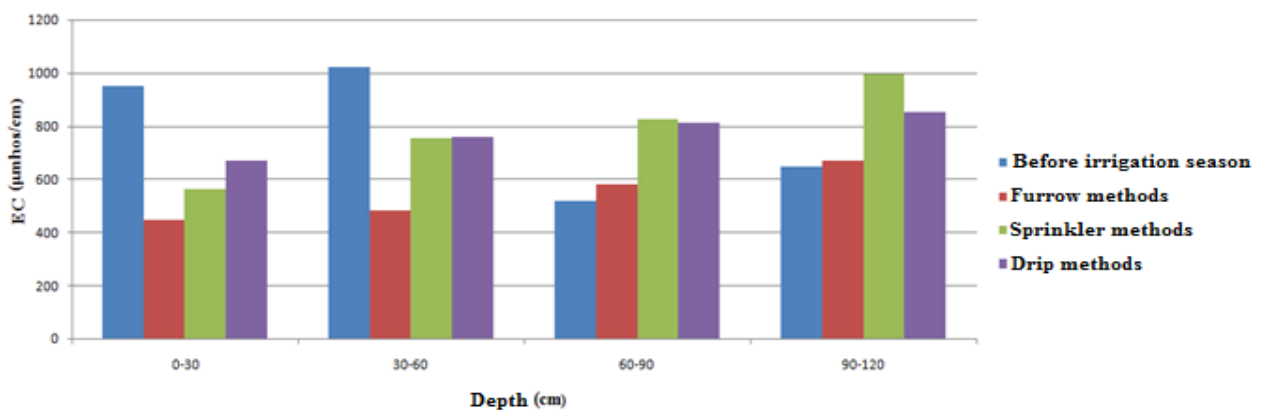


Figure 1. The change in salinity of experimental area soil before and after experiment

As a result, the most effective irrigation method is furrow method in reducing the salt concentration in the upper layers, and sprinkler and drip irrigation methods come after; the most effective ones in salt accumulation in the lower layers are sprinkler, drip and furrow irrigation methods. However, in these indicated results, taking soil samples from the bottom of furrow provides a great impact in the analysis of the effect of furrow irrigation method in salt changes on soil profile. So, when applications are made under the same conditions of this research (cultural processes, the quality of irrigation water, irrigation programmed), it is likely to see similar salinity levels.

Somani (1991) and Kanber et al. (1992) reported that salts are accumulated in the boundary of wetted perimeter in drip system. This causes high concentrations of salt in wetted volume. Under poor drainage conditions, salt accumulation has observed in such boundary and lower concentration in nearby emitters.

Although sprinkler irrigation is the most economical leaching technique, surge basin method has preferred mostly. Soil infiltration rate can be improved by surge basin irrigation especially in soils which are low hydraulic conductivity (Sönmez et al. 1996).

Ertek and Kanber (2001) stated that salts are mostly accumulated upper parts of soil profile in drip irrigated cotton plants. Beside this, salts are away from wetted perimeter from emitters especially in 30cm away from the emitters. Same authors observed that salts are more dominated within 15 cm soil depth.

## CONCLUSIONS

1. During irrigations, the plots in which three methods were applied separately, considering the irrigation periods, soil samples were taken before and after irrigation by one-skipping method and salinity values were examined in profile. In general, when salt concentrations of soil samples taken after irrigation; there is a reduction at layers having 0-60 cm depth but an increase at layers having 60-120 cm depth.

2. When salinity changes in profile are compared in terms of irrigation methods before and after the experiment; the maximum reduction in the salt in the layers of 0-60 cm depth are observed in furrow irrigation, sprinkler irrigation and drip irrigation method respectively. The maximum increase in the layers of 60-120 cm depth, on the other hand, is observed respectively in sprinkler irrigation, drip irrigation and furrow irrigation method.

The followings can be recommended in consequence of the general evaluation given above;

1. The basic principle of drip irrigation method is giving water to the plant with short intervals. As the close environment of plant remains constantly wet, salts remain outside the environment of plant. This also reduces the salt harm. However, as in this research, if irrigation interval is kept same with sprinkler and furrow irrigation, salt accumulation in soil becomes greater than other methods or there is less salt washing on the top layers. Because of this reason, soil drainage should be provided with more salt concentration of irrigation water in the application of drip irrigation method, and washing water must be given at the end of irrigation season.

2. In furrow irrigation method, salt is mowed towards the back of furrow; furrow base and slope are relatively less salty. Also in this study, soil samples collected from the furrow base, salt values were less than other methods. To plant the crops on both sides of furrow backs would reduce salt effect of plant.

**3. As it can be seen from the study, in the irrigated areas, while salinity in the upper layers of soil profile decreases with the help of washing during the irrigation seasons, salt that is washed, accumulates in the lower layers. Especially in heavy-structured soils, in case of having ground water in lower layers, salts brought by washing to the bottom of root area, would make ground water salty, high salinity ground water would increase with capillary so this would cause the formation of salty soil and soil including sodium in time. Therefore, whichever irrigation method is used, ground water must be observed, and if necessary, on-farm drainage must be established.**

**4. When the soil and water resources of the area are taken into consideration, irrigated farming and irrigation practices have importance. Lack of water resources, the scarcity of areas opened to irrigation, the low cost of irrigation efficiencies emerge as an important matter. For the solutions of those problems, researchers and investors are required to teach irrigation techniques and soil salinity control to local farmers.**

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# CALCIUM FOLIAR APPLICATION IN FUNCTION OF APPLE FRUIT QUALITY PRESERVING

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## ABSTRACT

The experiment was carried out with the fruits of apple varieties Idared and Granny Smith. The aim of the research was to test the influence of foliar calcium applications on the quality and storage of apple fruit cultivars. The cultivars were grafted on M9 rootstock and grown in an integrated production system. Foliar calcium preparations were applied every 15 days starting 6 weeks after fruiting and continuing until harvest. As a foliar application it was used a mixture of two products (Calbit C in concentration of 0.35 % and Boro plus in concentration of 0.05 %). The fruit analyses were made three times - after harvest, after 90 days of storage and after 10 days of shelf life. The results showed positive effects of foliar application on fruit quality of both apple cultivars, but the reaction of Idared cultivar was slightly better than Granny Smith

**Key Words:** Storage, shelf life, calcium foliar application, Idared, Granny Smith

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## INTRODUCTION

Well balanced nutrition program is crucial for high yield and fruit quality. Many factors affect the nutrition of fruit trees. The most important factors are type of soil and fertilizer application rates. Comparing with others, some cultivars respond differently on the nutrition program. Additional factors include rootstock, physical and chemical conditions of soil, and others. The soil testing is an indispensable tool in orchard management. Apple fruit analysis frequently shows a need for higher Ca levels. Low calcium content in the fruit cause several disorders such as: bitter pit, cork spot, scald and senescent breakdown during storage. Apples are not efficient at obtaining calcium from the soil, and are not especially efficient at translocating Ca from the roots to the leaves and fruit. Also, during drought stress, water containing calcium may be translocated from the fruit back into the leaves, thus reducing the Ca content of the fruit. Acid soils make Ca, and other nutrient problems worse, so proper liming is essential. The normal fruit Ca range in good fruit is from 0.05 - 0.09 % (Kader 2002; Marschner, 1986, Pašalić, 2006). However, values above 0.05% are generally required to minimize low Ca related fruit problems (Gvozdrenović and Davidović, 1990). Calcium is an important mineral which determine quality and decay resistance. The other conditions that affect apple Ca status are high levels of competitive cations, such as K, Mg, and N.. Calcium absorbed by the roots moves very slowly through the trees and into the fruit. Apple tree roots are poor at absorbing Ca from the soil (Van der Boon J. 1974). Because of this, foliar sprays and apple dips are commonly used to increase the Ca content of the fruit (Alexandar, 1986). Foliar Ca applications are not a substitute for keeping the soil properly limed. Anything that stimulates vegetative growth will work against adequate fruit Ca levels. High content of N is associated with reduced post-harvest life due to increased susceptibility to decay, mechanical damage and physiological disorders (Sharples, 1985; Kader, 2002). Boron deficiencies may reduce Ca movement in a tree. Boron plays a significant role in the trees ability to translocate Ca from the roots to other parts of the tree. Benefits of Ca to plants are: enhances crop quality, enhances cell wall strength, improves water management, improves post-harvest storage ability of fruit, etc. Some authors reported about the effect of post-harvest treatment of apple fruits with calcium (Krpina et al., 2007; Suljević and Drkenda 2011, Suljevic et. al., 2011).

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The aim of this study was to determine the influence of foliar application of calcium on the fruit quality during storage and *shelf-life*, by two topical apple cultivars in Bosnia and Herzegovina (Idared and Granny Smith).

## MATERIAL AND METHODS

The fruits of apple cultivars Idared and Granny Smith were grafted on the rootstock M9. Evaluation was carried out in the apple orchards in Gradačac - North-East of Bosnia and Herzegovina. The observation was done in June 2010 year. The trees were planted in 2004, at spacing of 3.8 m x 1 m. All trees were trained to spindle. The experiment was arranged as a random design with 3 trees in 4 replications (12 trees per variant). The orchard was managed according to standard commercial practice for integrated fruit production. According to textural classification, the soil was classified as medium heavy to heavy. Foliar application of calcium started from the time of 6 weeks after fruiting and was done every 15 days until harvest. Two products were used for foliar application, which were mixed together. The first product is Calbit- C (in concentrations of 0.35%), and another product called Boro Plus (in concentration of 0.05%). Beside the foliar application of Calcium the experiment included a control treatment (without foliar application of calcium). The optimal moment of harvest was determined by tests for physiological ripeness of fruit according to Werth (1997): iodine – starch test, fruit firmness, the contents of total soluble solids and total acid's content. The following pomological properties were monitored for fruit quality: fruit firmness (using penetrometer), content of total soluble solids (using refractometer), acid's content (by titration with 0.1 M NaOH), and total calcium content. The total calcium was estimated using previous deposition of phosphorus, aluminum and iron (using urotropina as reagent). Determination of calcium in solution was done by burning samples of apple fruits, and values are presented as %. Analyses of fruit were made in three terms. The first analysis was done immediately after harvest. After that the fruits were placed in storage under normal atmospheric conditions (temperature 4°C, relative humidity 85%) for 90 days. After removal from the storage, the second fruit analysis was done. The remaining fruits were exposed for 10 days of *shelf life* at the room temperature. After ten-days of *shelf life* the third analysis of the fruit quality was done. All measurements were performed on a sample of 30 fruits. All quantitative parameters were analyzed statistically and the values obtained in terms of further evaluation, were tested by mathematical - statistical tests (using three-factorial analysis of variance - ANOVA test) and Takey's Multiple Range Tests, at  $p < 0.05$ .

## RESULT AND DISCUSSION

Table 1 shows the values for Calcium content in the apple fruits and statistically significant differences observed between cultivars, term of storage and Ca foliar treatments.

After harvest, the fruits from cv. Idared had a higher value of Ca- content than the fruits from cv. Granny Smith. After harvest the treated fruits of cv. Idared had significantly higher value of Ca content than untreated fruits. Krpina et al. (2007), Suljević and Drkenda (2011), Suljević et al. (2011) also stated that post-harvest treatment with calcium had an influence on increase of calcium content in the apple fruits. There was no significant difference in Ca content between treated and untreated fruits of cv. Granny Smith. It means that the fruits of cv. Idared better bound Ca after foliar application.

In treated fruits of cv. Idared it was registered significant decrease of Ca content after the 90 days of storage as well as after *shelf life*. But, untreated fruits of cv. Idared did not have significant decrease of Ca content after 90 days of the storage. It means that during the storage the fruits of these apple cultivar bind calcium absorbed by the root. In treated fruits of cv. Granny Smith it was registered significant decrease of Ca content after the 90 days of storage, while the decrease of calcium after *shelf life* was not significant. Even in both apple cultivars it was registered a statistically significant decrease of calcium in the treated fruits during the storage and shelf life, this decrease of calcium content is stronger in cv. Idared than in cv. Granny Smith. It means that the fruits from cv. Granny Smith had better absorbed foliar applied Ca during storage than the fruits from cv. Idared.

**Table 1. Average content of Calcium in the apple fruits and statistically significant differences observed between cultivars, term of storage and Ca foliar treatment (%)**

Term of storage	Treatment	Cultivar				Treatment x term of storage		Average	± St. dev
		Granny Smith		Idared		Average	±St. dev		
		Average	±St. dev	Average	±St. dev				
1	Ca-B	0.040 a	0.010	0.054 c	0.002	0.05 a	0.008	0.04 a	0.007
2	Ca-B	0.034 b	0.007	0.034 b	0.001	0.03 b	0.009	0.03 b	0.008
3	Ca-B	0.033 b	0.008	0.024 d	0.007	0.03 b	0.005	0.02 c	0.006
Average	Ca-B	0.035 a	0.004	0.038 b	0.001	0.04 a	0.009		
1	Control	0.040 a	0.003	0.036 b	0.001	0.04 a	0.002		
2	Control	0.018 c	0.007	0.037 b	0.009	0.03 b	0.001		
3	Control	0.016 c	0.001	0.028 d	0.001	0.02 c	0.006		
Average	Control	0.030 b	0.001	0.034 a	0.005	0.03 b	0.009		
		0.030 a	0.001	0.04 b	0.009				

Table 2 shows values for fruit firmness and statistically significant differences observed between cultivars, term of storage and Ca foliar treatments. Test analysis of variance showed statistically significant influence of apple cultivar, term of storage and Ca foliar applications on the fruit firmness (Table 5). Apple cultivar Granny Smith had significantly greater fruit firmness (7.51 kg/cm<sup>2</sup>) than cv. Idared (5.78 kg/cm<sup>2</sup>). During the storage time fruits from untreated trees had significantly greater decrease in fruit firmness than fruits from the foliar treated trees. Storage of 90 days as well as 10 days of *shelf life* did have significant influence on decrease of fruit firmness. At the harvest day, the fruit firmness of cv. Granny Smith was equal in treated and untreated trees. It could mean that the trees of cv. Granny Smith have well fusion of calcium from the soil. But, the fruit firmness in the treated Idared's trees was significantly greater than in untreated trees. It means that trees of cv. Idared response faster on the foliar applied calcium than trees of cv. Granny Smith. The reason for weak response on the applying Ca directly on the trees of cv. Granny Smith could be that the fruits from this cultivar were picked from the higher located branches in the tree.

**Table 2. Average fruit firmness of fruit at apple cv. Idared and Granny Smith related to term of storage and Ca foliar application (kg/cm<sup>2</sup>)**

Term of storage	Treatment	Cultivar				Treatment x term of storage		Average	± St. dev
		Granny Smith		Idared		Average	± St. dev		
		Average	± St. dev	Average	± St. dev				
1.	Ca-B	8.46 a	0.41	7.55 c	0.62	7.99 a	0.70	7.87 a	0.73
2.	Ca-B	7.58 b	0.64	5.32 d	0.49	6.46 b	1.28	6.31 b	1.18
3.	Ca-B	6.98 c	0.55	5.07 d	0.68	6.02 c	1.14	5.76 c	1.20
Average	Ca-B	7.67 a	0.82	5.97 b	1.26	6.80a	1.04		
1.	Control	8.38 a	0.32	7.12 e	0.37	7.75 a	0.72		
2.	Control	7.11 b	0.5	5.25 f	0.55	6.18 b	1.08		
3.	Control	6.61 c	0.88	5.51 df	0.42	5.51 c	1.21		
Average	Control	7.37 a	0.88	5.60b	1.22	6.48 b	1.15		
		7.52a±0.86		5.78 b±1.26					

Kader (2002) also reported differences in Ca content depending on the position of the branches in the tree. After 90 days of storage it was registered significant decrease in fruit firmness in both apple cultivars as well as in treated and untreated fruits. Ten days period of *shelf-life* induces significant decrease of fruit firmness in treated fruits of cv. Granny Smith. Treated fruits of cv. Idared after 10 days of *shelf life* did not have important decrease of fruit firmness. Because of that it could be concluded that the Ca application had better impact on fruit firmness of apple cultivar Idared than on the Granny Smith



apple, during the *shelf-life*. The results for obtained decrease of fruit firmness of apple cultivar Idared and Granny Smith after foliar applied Ca are consistent with Suljević and Drkenda (2011) as well as Suljevic et al. (2011), who applied calcium after harvest.

Table 3 shows the values for total soluble solids content in the fruits and statistically significant differences observed between cultivars, term of storage and Ca foliar treatments. Foliar application of Ca induced slower degradation of polysaccharide as well as slower fruit ripening during storage of 90 days and *shelf life*. There is a significant difference between apple varieties according to change of sugar contents during the storage and *shelf life*. During the storage of 90 days, the treated fruits from cv. Granny Smith had significantly slower ripening than the untreated fruits. In the fruits of cv. Idared (after 90 days of storage) there was no significant difference in TSS content between treated and untreated fruits. But, observed data of cv. Granny Smith showed that the treated fruits after 90 days of storage had lower values of TSS than control fruits. Foliar application of Ca in cv. Granny Smith induce an increase of TSS during storage as well as during the *shelf life*. Untreated fruits of cv. Granny Smith had significant decrease of TSS after *shelf life* period. It means that foliar application of cv. Granny Smith had an influence on slower metabolism and decay of fruits after storage and during *shelf life*. There was no significant difference in TSS between treated and untreated fruits from cv. Idared after *shelf life*. Suljevic and Drkenda (2011) and Suljevic et al. (2011) reported that post-harvest treatment with calcium did not have a statistically significant influence on the TSS.

Table 3. Average values for total soluble solids content in the apple fruits and statistically significant differences observed between cultivars, term of storage and Ca foliar treatments ( $^{\circ}$  Brix)

Storage term	Treatment	Cultivar				Treatment x term of storage		Average	$\pm$ St. dev
		Granny Smith		Idared		Average	$\pm$ St. dev		
		Average	$\pm$ St. dev	Average	$\pm$ St. dev				
1.	Ca-B	11.17 a	0.13	11.93 b	0.10	11.55 a	0.40	11.60 a	0.49
2.	Ca-B	11.63 b	0.13	13.07 d	0.10	12.35 b	0.73	12.50 b	0.64
3.	Ca-B	12.10 c	0.08	11.97 c	0.05	12.03 b	0.10	12.02 c	0.10
Average	Ca-B	11.63a	0.40	12.32 b	0.54	11.98 a	0.58		
1.	Control	11.10 a	0.08	12.2 b	0.17	11.65 a	0.57		
2.	Control	12.70 c	0.13	13.13 d	0.13	12.65 b	0.50		
3.	Control	12.00 c	0.08	12.03 c	0.13	12.02 c	0.11		
Average	Control	11.76a	0.48	12.46 b	0.50	12.11 b	0.61		
		11.69 a $\pm$ 0.45		12.39 b $\pm$ 0.52					

The differences in acid's content had been caused by variety, storage time and their interaction as well as interaction of all three experimental factors (Table 4). The fruits from apple cultivar Granny Smith had greater content of acids than the fruits from cv. Idared. Foliar applied Calcium did not caused significant difference in acid's content at the harvest. Suljevic and Drkenda (2011) as well as Suljevic et al. (2011) also reported that post-harvest treatment with calcium did not have a statistically significant influence on the acid's content in apple fruits. The storage of 90 days induced a significant decrease of acids in the treated as well as untreated fruits. The treated fruits from cv. Granny Smith had also significant decrease of acids after *shelf life*. But, Calcium treated fruits of cv. Idared did not have decrease of acids after *shelf life* in comparison with control fruits. It means that foliar application of Ca caused in cv. Idared a slower metabolisms of acids during the *shelf life*.

**Table 4. Average values of acid's content in the apple fruits and statistically significant differences observed between cultivars, term of storage and Ca foliar treatments (%)**

Storage term	Treatment	Cultivar				Treatment x term of storage		Average	± St. dev
		Granny Smith		Idared		Average	±St. dev		
		Average	±St. dev	Average	±St. dev				
1	Ca-B	0.87 a	0.012	0.54 b	0.03	0.70 a	0.18	0.70 a	0.17
2	Ca-B	0.62 b	0.020	0.38 a	0.03	0.49 b	0.13	0.48 b	0.13
3	Ca-B	0.38 c	0.025	0.35 a	0.03	0.36 c	0.03	0.35 c	0.03
Average	Ca-B	0.62 a	0.213	0.42b	0.09	0.53 a	0.19		
1	Control	0.86 a	0.020	0.54 b	0.03	0.70 a	0.18		
2	Control	0.58 c	0.032	0.35 a	0.03	0.47 b	0.13		
3	Control	0.36 b	0.020	0.23 c	0.02	0.34 c	0.03		
Average	Control	0.60 a	0.218	0.39b	0.11	0.49 a	0.20		
		0.61a ±0.21		0.41 b	0.10				

In the table 5 are presented data of three-factorial analysis of variance.

**Table 5. Significance for the Effect of cultivar, calcium foliar application, term of storage and their interaction on fruit firmness, soluble solids, total acids and calcium content in apple fruits<sup>a</sup>**

Source of variability	Fruit firmness	Soluble solids	Total acids	Calcium content
Cultivar	***	***	***	***
Foliar application of Calcium	***	***	**	***
Term of storage	***	***	***	***
Cultivar x Foliar application of Calcium	NS	NS	NS	***
Cultivar x Term of storage	***	***	***	***
Foliar application of Calcium x Term of storage	NS	***	NS	**
Cultivar x Foliar application of Calcium x Term of storage	**	***	NS	***

<sup>a</sup> NS – not significant; \* - significant differences at p-value below 0.05; \*\* - significant differences at p-value below 0.01; \*\*\*- significant differences at p-value below 0.001

## CONCLUSIONS

The fruits of apple cultivars Idared and Granny Smith had responded on the Ca foliar application. Foliar application of Ca had induced slower degradation of polysaccharide as well as slower ripening during storage and *shelf life* of fruits. There is a significant difference between apple cultivars considering change of fruit firmness, sugar contents during the storage and *shelf life*. Foliar application of Ca had caused a slower metabolisms of acids in cv. Idared during the *shelf life*. During storage period of 90 days cv. Granny Smith better bound foliar applied Ca than cv. Idared.

It is undisputed that influence of cultivar, foliar application of Ca and storage on fruit quality is complex. Good quality of fruit depends on the numerous factors in the orchard and in post-harvest period. Many of them should be included in the studies to provide growers information about which cultivars, nutrition and storage conditions will provide the best results.

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# INVESTIGATION OF COLD STORAGE CONDITIONS OF *Arbutus unedo* L. FRUITS

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## ABSTRACT

Strawberry tree (*Arbutus unedo* L.) fruit contains a higher amount of nutrients and bioactive compounds compared to many other cultivated species. However, consumption of this fruit is currently not widespread. Many of the beneficial effects of the fruit go unnoticed since it has not been taken into culture. The fruits were collected from the forests by villagers in an unsuitable manner and sold without using containers in the market under adverse conditions. This research was aimed to determine cold storage conditions for *Arbutus* berries and to prolong its self-life in the market and also to increase its use in the pharmaceutical industry. For this purpose, fresh fruits collected from Çanakkale province in December 2010. The fruits were stored for 14 days at 0°C and 90% RH at either normal atmosphere (NA) or modified atmosphere packaging (MAP). Various parameters such as fruit color (L\*, a\*, b\*), weight losses, fruit firmness, total soluble solid (TSS) content, pH value, titratable acidity (TA) content were determined in 7 days interval. The fruits were kept at 20 °C plus 2 days for shelf life at the end of storage experiment. MAP treatment was found to be most favorable storage for fresh *Arbutus* berries.

**Key Words:** *Arbutus unedo* L., Fruit, Modified atmosphere, Quality, Color

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## INTRODUCTION

The strawberry tree (*Arbutus unedo* L.) fruit is an evergreen shrub or small tree, typical of the Mediterranean fringe and climate, and it is widely distributed in the Mediterranean region and North Africa. In Turkey, *Arbutus unedo* tree grows wildly especially in the Mediterranean region and it is found to grow on dry rocky slopes and hillsides, or in pine forests, particularly in the Taurus Mountains (Ayaz et al., 2000; Papoff et al., 1993). Strawberry tree fruits are suitable for the production of alcoholic beverages, jams, jellies and marmalades (Alarcao-e-Silva et al., 2001; Pallauf et al., 2008). They are frequently used in traditional medicine in some countries, such as Spain and Morocco (Tahraoui et al., 2007). In several Portuguese regions, the fruits are eaten raw or made into liqueurs, as well as bark or roots decoctions, which are used as anti-inflammatory, laxatives, carminatives, digestives, odontalgics and cardiotonics (Barros et al., 2010). Recently, important studies have been carried out to select the *Arbutus unedo* genotypes for superior fruit quality from the Northwestern part of Turkey, and thus to prevent extinction and to allow extensive cultivation of the strawberry trees (Çelikel et al., 2008). Fruits are an important part of our diet. They provide, not only the major dietary fibre component of our food, but also a range of micronutrients, including minerals, vitamins and antioxidant compounds, such as carotenoids and polyphenols. For example, carotenes act as a precursor for vitamin A, which can only be obtained from diet and which as an antioxidant, is known to play a role in the prevention of several diseases. Anthocyanins are the largest group of water-soluble pigments in the plant. Several studies have pointed out the anti-oxidant properties of anthocyanins and their positive role in our diet.

*Arbutus unedo* fruits are highly perishable, non-climacteric and a short self-life. Postharvest practices such as modified atmosphere packaging (MAP) reduces undesirable physiological, chemical/biochemical and physical changes in foods, it controls microbial growth and it prevents product contamination. MAP extends the shelf-life of fresh fruits. Loss of firmness, shriveled fruit surface, changing of fruit color, and development of decay are major problems shortening the shelf- life (Floros and Matsos, 2005).

The objective of this study was to determine cold storage conditions of *Arbutus unedo* fruits, the effects of packaging materials (MAP) and during the storage on quality of *Arbutus unedo* berries. For this purposes, *Arbutus unedo* fruits were packed with polyethylene bags (2h Gıda) and normal atmosphere then, stored at 0 °C for 14 day and + 2 day 20 °C shelf life.

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## MATERIALS AND METHODS

### Plant material

Ripe fresh strawberry tree (*Arbutus unedo* L.) fruits were randomly collected from Çanakkale province, Lapseki sub-province and Şevketiye village (40°23' N, 26° 52' E) at 92 m above sea level, which is located in the Northwestern part of Turkey. The fruits (approximately 2.5 kg of fruits for each replication) were picked at the optimum ripe stage. The *Arbutus unedo* berries were not selected for size, but reflected the typical size for the cultivar. Experiment was established with four replications. The fruits were stored at normal atmosphere and modified atmosphere packaging (MAP) methods for 14 days at 0 °C and 90% RH. The fruit color, weight loss, fruit firmness, total soluble solid (TSS) content, pH value, titratable acidity (TA) content were determined in 7 days interval. The fruits were kept at 20 °C plus 2 days for shelf life at the end of storage experiment.

### Quality analysis methods

- Color measurement of fruit samples was performed using a Minolta CR-400 model colorimeter (Minolta Co., Osaka, Japan) L\* (lightness/luminance), a\* (from red to green) and b\* (from yellow to blue) values, adopted by the Commission Internationale d'Éclairage (CIE), were measured in each experiment.
- For the weight losses measurement (%) was determined using a 0,001 g precision balance (Precisa XB 220A) at one week intervals. Weight loss was calculated as:  $\text{weight loss} = [(W_i - W_f) / W_i] \times 100$ ,  $W_i$  being the initial sample weight and  $W_f$  the final sample weight. The results are expressed as percentage weight loss.
- In intact fruits, fruit firmness was determined in using "Effegi" penetrometer (Shinjuku Fhr-5) equipped with a 3-mm diameter flat probe. Fruit were deformed 6 mm at a rate of 1 mm s<sup>-1</sup> and the maximum force developed during the test was recorded on 20 fruits for each treatment.

From each treatment, 250 g of fruits were taken, and pulped by using blender. The obtained fruit juice was used for total soluble (TSS) solids contents, pH value and titratable acidity (TE) content.

- The results were expressed as gram (g). TSS contents were determined by a digital refractometer (Kyoto Electronics Manufacturing Co. Ltd., Japan, Model RA-250HE) at 22 °C.
- The pH value was determined by potentiometric measurement made at 22 °C with pH meter (WTW, Germany).
- TA was determined by means of titration with NaOH 0.1 N until pH 8.1, and expressed as grams of citric acid per 100 ml of fresh fruit extract.

### Statistical Analysis

Data were evaluated in a two-way Anova analysis by using Minitab software (ver. 14).

## RESULTS AND DISCUSSION

The color parameters (L\*, a\* and b\*) of fruits were evaluated for external skin color of fruits. Proliac and Raynoud (1981) reported that carotenoids may be responsible for the yellow color in the flesh of the fruits, but the external red color is mainly due to the presence of other phenolic pigments, identified as 3-glucosylcyanidin. The differences between the brightness (L\*) of external side were found to be significantly important ( $p < 0.01$ ; Table 1). The L\* values of MAP fruits were higher at 14 day than NA fruits. The lowest external L\* value was determined in the 14-d and 14-d +2 MAP fruits (Fig.1, Table 1).

Similarly to the L\* values, the redness (a\*) in the external side was not affected by MAP conditions. Cold storage methods did not statistically vary the a\* and b\* values (Table 1). The a\* and b\* value was not dependent on the storage conditions, but it first increased and later decreased significantly by the end of the storage.

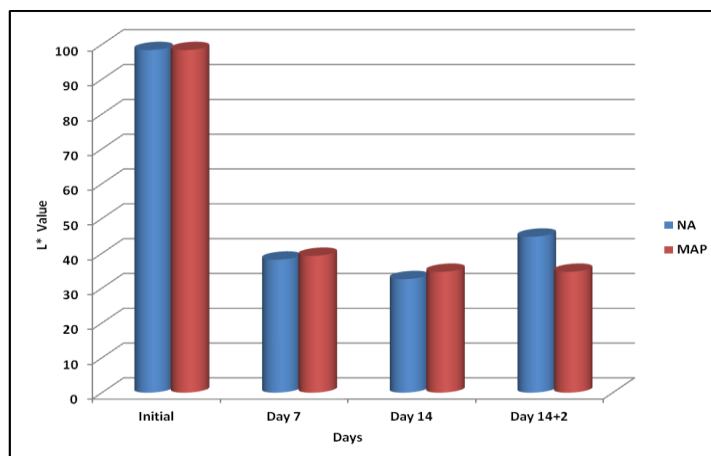


Figure 1. Effect of MAP and NA treatment on L\* value, during the storage

Packaging of *Arbutus unedo* fruits significantly (0.001) prevented dehydration. The non-packaged fruits lost their weight much more than the packaged fruits. NA fruits lost their initial weight at a 10.8% level at day 7. On the other hand, the MAP fruits lost only 0.4% of their weight at the same time. On the following sampling days, NA fruits lost significantly more weight compared to the MAP fruits (8.7 and 0.2%, 7.6 and 0.2%, 7.6 and 0.7%, respectively) (Table 1) and shriveling was developed in the NA fruits.

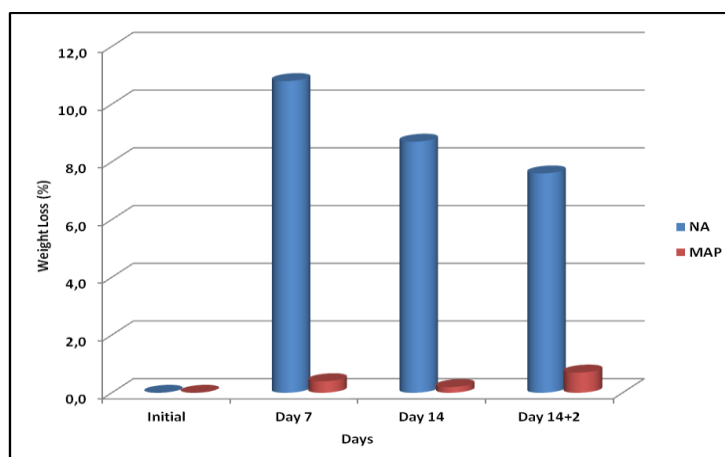


Figure 2. Effect of MAP and NA treatment on weight loss during the storage

No differences were found in the flesh firmness during the cold storage. But, the initial firmness of 307.39 g considerably decreased over time to 98.35 g (Table 1).

The concentration of total soluble solids ( $^{\circ}$ Brix) content was under the influence of both storage type and time. In the NA fruits, TSS content increased as the storage time was prolonged. There was not a quite a difference in the MAP fruits until they were stored for another two days for shelf life. On the other hand, MAP fruits contained significantly less soluble solids content compared to the NA fruits. pH decreased only in time independent of the storage type but showed a marked increase at the end of the shelf life (Table 1). Şeker et al. (2004) reported that *Arbutus* berries contained 14-20% total soluble solids at harvesting stage in the same ecological conditions.

Both storage type and time influenced the titratable acidity of the *Arbutus* fruits. TA content decreased sooner in the NA fruits compared to the MAP fruits as the fruits were stored longer than 7 days. Starting from the 14 days of storage, NA fruits contained higher acidity than the MAP fruits (Fig. 3).

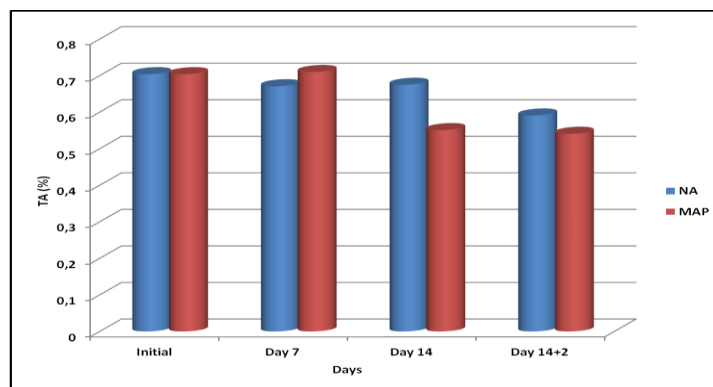


Figure 3. Effect of MAP and NA treatment on TA content during the storage

Many factors, such like the pH, temperature, light, presence of other phenolic compounds, enzymes, metal ions, sugars, ascorbic acid, and oxygen have impact on the stability of anthocyanins. In aqueous solution, anthocyanins to be coumarine derivatives undergo structural transformations that are pH-dependent. Therefore, processing and storage under low temperature can investigate to improve the stability.

## CONCLUSION

To our knowledge, there is no published article on *Arbutus unedo* storage by using NA and MAP treatments. So, this study is particularly important for obtaining preliminary results of different storage treatments on *Arbutus* berries. MA packaging effectively reduced mass loss during the storage period. While the mass loss of control fruit (NA) was 27.1% day 14+2 of storage, it was 1.3 % in fruit for packaged treatments. MA packaging material preserved the physicochemical characteristic and sensory quality during the storage period especially at 0°C. However, unpackaged (NA) *Arbutus unedo* fruits can be conserved for only 7 days due to significant changes in physical and sensory properties. However MAP has provided always better performance and extent twice the storage period. Therefore, suggested of *Arbutus unedo* fruits were 7 days for control fruit and 14 days for MA treatments. Plus 2 days 20 °C, so dangerous for MA treatments. Those results could be used for fresh *Arbutus* berry storage especially for food and pharmaceutical drug industries.

Table 1. Effect of NA and MAP treatments on *Arbutus unedo* fruits quality parameters during the cold storage

		Initial	Day 7	Day 14	Day 14+2
L* Value	NA	98.4 Aa	38.2 Ca	32.6 Da	44.8 Ba
	MAP	98.4 Aa	39.3 Ba	34.7 Ca	34.7 Cb
a*	NA	-7.277	29.207	25.133	23.223
	MAP	-7.277	29.423	25.605	22.793
	Mean	-7.277 C	29.395 A	25.369 B	23.008 B
b*	NA	2.496	13.997	14.940	9.737
	MAP	2.496	16.144	16.223	8.493
	Mean	2.496C	15.077 A	15.581 A	9.115 B
Weight Loss (%)	NA	0.0Ca	10.8 Aa	8.7 Ba	7.6 Ba
	MAP	0.0Aa	0.4 Ab	0.2 Ab	0.7 Ab
Flesh Firmness (g)	NA	307.39	193.08	118.49	90.46
	MAP	307.39	189.46	124.89	106.25
	Mean	307.39 A	191.27 B	121.69 C	98.35C
TSS (%)	NA	22.5 Ca	24.00 Ba	27.75 Aa	27.50 Aa
	MAP	22.5 Aa	22.5 Ab	22.25 Ab	21.08 Bb
pH	NA	3.52	3.32	3.33	3.48
	MAP	3.52	3.35	3.40	3.51
	Mean	3.52 A	3.33 B	3.37 B	3.50 A
TA (%)	NA	0.704 Aa	0.671 Bb	0.675 Ba	0.591 Ca
	MAP	0.704 Aa	0.710 Aa	0.551 Bb	0.541 Bb

\* Means within columns not followed by the same capital letter are significantly different at the P < 0:01 level of application time treatment.

\*\* Means within columns not followed by the same small letter are significantly different at the P < 0:01 level by of application

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# DETERMINING THE IDENTITY OF A PROMISING NEW SOUR CHERRY CULTIVAR USING SSR MARKERS

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## ABSTRACT

The genetic identity of a promising new sour cherry (*Prunus cerasus*) cultivar 'Čelička' was examined using seven microsatellite markers developed from peach (*Prunus persica*). Along with the previously mentioned cultivar, four international, commercial cultivars ('Schatten morelle', 'Rexelle', 'Doubbele Gorsem Kreiek', 'Heimanns Konservenweichsel') and two most commonly grown regional cultivars ('Maraska' and 'Oblačinska') were also evaluated using seven SSR primer pairs. In total, 46 different alleles were detected. UPGMA dendrogram based on genetic similarity (Dice) was constructed in order to examine the relationships among cultivars. 'Rexelle', 'Doubbele Gorsem Kreiek', 'Heimanns Konservenweichsel' clustered tightly with 'Schatten morelle', which is not surprising considering the fact that these three cultivars are supposed to be spontaneous seedlings of 'Schatten morelle'. The new cultivar 'Čelička' also displayed very high level of genetic similarity with 'Schatten morelle' indicating that even this new genotype might be a spontaneous seedling of 'Schatten morelle'. The cluster analysis showed that the examined 'Maraska' and 'Oblačinska' genotypes grouped very closely together. This may indicate a recent common ancestor or hybridization events, especially since 'Maraska' and 'Oblačinska' fit more descriptions of populations than that of classic cultivars.

Key Words: Sour cherry, microsatellite, genetic similarity

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## INTRODUCTION

Sour cherry (*Prunus cerasus* L. (syn. *Cerasus vulgaris* Mill., *Prunus vulgaris* Schur.) is a member of the family *Rosaceae*, subfamily *Prunoideae* and genus *Prunus*. Together with sweet cherry (*Prunus avium* (L.) L.), sour cherry belongs to the subgenus *Cerasus*. This species represents an allotetraploid fruit crop, which originated through a spontaneous hybridization between sweet cherry (*P. avium* L.;  $2n = 2x = 16$ ) and ground cherry (*P. fruticosa* Pail.;  $2n = 4x = 32$ ) (Olden and Nybom 1968; Webster 1996; lezzoni 2008).

The fruits of sour cherry are a valuable raw material for the fruit processing industry, but can also be used for fresh consumption. Recent studies indicate that the fruit of *P. cerasus* contains high levels of anthocyanin, which have antioxidant and anti-inflammatory properties (Blando et al. 2004).

The production of sour cherry in Bosnia and Herzegovina is rather underdeveloped (2,000 metric tons annual production according to the Statistical bulletin for B&H, 2011), especially considering the fact that Croatia and Macedonia belong to the group of 20 most significant producers of this fruit crop in the world and that Serbia, with annual production of 105,353 metric tons, holds the sixth overall place in the world production of sour cherry (FAOSTAT, 2011).

Different clones of 'Maraska', together with the clones of the cultivar 'Oblačinska' make up the majority of sour cherry assortment in the former republics of Yugoslavia (Puškar et al., 2005; Cerović i Radičević, 2008). Aside from dominating the production, these two cultivars are also considered autochthonous in this region. Although a study based on morphologic observation indicated that 'Oblačinska' sour cherry represents a diverse autochthonous population (Rakonjac et al. 2010), a molecular study that examined variability within the cultivar 'Oblačinska', using microsatellite markers, indicates that populations of this cultivar are not very genetically diverse (Puškar et al., 2005). Results from these two studies demonstrate the disadvantages of using morphologic markers for examining genetic identity and diversity studies.

Microsatellite molecular markers (SSR) have previously been used in a number of studies for examining sour cherry germplasm in USA, Turkey and the Baltic countries (Cantini et al., 2001; Kacar et

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al., 2006; Antonious et al., 2011). In all of these studies they have shown to be an excellent tool for analyzing genetic identity and genetic relationship between genotypes.

The main goal of this study was to determine the identity of a promising new sour cherry cultivar, which displayed excellent pomologic characteristics in an on-going study, using SSR markers. Molecular data would help reveal whether the new cultivar represents a completely new genotype which can then be used in local sour cherry production.

## MATERIAL AND METHODS

Genetic identity of a promising new sour cherry cultivar 'Čelička' was examined along with four international, commercial cultivars ('Schatten morelle', 'Rexelle', 'Doubbele Gorse Kreiek', 'Heimanns Konservenweichsel') and two most commonly grown regional cultivars ('Maraska' and 'Oblačinska') using seven microsatellite markers developed from peach (*Prunus persica*) (Tab 1.). The reference cultivars were found in three major fruit nurseries in Bosnia and Herzegovina, while the cultivar 'Čelička' is grown in a commercial orchard located in the vicinity of Sarajevo. During 2011, fresh leaves were taken from one tree of each genotype. DNA extraction was performed with Qiagen DNeasy® Plant Mini Kit (Qiagen, Valencia, CA, USA) according to the protocol included in the kit.

Table 1. Microsatellite (simple sequence repeats – SSR) code and DNA sequences of seven primer pairs used in the analysis of a promising new sour cherry cultivar and the reference cultivars.

SSR naziv	Forward primer	Reverse primer
UDP-96-005 <sup>a</sup>	GTA ACG CTC GCT ACC ACA AA	CCT GCA TAT CAC CAC CCA G
UDP-97-402 <sup>a</sup>	TCC CAT AAC CAA AAA AAA CAC C	TGG AGA AGG GTG GGT ACT TG
UDP-98-411 <sup>b</sup>	AAG CCA TCC ACT CAG CAC TC	CCA AAA ACC AAA ACC AAA GG
BPPCT-026 <sup>c</sup>	ATA CCT TTG CCA CTT GCG	TGA GTT GGA AGA AAA CGT AAC A
BPPCT-034 <sup>c</sup>	CTA CCT GAA ATA AGC AGA GCC AT	CAA TGG AGA ATG GGG TGC
BPPCT-039 <sup>c</sup>	ATT ACG TAC CCT AAA GCT TCT GC	GAT GTC ATG AAG ATT GGA GAG G
BPPCT-040 <sup>c</sup>	ATG AGG ACG TGT CTG AAT GG	AGC CAA ACC CCT CTT ATA CG

<sup>a</sup>Cipriani et al. (1999) <sup>b</sup>Testolini et al. (2000) <sup>c</sup>Dirlewanger et al. (2002)

PCR amplification of SSR sequences was performed in the Veriti™ Thermal Cycler (Applied Biosystems, Foster City, California, USA) using fluorescent labeled primers, which enabled the detection of PCR products using ABI 3130 Genetic Analyzer (Applied Biosystems). All PCR amplifications were performed as described in Puškar et al. (2005). The PCR product was diluted with ddH<sub>2</sub>O (1:50), then added to 8.75 µl HiDi and 0.25 µl Genescan 500 LIZ size standard. The data was analyzed using the software package GeneMapper 4.0 (Applied Biosystems).

Molecular data obtained through the analysis of the amplified DNA fragments was used to construct an SSR profile for each genotype. Number of alleles per locus and their range was calculated. Genetic distances were computed using the Dice similarity index and a cluster analysis was performed using the UPGMA method in the computer software NTSYS.

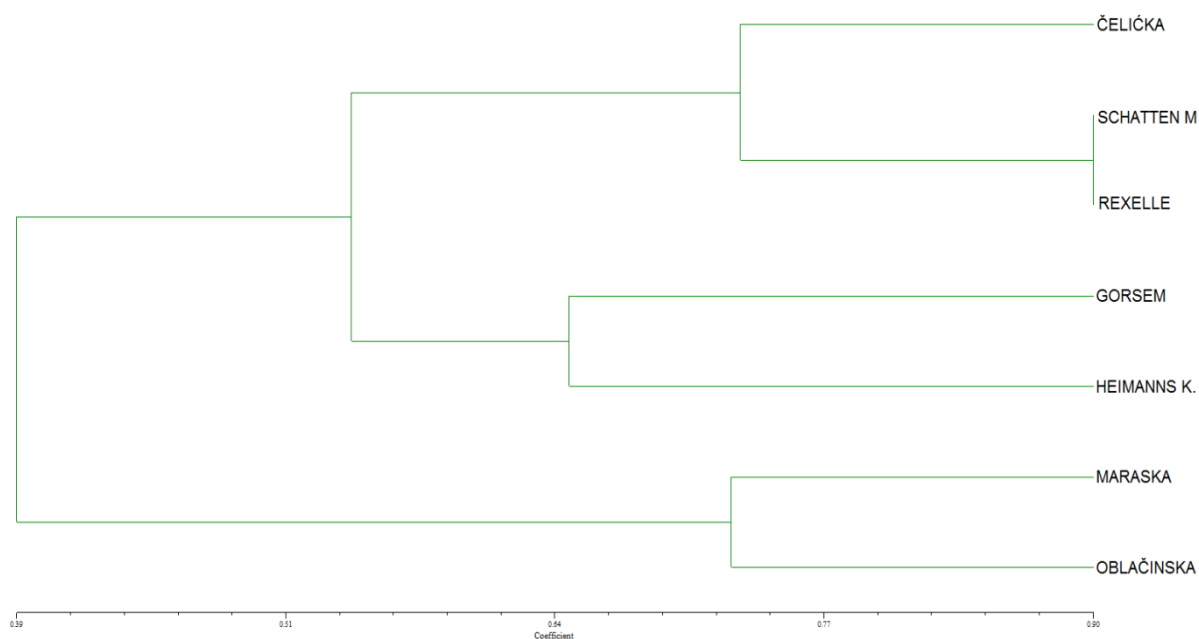
## RESULTS

In total, 46 different alleles were detected using seven SSRs, with 6.6 alleles per locus. Number of detected alleles per locus ranged from five alleles for UDP-96-005, to eight alleles for BPPCT-034 (Tab 2.).

**Table 2.** Number of alleles per locus and allele size range (bp) based on seven SSR loci for a promising new sour cherry cultivar and six reference cultivars.

	UDP-96-005	UDP-97-402	UDP-98-411	BPPCT-026	BPPCT-034	BPPCT-039	BPPCT-040	Mean
No. of alleles	5	6	7	7	8	7	6	46
Range (bp)	104/135	116/142	130/162	134/180	204/243	127/147	129/143	

Cluster analysis based on the Dice similarity index, classified all genotypes in two clusters (Fig. 1). The first one consists of the promising new sour cherry cultivar 'Čelička' and international, reference cultivars ('Schatten morelle', 'Rexelle', 'Doubbele Gorsem Kreiek', 'Heimanns Konservenweichsel'), while the second one comprises sour cherry cultivars, traditionally grown in the Balkan region ('Maraska' and 'Oblačinska').



**Figure 1.** UPGMA cluster analysis based on Dice similarity index computed from polymorphisms on 7 SSR loci in seven sour cherry genotypes

## DISCUSSION

Average number of alleles per locus, obtained in this study (6.6), was lower than the one obtained by Cantini et al. (2001). (The authors investigated 59 accessions of sour cherry germplasm conserved in Geneva, New York with 10.7 alleles per locus. Higher values for average number of alleles per locus (12.6) were also reported by Kacar et al. (2006) on 81 accession of turkish sour cherry germplasm. Similar values (8), as in this study, were obtained on 72 Finnish sour cherry germplasm accession (Antonious et al.,

2011). Considering that only seven sour cherry genotypes were analyzed in this study, the number of obtained alleles is satisfactory.

Cluster analysis revealed that the promising new sour cherry cultivar 'Čelička' is in fact closely related to 'Schatten morelle' and it may be spontaneous seedling 'Rexelle'. It could be observed that 'Čelička' is not closely related to domestic cultivars 'Maraska' and 'Oblačinska'. Cluster analysis confirmed the close relatedness of 'Maraska' and 'Oblačinska' which has also been reported on local sour cherry cultivars in Croatia using SSR markers by Puškar et al. (2005).

## CONCLUSION

The new cultivar 'Čelička' displayed very high level of genetic similarity with 'Schatten morelle' indicating that this new genotype might, in fact, be a spontaneous seedling of the 'Schatten morelle' famous cultivar. The cluster analysis showed that the examined 'Maraska' and 'Oblačinska' genotypes grouped very closely together. This may indicate a recent common ancestor or hybridization events, especially since 'Maraska' and 'Oblačinska' fit more descriptions of population than that of classic cultivars.

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# RESEARCH RESULTS ON FORAGE CROP ALTERNATIVES FOR ARABLE LANDS IN MEDITERRANEAN CONDITIONS OF AEGEAN REGION

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## ABSTRACT

Pastures have the most significant role in ruminant feeding in Turkey. Gençkan et al (1989) calculated that about 69% of crude protein, 62% of starch and 33% of roughage needs of ruminant livestock are provided by pastures. The rest of the feed necessary for animal husbandry in the country is obtained from cultivated forages, concentrates, cereal and grain legume straw, agro-industry by-products and organic residues. Forage crops production area is only about 7% of total arable lands, despite a slight increase in recent years and it is far behind the target level which is 20%. It is obvious that there is an urgent need to carry out research studies on a wide range of forage crops in the country and neighbouring ecologies. Since intensive works on forage crop introductions, adaptations and cultivation techniques for specific regions are also necessary, some experiments were conducted in Izmir, Mediterranean part of Turkey. The results of field experiments revealed that alfalfa may be a conventional perennial forage crop for 3 to 5 years rotation system in arable lands of Mediterranean ecologies, while annuals should be considered in short rotations during fall-winter-spring seasons. Since there is a gap of 5-6 months in the fields during the winter period in traditional cotton-cotton or cotton-wheat rotation in coastal regions there are possibilities of using annual legumes and cereal mixtures as second crop for forage production and soil renovation. In an attempt to test the seasonal changes of quantitative and qualitative performances of 5 alfalfa cultivars (ABP-987, NS-2011, NS-2022, NS-2020 and P-5715) 3 different cutting regimes were imposed during 1997-98. Results displayed that spring cuttings had the highest yield performances and cv.NS-2022 had highest green and dry matter yields. In second experiment, effect of cutting dates on various winter forage crop mixtures (*Vicia sativa*, *Trifolium resupinatum*, *Hordeum vulgare*, *Lolium italicum*) were investigated and *V.sativa* and *T.resupinatum* seemed to be the most effective legumes for mixtures. *H.vulgare* and *L.italicum* were the most proper partners. In other experiment, effects of seeding techniques (seeding in the same or separate rows) on various winter forage crops (*Vicia sativa*, *Vicia faba*, *Hordeum vulgare*, *Triticale*) were investigated. Results indicated the superiority of *V.faba*+*H.vulgare* and *V.sativa*+*H.vulgare* mixtures over the *Triticale* mixtures.

Key Words: Mediterranean ecology, alfalfa, annual legumes, cereals

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## INTRODUCTION

Forage crops and livestock husbandry are two productive systems highly linked between each other. In fact, only the availability of choice forage can warrant the quality and healthfulness of animal productions. In this context, the role of forage crops is very important, because of their high forage quality and feeding value (Pardini, 2004). Despite the vital significance of forage cultivation for livestock husbandry also in Mediterranean environments, unfavorable and adverse effects of climatic conditions in these ecologies limit and shape the cropping pattern and regional vegetation. Aschmann (1973) defined the regions with Mediterranean climate in the world like areas in which at least 65% of the year's precipitation occurs in winter. Annual precipitation ranges between 275 and 900 mm, the average temperature in winter months is below 15°C and the hours per year at which the temperature falls below freezing (0°C) do not exceed 3% of the total. The areas with Mediterranean climate are characterized by humid and mild winters and hot and dry summers. Plant growth takes place mainly under favorable conditions in spring and autumn, the metabolic activity being limited as water stress together with high radiation and evaporative demand in the atmosphere are increased during summer. Although low temperature stress can damage cold sensitive species in winter, summer drought plays the most important role in the limitation of plant growth (Sánchez-Díaz, 2001). In the Mediterranean regions of Turkey, forage crop production is presently limited to only a few species such as alfalfa, vetches and sainfoin, contrasting strongly with that in developed Mediterranean countries (Koç, 2000) Alfalfa (*Medicago sativa*) is one of the main forage crops, due to its good adaptation and yielding capacity. Nevertheless, a large part of Mediterranean regions devoted to fodder crops are characterized by summer drought, poorly fertile soils (shallow and mostly clay), with low forage productions, both in yield and quality. Therefore, the knowledge of suitable agronomic techniques can be useful to improve roughage production in Turkey of which pastures have the most significant role in ruminant feeding.

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In the Mediterranean regions of Turkey, alfalfa may be a conventional forage crop for 3 to 5 years rotation system in arable lands, while annuals should be considered in short rotations during fall-winter-spring period. Since there is a gap of 5-6 months in the fields during winter period in traditional cotton-cotton or cotton-wheat rotation in coastal regions, there are possibilities of using annual legumes and cereal mixtures as second crop for forage production and soil renovation. Legumes such as vetches (*Vicia sp.*), annual clovers (*Trifolium resupinatum*, *Trifolium fragiferum*) and cereals such as barley (*Hordeum vulgare*), oats (*Avena sativa*) and triticale are promising alternatives for additional rainfed roughage production during the period between October and April in succeeding year. Farnworth (1972) indicated the significance of utilizing above mentioned period to grow barley and its satisfactory dry matter yield of 7800 kg ha<sup>-1</sup>. Avcioglu (1979) indicated that *Vicia sativa* mixed with barley or oats at a rate of 50% gave highest green herbage, dry matter and crude protein yields of 41 t ha<sup>-1</sup>, 8 t ha<sup>-1</sup> and 1.2 t ha<sup>-1</sup>, respectively. Many research workers conducted experiments on wheat, barley and oats separately or mixed with common or hairy vetch and showed the possibilities of producing 9500-6000 kg ha<sup>-1</sup> dry matter and 650-450 kg ha<sup>-1</sup> crude protein (Aydin and Tosun, 1991; Soya et al., 1988). Pejic (1976) tested hairy vetch with rye or barley in different rate of mixtures and found that the mixture containing 75% vetch + 25% rye had the highest hay yield of 6300 kg ha<sup>-1</sup>. He also stated that crude protein yield was highest in the mixtures of 50% vetch + 50% rye. Moreno et al. (1975) reported that green matter and dry matter yields of common vetch were 36600 kg ha<sup>-1</sup> and 7100 kg ha<sup>-1</sup>, respectively. Many research workers demonstrated that higher rates of legumes in mixtures increased hay quality whereas cereals were more effective on quantity of biomass (Gonzales et al., 1967; Munzur, 1989). The aim of this article was to evaluate the results of different experiments conducted in the western Turkey with alfalfa, annual legumes and cereals grown alone or in mixture in the area.

## MATERIALS AND METHODS

Consecutive experiments on perennial forage crops and annual legume+cereal mixtures as second crops were conducted in Izmir region between 1976 and 2000. Four of them were chosen to compare the performances of different crop materials. All studies were carried out on silty-clay loam soil with 7.8 pH in Bornova experimental field of Ege University (27°E, 38°N) located at about 20 m a.s.l. with typical Mediterranean climate characteristics.

**Experiment 1:** Seasonal changes of quantitative and qualitative performances of some alfalfa cultivars in the Mediterranean coastal part of Aegean Region. The field studies were conducted during 1997 and 1998 growing season on a silty-clay loam soil with 7.8 pH in the Bornova experimental area in Ege University. Meteorological data in 1997 and 1998 were monthly mean temperature 16.8-17.7°C, monthly total precipitation 616-839.4 mm, monthly mean relative humidity 59-61%, monthly mean duration of sunshine 8.0-7.5 h/day, respectively. 5 alfalfa cultivars (C) (ABP-987, NS-2011, NS-2022, NS-2020, Pioneer 5715) and 3 cutting times (CT) (i:late April, ii:mid July, iii:late October) based on seasonal changes were applied. The experimental design was a split plot arrangement of a randomized complete block with 4 replications. Each sub-plot consisted of 10 rows 20 cm apart and 5 m in length. The plots were harvested at 10-25% bloome stage during the season, and only 3 of them were chosen as cutting times as mentioned before. Samples were measured in terms of different characteristics and only plant height, green herbage yield, dry matter yield were presented in the article. In variation analysis, the least significant difference test was performed using the data related to alfalfa cultivars and cutting practices for each year and 2 year average.

**Experiment 2:** Effect of cutting dates on various winter forage crop mixtures. Meteorological data of growing periods in 1996-97 and 1997-98 were monthly mean temperature 10.6-10.4°C, total precipitation 502-461 mm, monthly mean relative humidity 64.8%-64.6%, monthly mean duration of sunshine 5.3-5.4 h day<sup>-1</sup> respectively. 3 different cutting dates (1st April, 16th April and 1st May) and 8 crop alternatives (*V.sativa*, *T.resupinatum*, *H.vulgare*, *L.multiflorum* and their mixtures (including only one legume and one grass) were experimented. Experimental design was a split-plot arrangement of a randomized complete block with 4 replications. The cutting times were main plots, and crop alternatives were subplots. Each sub-plot consisted of 14 rows 20 cm apart and 5 m in length. Samples of three different cutting dates were evaluated in terms of green herbage, dry matter and crude protein yields.

**Experiment 3:** Effect of seeding techniques on various winter forage crop mixtures. Meteorological data of growing periods in 1991-1992 were monthly mean temperature 10.5°C, total precipitation 273 mm, monthly

mean relative humidity 59.9%, and monthly mean duration of sunshine 6.2 h.day<sup>-1</sup>, respectively. 2 different seeding technique (sowing in same or separate rows) and 4 different crop alternatives (*V.sativa*, *V.faba*, *H.vulgare* and *Triticale* mixtures including only one legume and one cereal in each combination) were applied. The experimental design was a randomized complete block with 4 replications. Each plot consisted of 10 rows 20 cm apart and 5 m in length. Samples of two different seeding techniques were evaluated in terms of green herbage, dry matter and crude protein yields.

## RESULTS AND DISCUSSION

Experiment 1: The results of the effect of seasonal cutting practices and cultivars on the qualitative and quantitative performances of alfalfa cultivars are presented in Table 1. The highest plant height was observed in spring cuttings and control alfalfa, Pioneer 5715 in both years. Summer cuttings displayed the lowest plant height.

Table 1: Effects of seasonal cutting times (CT) and alfalfa cultivars (C) in qualitative and quantitative parameters

Cultivars	1997				1998				2 years average			
	i	ii	iii	Mean	i	ii	iii	Mean	i	ii	iii	Mean
	Plant Height (cm)											
ABP-987	63.9	47.0	43.4	51.4	65.3	61.9	63.3	63.5	64.6	54.4	53.4	57.5
NS-2011	66.9	45.4	44.3	52.2	66.7	60.7	63.5	63.6	66.8	53.0	53.9	57.9
NS-2022	73.7	46.0	44.8	54.8	71.5	63.6	71.8	69.0	72.6	54.8	58.3	61.9
NS-2020	66.8	49.4	45.3	53.8	68.4	64.0	64.5	65.6	67.6	56.7	54.9	59.7
Pioneer	72.3	49.9	47.5	56.6	72.2	65.5	67.7	68.5	72.2	57.7	57.6	62.5
Mean	68.7	47.5	45.0	53.8	68.8	63.1	66.2	66.0	68.8	55.3	55.6	59.9
LSD (0.05)	CT:1.8 C:2.3 CTxC:3.9				CT:4.2 C:2.8 CTxC:ns				CT:2.4 C:2.2 CTxC:ns			
	Green Herbage Yield (kg/1000m <sup>2</sup> )											
ABP-987	1172	848	1008	1009	1742	1575	1110	1476	1457	1212	1059	1243
NS-2011	1197	842	975	1004	1817	1450	943	1403	1507	1146	959	1204
NS-2022	1450	1067	1062	1193	2083	1883	1182	1716	1767	1475	1122	1454
NS-2020	1300	938	1058	1099	1925	1767	1077	1589	1613	1353	1068	1344
Pioneer	1233	905	1000	1046	1813	1592	1032	1479	1523	1248	1016	1263
Mean	1270	920	1021	1070	1876	1653	1069	1533	1573	1287	1045	1302
LSD (0.05)	CT:65 C:88 CTxC:ns				CT:290 C:104 CTxC:ns				CT:140 C:82 CTxC:ns			
	Dry Matter Yield (kg/1000m <sup>2</sup> )											
ABP-987	247	223	280	250	367	382	288	346	307	303	284	298
NS-2011	263	217	280	253	396	348	235	326	329	282	257	290
NS-2022	310	283	301	298	446	475	309	410	378	379	305	354
NS-2020	278	241	289	269	405	448	276	376	341	345	282	323
Pioneer	269	231	274	258	389	400	261	350	329	315	267	304
Mean	273	239	285	266	401	411	274	362	337	325	279	314
LSD (0.05)	CT:27 C:23 CTxC:ns				CT:73 C:26 CTxC:ns				CT:34 C:21 CTxC:ns			

The cutting time x cultivar interaction was not significant, indicating that the alfalfa cultivars did not respond differentially to the cutting practices. It might happen that higher temperatures during the summer period reduced the development of vegetative growth causing lower plant height. Avcioglu et al. (1999) also indicated that many legumes are significantly affected by multiple stress factors in Mediterranean ecologies. There were no significant interactions in different years and two-year's average in terms of green herbage yield. NS-2022 alfalfa and spring cuttings had the higher green herbage yields than other practices and cultivars. Francis (1988) also suggested that spring cuttings are usually higher than summer and autumn cuttings in which temperature and humidity factors are closer to plants' needs. Cutting practices significantly affected the dry matter contents whereas cultivars had no significant variation. These could be due to the genotypic characteristics of the cultivars used in the study. Autumn cuttings had the highest dry matter contents in both years whereas the spring cuttings had the lowest in both years and in two year average. These results were in agreement with Pfitzenmeyer (1963) who claimed the significance of effect of climatic changes of seasonal variations on alfalfa growth. All cultivars and cutting times had significantly different dry matter yields, spring and autumn harvests having the highest yields in 1997 and spring and autumn having the highest yields in 1998 and in two years average. This might be due to the effect of seasonal changes in climatic parameters and partly because of the green matter yield variation among the cultivars. It is well known that dry matter yield is the composition of dry



matter contents times the green matter yields of crops, NS-2022 had obviously more green matter yield than others. The same situation was also true for the cutting practices. There were significant differences between harvest times in both years and in two-year average. The cultivar x cutting practices interaction was found not to be significant indicating that the alfalfa cultivars responded similarly to the cutting practices. This might be due to the genetic behavior of the alfalfa crop and the limited occurrence of phosphorous in legume tissues. These results were in agreement with those of Bergmann (1986).

Experiment 2: The results of the effect of different cutting dates on green herbage, dry matter and crude protein yields of crop alternatives were presented in Table 2.

Table 2: Effects of different cutting dates on green herbage, dry matter and crude protein yields of crop alternatives (kg.ha<sup>-1</sup>) (two year average, 1997-1998)

Crop Alternatives(CA)	Cutting Dates (CD)							
	-----Green Herbage Yield-----				-----Dry Matter Yield-----			
	1 April	16 April	1 May	Mean	1 April	16 April	1 May	Mean
<i>V.sativa</i>	37 730	40 420	74 720	50 957	5 280	6 800	14 880	8 987
<i>T.resupinatum</i>	35 610	39 640	49 610	41 620	3 730	4 660	6 900	5 097
<i>H.vulgare</i>	21 670	28 620	40 270	30 187	4 080	6 460	10 710	7 083
<i>L.italicum</i>	26 320	29 520	33 300	29 713	4 060	5 450	6 730	5 413
<i>V.sativa+H.vulgare</i>	49 020	66 390	99 400	71 603	7 920	12 710	21 660	14 097
<i>V.sativa+L.italicum</i>	64 820	74 420	100 060	79 767	10 450	13 010	19 350	14 270
<i>T.resupinatum+ H.vulgare</i>	56 650	69 200	92 510	72 787	7 980	10 510	18 300	12 263
<i>T.resupinatum+L.italicum</i>	51 530	67 560	93 840	70 977	6 950	10 260	15 590	10 933
Mean	42 919	51 971	72 964	-	6 306	8 733	14 265	-
LSD (0.05)	CD: 960 CA: 2 120 CD x CA: 3 680				CD: 290 CA: 460 CD x CA: 800			

Crop Alternatives(CA)	Cutting Dates (CD)			
	-----Crude Protein Yield-----			
	1 April	16 April	1 May	Mean
<i>V.sativa</i>	1 183	1 322	2 537	1 681
<i>T.resupinatum</i>	865	947	1 249	1 020
<i>H.vulgare</i>	549	698	874	707
<i>L.italicum</i>	548	582	564	565
<i>V.sativa+H.vulgare</i>	1 377	1 846	2 640	1 954
<i>V.sativa+L.italicum</i>	1 896	1 980	2 486	2 121
<i>T.resupinatum+ H.vulgare</i>	1 398	1 699	2 194	1 764
<i>T.resupinatum+L.italicum</i>	1 218	1 513	1 946	1 559
Mean	1 129	1 323	1 811	-
LSD (0.05)	CD: 46 CA: 76 CD x CA: 131			

The cutting time x crop alternative interaction was highly significant, indicating that crop alternatives did respond differentially to the cutting dates. Highest green herbage yield was observed in *Vicia sativa* + *Hordeum vulgare* and *Vicia sativa* + *Lolium multiflorum* mixtures cut at 1 May whereas the yield of *Hordeum vulgare* cut at 1 April was lowest. In general, late cuttings were for more successful than early cuttings and the mixtures including *Vicia sativa* and *Lolium multiflorum* had higher yield performances. These results were in agreement with the indications of Farmworth (1972) and Avcioglu (1979), but our yield values were far more than their results. Highest dry matter yields were obtained at 1 May cutting in *Vicia sativa* + *Hordeum vulgare* and *Vicia sativa* + *Lolium multiflorum* mixtures whereas *Trifolium resupinatum* had the lowest dry matter yield at first cutting. Considering the significance of cutting time x crop alternative interaction, it might be concluded that dry matter yields of crop alternatives have been highly affected by cutting dates similar to green herbage yields. From this viewpoint it could be also suggested that late cuttings were favorable for better growth rates which allow the crops to produce higher biomass and to store richer dry matter content (Beckmann, 1998). Data related to dry matter yields were also in agreement with the results of many other research workers (Gonzales et al., 1967; Pejic, 1976) but our yield values were extremely high due to the exceptional climatic conditions in 1997 and 1998. The data related to crude protein yields was also similar to those of green herbage and dry matter yields. As expected, *Vicia sativa* + *Hordeum vulgare* mixture cut at 1 May had the highest crude protein yield. Pejic (1976) reported that rate of legumes in mixtures increased crude protein content of the material and hairy vetch was a proper component of this kind of mixtures. Moreno et al. (1975)'s indications were also similar.

Experiment 3: The results of effect of sowing technique on green herbage, dry matter and crude protein yields of legume + cereal mixtures were presented in Table 3. Statistical analysis indicated the significance of variation among the legume + cereal mixtures in terms of green herbage yield and *Vicia faba*+*Hordeum vulgare* and *V.sativa*+*H.vulgare* mixtures possessed highest values. There was not any significant difference between sowing techniques. Green herbage yield results also indicated the superiority of mixtures including *H.vulgare* over others. These results were in agreement with the findings of Gonzales et al. (1967) and Tuncer and Avcioglu (1993). Dry matter yield results were almost similar to green matter yields, except *V.sativa*+*H.vulgare* mixtures being almost equal to *V.faba*+*Triticale* mixtures. Dry matter yield of *V.sativa*+*Triticale* mixtures was least among other mixtures. Crude protein yields of different mixtures displayed again the superiority of *V.faba*+*H.vulgare* and *Vicia sativa* mixtures over the others, indicating the better performance of *H.vulgare* in the mixtures compared to *Triticale*.

Table 3: Effects of sowing technique on the green herbage, dry matter and crude protein yields of different legume+cereal mixtures (kg ha<sup>-1</sup>)

Mixture	Sowing Technique								
	Same Rows	Separate Rows	Mean	Same Rows	Separate Rows	Mean	Same Rows	Separate Rows	Mean
	Green Herbage Yield			Dry Matter Yield			Crude Protein Yield		
<i>Vicia faba</i> + <i>Hordeum vulgare</i>	39 300	38 850	39 075 a	8 253	8 172	8 213 a	913	922	918 a
<i>Vicia faba</i> + <i>Triticale</i>	28 650	32 550	30 600 b	6 324	7 181	6 753 b	591	685	638 b
<i>Vicia sativa</i> + <i>Hordeum vulgare</i>	39 500	42 070	40 785 a	6 761	7 223	6 992 b	872	937	905 a
<i>Vicia sativa</i> + <i>Triticale</i>	28 070	28 110	28 090 b	5 095	5 185	5 140 c	615	620	618 b
Mean	33 880	35 395	-	6 608	6 940	-	748	791	-

Different letters indicate significant differences at  $p < 0.05$

## CONCLUSION

Spring cuttings of alfalfa had the highest yield performances, and NS-2022 cv. had highest green and dry matter yields. NS-2020 also had better quality factors such as high crude protein and ash content. These cultivars should be screened for breeding programmes in the area and more attention should be given to the spring cutting practices of alfalfa under farm conditions.

**There are many possibilities of using different legume+cereal mixtures as second crop for winter period in wheat-cotton and cotton-cotton cropping systems in Mediterranean ecologies. This type of cultivation, in another word crop rotation means an additional rainfed roughage production and supply for the urgent demand of livestock husbandry sector. *Vicia sativa* and *Trifolium resupinatum* seems to be the most effective legumes for these kinds of mixtures and *Hordeum vulgare* and *Lolium multiflorum* are the most successful partners. Late cuttings till early May should be the most favorable stages in terms of green herbage, dry matter and crude protein yields in Izmir region.**

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# SALT AND BORON CAUSE CHANGES IN “SULTANI ÇEKİRDEKSİZ” GRAPE cv. (*Vitis vinifera* L.) GRAFTED ON DIFFERENT ROOTSTOCKS

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## ABSTRACT

Electrophoretic enzyme profiles of “Sultani Çekirdeksiz” grape cultivar (*Vitis vinifera* L.) grafted upon eight American rootstocks were determined using PAGE technique after application of salt (NaCl and Na<sub>2</sub>SO<sub>4</sub>) with or without boron (20 mg/kg). Analysis showed that the peroxidase and superoxide dismutase profiles were obtainable from the leaves collected 7 days after the applications. On the other hand the catalase banding patterns were visible only after 2 days. All enzyme profiles changed with the rootstocks and the applications except for the 1103P in which no difference was observed among the applications in the peroxidase. Results indicated that the enzymatic response of “Sultani Çekirdeksiz” cv. to salt and boron stress differed with the type of the rootstock on which it was grafted.

Key Words: Grapevine, enzymes, Sultani, salt, boron stress

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## INTRODUCTION

Throughout their growth and development, grapevines endure various environmental stress factors. Salinity results in the elevated soil osmotic potential making water unavailable to plant and specific effects of elements such as sodium (Na), chlorine (Cl) and boron (B) etc. present in excess (Söylemezoğlu et al. 2009). Combination of salinity and B toxicity influence membrane functions, increase stomatal resistance and disturb photosynthetic pigment production (Camacho-Cristobal et al. 2008).

Toxic effects of different elements together with environmental factors lead in the formation of reactive oxygen species (ROS) (Mittler 2002). Environmental stress conditions change the expression of many genes involved in antioxidants and proteins to cope with the stress (Nedeva et al 2005, Brahim and Mohamed 2011). Antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT) and ascorbate peroxidase (PER) protect plants against the ROS (Zhu et al 2004).

This research was carried out to determine banding patterns of three enzymes systems (SOD, CAT and PER) in the grafted “Sultani” (*Vitis vinifera* L. cv) plants subjected to salinity with or without boron toxicity.

## MATERIALS AND METHOD

### Plant material

“Sultani Çekirdeksiz” (*Vitis vinifera* L. cv) scions were grafted on eight different American grape rootstocks (99 Richter, 110 Richter, Kober 5 BB, SO<sub>4</sub>, 1103 Paulsen, 1616 Couderc, 140 Ruggeri, and 41 B). After callus development was complete, graftlings were acclimatized to the greenhouse environment and later transplanted to plastic pots lined with a PE bag. The growth medium contained 15 kg soil, 5% perlite and 5% peat moss. Plants were treated with salt solutions (0, 25 and 50 mM NaCl and Na<sub>2</sub>SO<sub>4</sub> 1:1 v/v) with or without boron solutions (0 and 20 mg kg<sup>-1</sup>). Treatments were carried out twice 5 days apart.

The trial was designed as random parcels with 5 replicates containing 5 grafted vines in each replication.

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## Enzyme extraction

Leaf samples collected from the basal part of the plants (4 or 5<sup>th</sup> node) 2, 4 and 7 days after the applications were taken to the laboratory where tissue samples were obtained for electrophoresis. The 1.5 g samples were processed for isoenzyme extraction following the procedure of Arulsekar and Parfitt (1986). The extraction buffer contained 0.05 M Tris (pH 8.0) with 0.007 M citric acid (monohydrate), 0.1% cysteine hydrochloride, 0.1% ascorbic acid, 1.0% polyethylene glycol (M, 3500), and 1 mM 2-mercaptoethanol. The final pH was about 8.0.

Samples were crushed with liquid nitrogen using a pestle and a mortar. 0.6 mg PVPP (Sigma P 6755) and 30 ml extraction buffer were added and later homogenized at 15 000 *xg* for 20 seconds on ice. After filtering through 4 layer cheesecloth, they were centrifuged for 15 min at 14 000 rpm. Supernatant was used as enzyme source and kept under -35°C until used.

PAGE was performed with a mini protean II cell (Biorad, Hercules, Calif.) according to Laemmli (1970) for the three enzyme systems (peroxidase EC 1.11.1.7; superoxide dismutase EC 1.15.1.1 and catalase EC 1.11.1.6). Stacking gel concentration was 4%.

Electrophoresis was run at 4°C. Samples dyed with bromophenol blue were loaded and run at 100 Volts until the samples entered into separation gel. Electrophoresis continued at 350 Volts until the buffer front had migrated 8 cm past the origin in the anode direction. Staining solutions were prepared immediately before the end of the gel run. Gels were immersed in the staining solution and incubated at 37°C in the dark until the isoenzyme bands were stained according to Graham et al. (1964) for peroxidase (PER), Chen and Pan (1996) modified from Beauchamp ve Fridovich (1971) for superoxide dismutase (SOD) and Söylemezoğlu (1996) for catalase (CAT). Bands were immediately recorded and scored.

## RESULTS

PER and SOD were detected on 12% separation gel in the 7-d leaves and CAT was on 9.45% (Davis 1964) separation gel in 2-d leaves. Band profiles of the "Sultani Çekirdeksiz" vines grafted on different rootstocks differed with the stress conditions in an enzyme system.

SOD enzyme profiles showed that salt with or without boron applications did not produce any variations in the "Sultani Çekirdeksiz" plants grafted on 140Ru, 110R and 1103P (Fig. 1). On the other hand, "Sultani Çekirdeksiz" on 99R, 41B, 5BB and SO<sub>4</sub> rootstocks showed variations in their response to the applications. There was a clear hyperactivity (i.e., more bands) when the plants on 41B were exposed to stress conditions. While lower salt concentration caused an increase in activity in 5BB, it was higher concentration and added stress of boron that resulted in elevated activity in SO<sub>4</sub> rootstock.

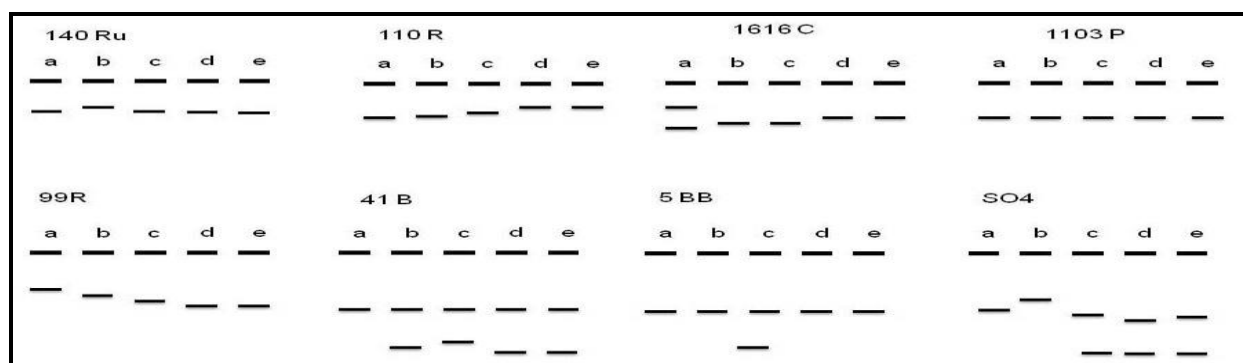


Figure 1. SOD enzyme profile of the grafted "Sultani Çekirdeksiz" vines on the different rootstocks. a: Control, b: 25 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>, c: 50 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>, d: 25 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>+20 ppm B, e: 50 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>+20 ppm B

In the CAT enzyme system, profiles of the rootstocks changed greatly depending on the stress factor (Fig. 2). Application of higher salt concentration and added boron stress induced hyperactivity in 1616C, 1103P and 99R rootstocks. In the rest of the rootstocks, boron stress conditions generally did not stimulate the expression of the enzymes, except for 110R.

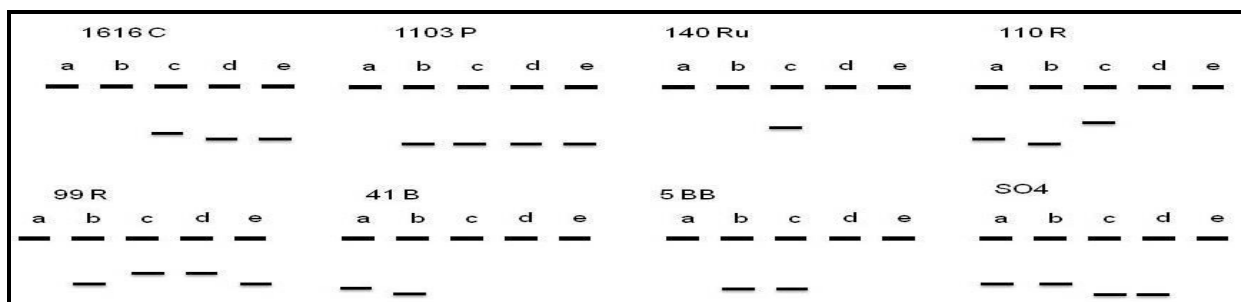


Figure 2. CAT enzyme profile of the grafted "Sultani Çekirdeksiz" vines on the different rootstocks. a: Control, b: 25 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>, c: 50 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>, d: 25 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>+20 ppm B, e: 50 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>+20 ppm B.

1103P response to the stress conditions did not change in the PER enzyme system (Fig. 3). However, the reactions of the rootstocks (1616C and 140Ru) resulted in an increased activity compared to the control plants. Rootstocks 41B and 5BB produced same number of bands but with a different profile. Low salt concentration and its application with boron caused an elevated activity in 110R and 99R, respectively. SO<sub>4</sub> only produced the same profile with the control when exposed to low salt concentration.

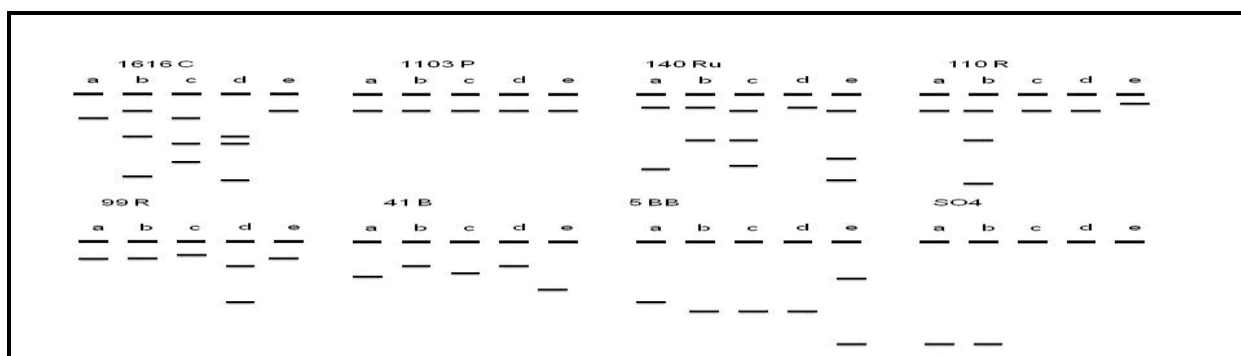


Figure 3. PER enzyme profile of the grafted "Sultani Çekirdeksiz" vines on the different rootstocks. a: Control, b: 25 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>, c: 50 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>, d: 25 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>+20 ppm B, e: 50 mM NaCl+Na<sub>2</sub>SO<sub>4</sub>+20 ppm B

## DISCUSSION

Boron is an essential micronutrient element required for growth and development of vascular plants (Çakmak and Römheld 1997). Boron toxicity is a significant disorder in arid and semi-arid environments (Nable et al. 1997). The major symptoms of B toxicity are inhibition of root growth, loss of dry matter and distortion of leaves leading to necrosis (Oertli 1993, El-Motaium et al. 1994). Salinity, on the other hand, limits vegetative and reproductive growth of plants by inducing severe physiological dysfunctions and causing harmful effects, even at low salt concentrations (Shannon et al. 1994). Tissue injury is induced not only by the osmotic effects of salts but also by specific toxic effects resulting from the accumulation of Cl<sup>-</sup> and Na<sup>+</sup> (Hasegawa et al. 2000). The toxic effects of various elements in linked with environmental factors result in the formation of reactive oxygen species (ROS) (Mittler 2002). The ROS are strong oxidizing agents causing oxidative damage to lipids and proteins and lead to cell death (Molassiotis et al. 2006). The balance between production and removal of ROS are tightly controlled by the antioxidant enzymes (Apel and Hirt 2004) such as SOD, CAT and ascorbate PER.

In this study, the response of the "Sultani Çekirdeksiz" grapevines grafted on eight different rootstocks was evaluated in terms of their enzymatic banding patterns determined electrophoretically. Sampling for determination of the banding profiles was best at 7 and 2 days after the stress applications in SOD-PER and CAT, respectively. Some differences in the time of detection were reported with other studies. For instance, Zhang et al. (2008) detected the changes in SOD and amylase in wheat immediately after the irradiation and radiation applications. SOD activity and isozyme patterns were measured in the wheat seedlings 3-5 days after the salt treatment (Eyidoğan et al. 2003). Bandoğlu et al. (2004) tested SOD, CAT, PER and glutathione reductase activities in the lentil plants 5 days after the NaCl salinity stress.

Yıldırım et al. (2004) sampled the short-term NaCl stressed 1616C and Razaki cv. 2, 4 and 7 days after the application and found that at 7 day SOD activity was highest and catalase activity was very low, and increased with increasing NaCl concentration.

Rootstocks differed in their response depending on the stress conditions applied. They tended to produce more bands compared to the control plants, showing these enzymes were more produced with salinity and excess boron conditions. Activity and expression of genes involved in antioxidant enzymes were shown to change in some plants under several environmental conditions (Brahim and Mohamed 2011). Özden et al. (2009) reported that SOD and CAT activities decreased and ascorbate PER activity increased in Öküzgözü (*V. vinifera* L. cv.). Vitis rootstocks vary in their ability to exclude Cl<sup>-</sup> (*V. rupestris*, *V. cinerea*, *V. champinii* and *V. berlandieri*, in reducing order) and in their salinity tolerance (Antcliff et al. 1983, Southey and Jooste 1991). Ersöz (2009) stated that CAT and APX enzyme activities of rootstocks increased but SOD activity decreased as a response to salinity and that the lowest and the highest CAT activity were observed in 99 R and 41 B rootstocks, respectively. Sairam et al. (1998) reported that drought tolerant wheat plants had highest ascorbate peroxidase and catalase activity. Güneş et al. (2003) reported that rootstock genotype could determine the level of B and tolerance in the gape cultivars.

Both salinity and boron toxicity cause changes in the biochemical reactions involved in defense mechanisms against reactive oxygen species. Catalase, peroxidase and superoxide dismutase are the main enzymes in protecting the plants against oxidative stress. Detection of these enzymes using electrophoretic methods may change with their expression time and level in the plants.

#### Acknowledgements

This paper was partly produced from the data obtained in the TÜBİTAK-TOVAG Project (No. 106-O-061).

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# COMPARISON OF SOIL PROPERTIES BETWEEN UNCULTIVATED AND CULTIVATED LAND IN CENTRAL PART OF BOSNIA AND HERZEGOVINA

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## ABSTRACT

Human demands for the use of land resources have increased the need to assess soil quality changes for the cause of prevention of soil degradation processes. In order to assess effects of land use changes in quality of soil properties, in three forest nurseries in central part of Bosnia and Herzegovina, soil samples were collected from uncultivated soils used as grassland and adjacent cultivated soil used for forest conifer seedling production. Cultivated soil resulted in lower aggregate stability, humus quality changes and significant decrease in total organic carbon, total nitrogen, cation exchange capacity, as well as base saturation. Computed deterioration index (DI) for these soil parameters revealed a high negative index for soils cultivated for forest seedling production compare to uncultivated ones at all three investigated sites (DI<sub>1</sub>=-257, DI<sub>2</sub>=-119, DI<sub>3</sub>=-176). Accordingly, long term cultivation activities in forest nurseries influenced soil quality decline. Therefore, such activities should be controlled by the regional and country level laws and regulations.

**Key Words:** Deterioration index, land use, forest nursery, soil degradation

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## INTRODUCTION

Human demands for the use of land resources have increased the need to assess soil quality changes for the soil degradation prevention causes. Soil degradation is a process associated with the loss of the soil ability to provide certain function and it occurs where human activities (either directly or indirectly) make the soil less vigorous or less healthy. Land/soil degradation can occur as a result of natural hazardous and or due to unsuitable land use and inappropriate land management practice (Blum 2008). According to the soil thematic strategy inappropriate anthropogenic activities are considered as the important soil quality deterioration threats (EC 2006).

Soil deterioration is a widely spread appearance and a well-known problem, associated with industrial and urban development in many parts of Bosnia and Herzegovina (Resulović 1998). While on the other hand, deterioration processes, related to inappropriate land use during plant production which are difficult to see, remain insufficiently studied. Specialized for the bareroot seedlings productions of conifer tree species, forest nurseries in B&H generally apply uniform management practice, where different drainage systems are almost the only site specific anthropogenic activity on the land. The results show that different cultivation activities in bare root soils affect particularly soil organic matter turnover, which alternation reflects wide range of biological, physical and chemical features (Davey 1984, Rose et al. 1995). Furthermore, cultivation and drainage change the relative proportion of solid and pores and they can indeed improve soil physical properties (Warkentin 1984). On the contrary inappropriate land use may cause compaction, crusting, acidification, nutrients depletion and chemical contamination of soil, creating serious environmental problems (Tóth et al. 2008). Soil quality is necessary indicator of environmental quality (Herrick 2000). Therefore, control of soil quality indicators on local and regional level is presumed for sustainable land management. In order to provide better understanding of cultivation effects on soil and environment quality the aims of this study were to 1) distinguish specific soil property changes subjected to cultivation activities in forest nursery soils, 2) estimate soil formation trends and 3) distinguish deterioration rates related to site specifics.

## MATERIALS AND METHODS

### Site description

The study was carried out in three forest nurseries in central part of Bosnia and Herzegovina. Soil factors were site specific, as shown in Table 1, while anthropogenic factors were generally uniform. Soils

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parent materials were heterogenic colluvial overburdens with specific textural and mineralogical features different among studied sites. Soil parent material at the site 1 is acid colluvium (Tokić 1983) laying over Triassic limestone (Strajin et al. 1978). Parent material at the second site belongs to Pleistocene overburdens of the ultramafic (peridotites and serpentinised peridotites) zone of Bosnia and Herzegovina (Sunarić-Pamić et al. 1966) and the third site was also very interesting for the geological age of it alluvial-glacial materials dating from Silur and Devon, being mainly composed from chlorate-muscovite, quartz-sericite, sericite shale, tourmaline, zircon, hematite and limonite (Živanović et al. 1967). The Soil Map of B&H (in scale 1:50 000) was used to obtain soil types at the studied sites. Uncultivated soils, which had been used as permanent grasslands, were detected during field observations in surrounding area of the nurseries. Bare root soils (cultivated soils) were objected to standard nursery management practice, during thirty years of conifer seedlings production, which encompasses conventional tillage (ploughing every second or third year down to the depth of 30 cm), fertilizers application (NPK 7:14:21, KAN 27±0.5 %), seasonal irrigation, basic nursery plots drainage, conifer sawdust mulching and pesticides application.

**Table 1. Main description data of the investigated sites**

Site specifics	Site 1 (Ajdinovići)	Site 2 (Žepče)	Site 3 (Busovača)
Average temperatures in °C <sup>1</sup>	7.6	11.2	8.4
Average precipitation in mm <sup>1</sup>	926.5	838.6	848.4
Relief	steep land	flat land	flat land
Altitude above mean sea level	850 m a.s.l.	235 m a.s.l.	385 m a.s.l.
Parent material <sup>2</sup>	silicate colluviums	silicate alluvial-colluvial sediments	silicate fluvio-glacial sediments
Soil type <sup>3</sup>	Cambisol	Fluvisol	Fluvisol

Source: <sup>1</sup>Federal hydrometeorological institute of Bosnia and Herzegovina, <sup>2</sup>Geological Map of SFRJ 1:100 000, <sup>3</sup>Soil Map of SFRJ 1:50 000

### Field methods and soil sampling

Six soil profiles (3 profiles of uncultivated and 3 of cultivated soil) at the study sites were described according to FAO field guide (2006) and classified according to WRB classification system (IUSS Working Group WRB, 2006). Soil samples were collected from the profiles for particle size analysis and also from surface area (64 representative samples) of approximately 25x25 m<sup>2</sup> using augers, for chemical analysis. Every representative sample was made of multiple samples by homogenization of approximately 50 soil partitions from the depths of 0 to 10 cm and 10 to 30 cm. Samples were dried over the night at 40 °C, mild and sieved through the 2 mm sieve.

### Analytic methods

In this study analyzed physical soil properties were soil texture determined by pipette-B method in dispersion with 0.4 M Na<sub>2</sub>P<sub>4</sub>O<sub>7</sub>·x10H<sub>2</sub>O, soil bulk density (BD) by gravimetric method and percent of pore space. Soil pH values were measured in the suspension of soil and extraction reagent 1 M KCl, both in ratio 1:2.5. Amounts of total organic carbon (TOC) and total nitrogen (TN) were determined by dry combustion method using Element Analyzer (Heraeus vario EL.). Analysis of cation exchange capacity were made by using 1 M NH<sub>4</sub>Cl extraction procedure (König & Fortmann, 1996) and pseudo-total concentrations of phosphorous (P) and potassium (K) were made by HNO<sub>3</sub> pressure digestion procedure. Concentrations of all analyzed elements in extracts were determined in prepared solution with inductively coupled plasma optic emission spectrophotometer (Spectro-ciros, ICP-OES).

### Statistical analysis and calculation of soil deterioration index

Descriptive statistics were calculated for every studied site and two aspects of a land-use at the depths of 0 to 10 and 10 to 30 cm. Kolmogorov-Smirnov Z test was conducted to test the differences in element concentrations among cultivated and uncultivated soils.

The soil deterioration index (DI) (Islam and Weil 2000, Lemenih et al. 2004) was computed on the assumption that the status of individual property of cultivated soil was once the same to the one in adjacent uncultivated soil. The differences between mean values of individual properties in cultivated and uncultivated soil were compared to baseline values in uncultivated soil, and these percents were summed to compute cumulative soil DI.

## RESULTS AND DISCUSSION

### Soil morphological features and particle size distribution

Soils were classified, during field studies, according to WRB classification system (IUSS WRB working group 2006). Site 1 was characterized by Cambisol type (Dystric, Colluvic), while site 2 and site 3 by Fluvisol. Soils cultivated for the forest seedlings production were attributed with the suffix "Anthric" and they were recognized according to their diagnostic "Ap" horizon. Presence of the Ap horizon is inevitably the major distinction from uncultivated soils in soil profile morphology resulted from a long-term ploughing and fertilization. Compare to the uncultivated soil, new-formed horizon, which does not exceed 30 cm of a soil depth, expresses new quality parameters i.e., lower structure grade and aggregate stability, clear and strait boundary and smaller number of roots, as shown in Table 2. Lighter color of the Ap horizon as morphological indication of the organic matter loss was found only at site 1.

**Table 2. The main morphological soil properties**

Soil type	Depth	Horizon	Color	Texture	Structure grade, form		Roots	Boundary	
Site 1	Cambisol, Dystric	0-10	Ah	10YR3/4	silty-loam	moderate	crumb	25/dm <sup>2</sup>	gradual
		10-50	Bv	10YR4/3	silty-loam	moderate	crumb	-	gradual
		50-100	I	10YR5/3	silty-loam	weak	-	5/dm <sup>2</sup>	-
	Cambisol, Anthric	0-25	Ap	10YR5/4	silty-loam	weak	crumb	3/dm <sup>2</sup>	abrupt
		25-60	Bv	10YR6/3	silty-loam	weak	crumb	-	diffuze
		60-150	I	10YR5/6	silty-loam	weak	-	-	diffuze
Site 2	Fluvisol	0-10	Ah	10YR4/3	loam	weak	crumb	13/dm <sup>2</sup>	clear
		10-30	I	10YR5/4	loam	weak	crumb	-	diffuze
		30-70	II	10YR5/4	clayly-loam	-	-	-	diffuze
	Fluvisol, Anthric	0-10	Ah	10YR4/3	loam	weak	crumb	10/dm <sup>2</sup>	diffuze
		10-30	I	10YR4/1	loam	weak	crumb	-	diffuze
		30-65	II	10YR4/3	clayly-loam	-	-	-	gradual
Site 3	Fluvisol	0-15	Ah	10YR5/3	sandy-loam	moderate	crumb	15/dm <sup>2</sup>	clear
		15-25	I	10YR5/4	sandy-loam	moderate	crumb	10/dm <sup>2</sup>	gradual
		25-65	II	-	gravel	-	-	-	clear
	Fluvisol, Anthric	0-10	Ap	10YR5/3	sandy-loam	moderate	crumb	15/dm <sup>2</sup>	clear
		10-30	Ap	10YR5/4	sandy-loam	moderate	crumb	15/dm <sup>2</sup>	gradual
		30-70	I	-	sand	-	-	-	gradual

Particle size distribution between uncultivated and cultivated soils of the considered depths did not differ significantly (Table 3), which enables comparison of other soil properties (Lemenih et al. 2004). Greater clay content in the surface part of the Ap horizon could be attributed to a plough induced homogenization of Ah and Bv horizon which is commonly richer in clay content. Although particle size distribution is considered as a resilient soil property, it can be influenced by cultivation through homogenization of upper soil horizons, accelerated illimerisation of clay, or by surface and lateral runoff at a steep slope relief.

**Table 3. Particle size distribution of the uncultivated and cultivated soils**

	Depth (cm)	Uncultivated			Cultivated			
		Sand	Silt	Clay	Depth (cm)	Sand	Silt	Clay
Site 1	0-10	12.7	64.4	22.9	0-25	10.6	61.3	28.2
	10-50	13.7	61.1	25.2	25-60	17.1	50.3	31.6
	50-100	32.9	51.0	16.1	60-150	33.4	42.9	23.7
Site 2	0-10	38.8	42.3	18.9	0-10	33.8	44.7	21.5
	10-30	38.6	43.0	18.4	10-30	28.3	46.0	25.7
	30-70	36.9	40.7	22.4	30-65	37.0	43.4	19.6
Site 3	0-15	47.9	43.8	8.3	0-10	36.5	53.9	9.6
	15-25	50.5	41.7	7.8	10-30	63.3	28.8	7.9
	25-65	79.9	14.7	5.4	30-70	42.1	42.5	15.4

### Comparison of cultivated and uncultivated soil properties

Soil bulk density and pore space did not differ radically between compared soils (Table 4). Soil cultivation significantly (site 1:  $Z=1.265$ ,  $N=10$ ,  $p<0.05$ , site 2:  $Z=1.265$ ,  $N=10$ ,  $p<0.05$ , site 3:  $Z=1.368$ ,  $N=11$ ,  $p<0.05$  and  $Z=1.595$ ,  $N=11$ ,  $p<0.01$ ) decreased amounts of TOC and TN at all three sites in 0-10 cm and 10-30 cm soil layer, except at the site 2 at the depth 10-30 cm.

**Table 4.** Mean values and standard deviations of some soil physical and chemical properties for representative samples taken for the depths 0-10 and 10-30 cm

Soil properties	Depth (cm)	Site 1		Site 2			Site 3			
		uncultivated	cultivated	KS	uncultivated	cultivated	KS	uncultivated	cultivated	KS
Bulk density (g cm <sup>-3</sup> )	0-10	1.1	1.1		1.3	1.3		1.1	1.1	
	10-30	1.2	1.1		1.4	1.5		1.2	1.4	
Pore space (%)	0-10	59.1	59.0		50,0	50,0		59,6	61,0	
	10-30	57.9	59.0		46,1	42,3		55,0	45,3	
pH (KCl)	0-10	4.2±0.4	3.9±0.1		5.9±0.1	5.9±0.8		5.1±0.5	5.3±0.4	
	10-30	4.2±0.2	3.9±0.0		5.9±0.2	5.9±0.9		5.1±0.2	5.1±0.2	
Total organic C (g kg <sup>-1</sup> )	0-10	53.6±19.3	27.8±1.2 *		26.4±9.9	17.1±2.4		32.9±6.8	17.8±5.5 *	
	10-30	35.9±11.0	25.7±1.8 *		16.2±4.0	16.4±2.8		19.9±2.2	13.5±2.5 *	
Total N (g kg <sup>-1</sup> )	0-10	4.0±1.4	2.1±0.2 *		2.2±0.8	1.5±0.2 *		2.6±0.4	1.3±0.2 **	
	10-30	2.9±1.0	2.0±0.2 *		1.5±0.3	1.5±0.2		1.8±0.2	1.1±0.2 **	
CEC (cmol kg <sup>-1</sup> )	0-10	14.9±7.5	7.6±1.8 *		13.0±6.2	11.2±4.0		19.6±1.8	9.6±2.7 **	
	10-30	13.5±6.4	7.4±1.9 *		14.5±2.8	12.8±3.1		16.5±1.2	8.7±2.8 *	
Base saturation (%)	0-10	81.5±21	33.4±7 *		97.9±0.5	97.7±0.5		97.8±0.7	96.6±1.3	
	10-30	77.4±23	32.9±8 **		98.5±0.6	98.1±1.0		97.1±0.9	95.0±2.5	
Total P (g kg <sup>-1</sup> )	0-10	0.36±0.2	0.59±0.2		0.43±0.1	0.45±0.1		0.57±0.2	0.51±0.1	
	10-30	0.34±0.1	0.56±0.2		0.40±0.1	0.43±0.1		0.57±0.2	0.50±0.1	
Total K (g kg <sup>-1</sup> )	0-10	9.16±0.3	8.47±1.2		8.91±0.6	9.55±1.2		11.4±0.5	12.1±3.9	
	10-30	9.47±0.4	8.85±0.6		8.95±0.4	9.20±0.9		11.5±0.5	12.2±4.2	
Exchangeable K	0-10	3.9±1.0	5.3±1.4		2.7±0.3	1.0±0.3		1.8±0.3	1.1±0.3 **	
	10-30	2.9±0.5	4.3±0.8		1.8±0.1	1.0±0.2		1.4±0.3	0.9±0.1 **	
Exchangeable Ca	0-10	68.0±19.8	24.0±6.0		62.7±6.5	63.4±16.7		74.1±4.3	71.9±2.2	
	10-30	66.2±22.5	25.0±7.9		60.4±4.6	64.3±16.9		73.7±4.4	73.0±3.8	
Exchangeable Mg	0-10	8.0±2.7	3.6±1.0		29.4±8.6	32.8±17.0		20.4±2.5	23.9±3.0	
	10-30	6.5±2.0	3.3±0.8		33.7±5.3	32.3±16.4		20.1±2.2	20.9±3.3	
Exchangeable Na	0-10	1.6±1.1	0.7±0.1		3.0±1.7	0.5±0.2		1.6±0.9	0.3±0.1	
	10-30	1.8±1.1	0.7±0.3		2.5±0.5	0.5±0.1		1.8±1.1	0.2±0.2	

KS-Kolmogoro-Smirnof Z tests, \* - significant at  $p < 0.05$ , \*\* - significant at  $p < 0.01$   
 $N=5$  at Site 1 and Site 2;  $N=4$  for uncultivated and  $N=6$  for cultivated soil at Site 3

Substantial organic matter loss in bare root forest nursery soils is broadly recognized cultivation effect (Davey 1984) altering large variety of soil properties (Rose et al. 1995). Bare root forest nursery soils were attributed to decline in soil fertility parameters i.e., cation exchange capacity (CEC) and base saturation (BS), indicating substantial degree of soil quality decline (Driessche 1984). Cation exchange capacity and BS of both considered depths were significantly lower in cultivated soil at site 1 ( $Z=2.205$ ,  $N=10$ ,  $p<0.05$ ,  $Z=2.339$ ,  $N=10$ ,  $p<0.05$ ,  $Z=2.205$ ,  $N=10$ ,  $p<0.05$ ,  $Z=2.449$ ,  $N=10$ ,  $p<0.01$ ), while at the site 3 only CEC was lower ( $Z=1.549$ ,  $N=10$ ,  $p<0.01$ ,  $Z=1.291$ ,  $N=10$ ,  $p<0.05$ ) (Table 4). Insignificant decrease of CEC occurred at site 2. It is assumed that acidification processes had occurred at the site 1 because of the small natural resilience of dystric soils on steep slopes in humid mountain climate. High base saturation at site 2 and 3 implied relatively stable values of BS and soil reaction. Individual cations depletion was the most prominent also at site 1 except in exchangeable K. Second site had no significant changes in

single cation values, while K at site 2 and site 3 was lower in cultivated soil. Depletion in TOC, TN and CEC followed the order: site 1>site 3>site2.

Pseudo-total concentrations of P were mainly higher in cultivated soil, except for the site 3 where they were just about equal. On the contraire K values were lower in cultivated soil at site 1 and higher at two other sites.

#### Deterioration index for the cultivated and uncultivated soils

The computed soil deterioration index (DI) reflects the percent changes in soil properties from their values in uncultivated soil used as grassland for the past 30 years or more (Table 5). Soils under cultivation used for forest seedling production showed substantial rate of deterioration. A possible explanation for a different DI values, between studied sites are differences in site specifics i.e., climate, relief, parent material and natural soil properties, although lower rate of deterioration at site 2 is most likely related to lower intensity of tillage, due to reduced seedlings production in the last 15 years. Reduced production of bare root seedlings caused lower intensity of seasonal ploughing, which is found to correlate foremost with the amounts of the organic matter (Balesdent et al. 1990).

*Table 5. Deterioration indices (DI) (%) for some soil properties for representative samples in 0-10 cm of cultivated soil, calculated as the relative difference between mean values of individual soil property and referent value of the same property of the uncultivated grassland soil*

Soil property	Site 1	Site 2	Site 3
	Cultivated soil for forest nursery production		
Bulk density	0,0	0,0	0,0
Pore space	-0,2	0,0	2,3
Total organic C	-48,1	-35,0	-46,0
Total N	-46,7	-31,1	-50,9
CEC	-49,0	-13,8	-51,0
BS	-59,0	-0,2	-1,2
Total P	63,9	4,7	-10,5
Total K	-7,5	7,2	6,1
Exchangable K	35,9	-63,0	-38,9
Exchangable Ca	-91,2	1,1	-3,0
Exchangable Mg	-55,0	11,6	17,2
Overall DI	-256,9	-118,6	-175,9

#### CONCLUSIONS

This study shows that cultivated soils in forest nurseries differ significantly for almost all soil properties from adjacent uncultivated soils. Cultivated soils showed substantial decline in the TOC, TN and CEC values at studied sites, which indicates degradation trend. Computed DI revealed highly negative effect with a different rate of deterioration in relation to the site. Accordingly, it is assumed that long term cultivation activities in forest nurseries affect soil quality decline. Therefore, cultivation activities should be controlled by the regional and country level laws and regulations in order to obtain sustainable land management

#### ACKNOWLEDGMENTS

Support for the soil laboratory analysis is acknowledged to Büsngen Institute in Göttingen (Germany) and Institute for PAM, Faculty of Agriculture and Food Science, Sarajevo, while field studies were realized thanks to contribution of NORAGRIC's UMB (Norway) project.

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# GRAPE SEED

Burçak İŞÇİ<sup>1</sup> Şebnem KAVAKLI<sup>2</sup>

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## ABSTRACT

Grapes (*Vitis vinifera*) are consumed worldwide, which is history of based on BC 6000-5000, are extremely important food for both nutritionally and economically. In our age, grape, wine and grape seed extracts (GSE) have been identified as powerful antioxidants.

Grape seed oil contains a high percentage of omega 6, which can significantly raise high-density lipoprotein cholesterol and reduce low-density lipoprotein cholesterol levels.

Particularly, grape seeds are rich in polyphenols that are commonly known as proanthocyanidins. There are many studies showing cancer chemopreventive potential of GSE against especially breast carcinoma and other cancer types such as prostate, colon, lung, skin etc.

The consumption of fresh fruits and vegetables is shown to be associated with the reduced risk and mortality of cancers. In conclusion, this review was aimed to explain that what GSE include and determine which kind of effects by GSE in treatment of major cancer types.

**Key Words:** Grape, seed, extract, cancer, proanthocyanidins

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## INTRODUCTION

Grapes (*Vitis vinifera* L.) are considered as the world's largest fruit crops, with an approximate annual production of 68 million tons. Grape grown is economically important in a lot of countries, and particularly in Turkey. According to recent statistical data, the total grapevine area in Turkey is 482.789 ha; the total fresh grape production is 3.918.440 tons, and crop yield is 8116, 2 kg/ha (FAO, 2008). It could be thought that the production capacity of grape seeds annually is approximately 30.000 tons in Turkey (Tangolar et al., 2009). 50 kg of grape seed is needed to obtain a litre of cold pressed grape seed oil (Khanna et al., 2002).

Grapes are native to the warm temperate zone. The composition of grapes are water, sugar, minerals, organic acids, nitrogenous agents, enzymes, vitamins and phenolic compounds. The family has been characterized by the occurrence of linoleic, oleic, palmitic, and stearic acids in all cultivars. The glucose and fructose found in grapes and via direct diffusion bleeding, particularly because of pass-quality infant and children nutrition is important (Akin, 2011).

Grapes and grape products have been used throughout history for their medicinal and nutritive properties. The leaves and fruit of the grape have been used medicinally since ancient Greece. The grape seeds used to produce grape seed extract are generally obtained from wine manufacturers.

More varieties of red grapes, resveratrol obtained from the plant pathogen attacks, wounding, UV light exposure is a phytoalexin produced by plants in such cases. This substance inhibits proliferation of cancer cells to the cells, the cell changes and cancer-causing cells, tissue formation pressures. Grape seed is a well known oil seed crop containing typically 8-20% (w/w) of oil. The main concern in grape seed oil is the high content of the unsaturated fatty acids such as linoleic acid (72-76 %, w/w), which is higher than those in safflower oil (70/72%), sunflower oil (60-62%) and corn oil (52%) (Akin, 2012).

Grape seeds also contain protein, carbohydrates, polyphenols, crude fibre, ash and other inorganic materials (Ağaoğlu, 1999; Fine, 2000).

Grape seed oil is reputed to contain plentiful antioxidants, as well as to lower cholesterol levels, vitamins ( $\beta$ -carotene, vitamin E and C) and phenolic compounds. 60-70% of the polyphenols which can be

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extracted from grape textures, is in the seed, 28-35% is in the fruit skin and 10% is in the fruit flesh. Grape seed extract contains proanthocyanidins, a class of flavanols.

Investigated the effect of initiation of medical aspects of resveratrol because of French people consume foods high in cholesterol despite of the low percentage of cardiovascular diseases. It's thought to be due more consumption of red wine (Alkan, 2007). Accepted as the French paradox, this shows how important is grape and grape extracts.

Grapes and grapes derived extracts especially resveratrol from grapes, various anthocyanidins, proanthocyanidins, grape extract of phytoestrogens effects various cancer types.

The effect of resveratrol is not just the initial stage of cancer. Cancer onset, and progression stages of development are also effective and causes a reduction in almost all cancer types, including different rates (Doyuran Yıldız, 2007). It is breast cancer estrogen-receptor antagonist. That enables users to create estrogen response against the cancer cell (Sayın et al., 2008). It's inhibits the growth of cells (Lu and Serrero, 1999). Similar effects have also shown that growth of prostate cells (Hudson et al., 2007). Suppression of tumor development provides intestinal cancer and it shows antiproliferative effect on the cancer cells (Zhang et al., 2009). Grape seed extracts are obtained as a result, such as suppressed tumor growth at a rate of 40% and also reduces the formation of polyps reported (Velmurugan et al., 2010). Resveratrol regulates the expression of survivin which suppresses apoptosis in skin cancer (Aziz et al., 2005). Also resveratrol provides suppression of oxidative stress in skin cancer (Ndiaye et al., 2011).

Phytoestrogens is the other important grape extract group of cancer affecting (Büyüktuncer and Başaran, 2005). They are found in particularly dry grapes. Due to antiproliferative effects, guarding against cancer. In addition, because of the antiangiogenic effects of angiogenesis, prints and other healthy tissues and spread of cancer cells (metastasis), and suppress the spread. Another important task of phytoestrogens, which play an important role in the proliferation of cancer cells will have an effect of various kinase enzymes (Umland et al., 2000). The main types of cancers as indicated that effect studies phytoestrogen breast, prostate, stomach, colon, pancreatic cancer (İnanç and Tuna, 2005).

Grape Seed Proanthocyanidin Extracts (GSPE) are polyphenolic bioflavonoids. They are very effective in the treatment of cancer and tumor formation pressures. Lung, breast, stomach, liver and leukemia is the most effective types of cancer with GSPE (Ye et al., 1999). These types of cancer cells by up to 48% depending on the amount of matter and duration of administration suppresses cell growth are expressed in various studies. Inhibit proliferation of tumor cells in lung cancer (Akhtar et al., 2009) and directed cell apoptosis (Singh et al., 2011) indicated. Proliferative effect was observed in colon cancer (Dinicola et al., 2012). Cancer, colon cancer tissues as well as other effects of proanthocyanidins (Engelbrecht et al., 2007) of various kinases, oxidative stress, estrogen (Eng et al., 2003), suppression, cancer, evidence of an effective way to influence the signal, stopping the cell cycle (Kaur et al., 2008), cell apoptosis routing (Walter et al., 2010), is seen as playing a regulatory role in the immune system (Katiyar, 2008).

Usually obtained from grapes, which is accepted to be effective in the treatment of cancer, a variety of additional extracts in grape extracts are also present. These grapes in the nucleus of quercetin, and piceatannol, tocotrienol-rich materials. Quercetin has been reported to be anticarcinogenic breast, leukemia, colon, ovary, stomach and lung cancers (Doyuran Yıldız, 2007). Breast cancer showed that the antioxidant and antiproliferative effects of ingredients rich in Tocotrienolce (Choi and Lee, 2009). Piceatannol suppressed proliferation of bladder cancer studies, has blocked the cell cycle and cell apoptosis directed (Kuo and Hsu, 2008).

Grape seed extracts (GSE) showed angiogenesis of breast cancer is considered one of the most important effects. Vascular Endothelial Growth Factor (VEGF) and that inhibition of angiogenesis is an important factor for antiangiogenesis therapy. VEGF and effective in the formation of cancer cells related kinases act. GSE induce these kinases. Thus, VEGF, and antiangiogenic activity in a study that was released (Wen et al., 2008).

## CONCLUSION

Recent studies have shown that proanthocyanidins in grape seeds possess antioxidative, antiinflammatory, antiarthritic and antitumor promoting activities and prevent heart disease and skin aging.

Today, many studies in various cancer types, many different substances derived from fruits and vegetables are important therapeutic potential. Most of the research are done in vitro, but this results in significant amounts.

Cancer and grape seed extracts obtained from grape extracts most often under the suppressive various cancer types, the stopper, the biochemistry of the cell to a cancer cell has an impact in the opposite direction causes the various activations. But the future is expected to benefit from these substances in cancer treatments.

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# EVALUATION OF GENOTYPE BY PLANTING DATE INTERACTIONS IN SWEET CORN BY USING GGE BILOT ANALYSIS

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## ABSTRACT

Five hybrid sweet corn genotypes were evaluated through 3 planting dates (6<sup>th</sup> May, 20<sup>th</sup> July and 20<sup>th</sup> August) in 2010 and 2011 growing seasons. Field trials were conducted at experimental fields of Ege University. Analysis of variance (ANOVA) was calculated for fresh grain yield of 5 hybrid sweet corn cultivars at 6 different environments (three planting date were performed through two years) and ANOVA showed that mean squares of genotypes, planting dates and genotype x planting interaction date were highly significant at  $p=0,01$ . GGE biplot analysis was used for interpreting to genotype by planting date interactions. GGE biplot analysis showed that Merkur can be proposed for the farmers which prefer 20<sup>th</sup> July as planting date and El Toro can be proposed for 6<sup>th</sup> May an 20<sup>th</sup> August planting dates and it was seen that GGE biplot is an useful tool for evaluating Genotype x Planting Date interactions and seasonal adaptations.

**Key Words:** GGE Biplot, Genotype x Environment Interactions, sweet corn, planting date.

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## INTRODUCTION

Sweet corn (*Zea mays saccharata* Sturt) is come up as a result of a mutation in Sugary 1 locus on dent corn (*Zea mays indentata*). Traditional North American sweet corn is a sweet corn variety which is homozygous for recessive sugary 1 allele (Tracy et. al. 2006). In addition, lots of sweet corn hybrid cultivars have been developed along with two additional genes called Sheunken2 (sh2) and Sugary Enhancer (se) which have been incorporated into commercial lines (Hassell et. al. 2003). Sweet corn differs from dent corn in terms of flavour, tenderness, texture, seed viability and appearance of plants and ears (Tracy, 1994; Assuncao et. al., 2010). In Turkey, sweet corn is being used as canned, fresh and frozen. Therefore, consumption of sweet corn is increasing day by day.

It is well known that, sweet corn has a shorter vegetation period than that of dent corn when they compared with respect to maturation days. Therefore sweet corn can be produced through a wide growing window to supply continuous market requirement (Tracy, 2001; Garcia et. al., 2009). Hence sweet corn is affected by numerous abiotic stress factors such as low temperature and drought. Assessment of the interaction between genotypes and planting dates is essential from the point of sweet corn producers.

Changing of relative performance of genotypes over different environments is described as genotype by environment interaction (GEI) (Xu, 2010). Numerous economic and agronomic traits such as grain yield, exhibit quantitative inheritance and most of them are affected by GEI (Fan et. al., 2007). Genotype by environment interactions determined in multi location trials reduced the correlation between phenotypic and genotypic values and were found to reduce gain from selection (Comstock and Moll, 1963; Tonk et. al., 2011). It means across environments are adequate indicators of genotypic performance only in the absence of GEI (Kaya et. al., 2006).

Because of this reason, ignoring the interaction is problematic when it is larger than genotype main effects which is main scenario in many yield trials. (Gauch and Zobel, 1996). Different planting dates are assumed as different environments so genotype x planting date interactions can be evaluated through various statistical methods in planting date trials. Yan et. al., (2000), developed GGE biplot method which is recently being used in the assessment of multi-environment trials. GGE biplot is a biplot that is used for displaying multi environment trials (MET) data (Yan et. al., 2001). GGE biplot is established through graphically displaying of first two principal components (PC1 and PC2, also referred to primary and secondary effects) which are obtained from singular value decomposition (SVD) of environment-centered data (Yan, 2001).

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Sweet corn is generally planted in lately April or early May for the regions which have Mediterranean climate conditions. On the other hand it can be planted as after crop plant in July after harvest of wheat. Also, sweet corn has a short maturing time and there is a continuous market need of fresh sweet corn, thus month of August was performed in this study.

Although sweet corn is produced through a wide growth season window, there are a few studies about effects of different planting dates on growing and yield traits. Planting dates separated by 3 weeks in Wisconsin had no effects on plant height but did influence day to silking and yield components of crosses of several open pollinated sweet corn cultivars (Revilla and Tracy, 1997; Williams, 2008). Especially in Turkey, there is not sufficient number of studies on sweet corn which include both genotype x planting date interaction and stability of genotypes issues. Even though Oktem et.al. (2004), applied 8 different planting dates between 25<sup>th</sup> April and 10<sup>th</sup> August in Southeastern Anatolia Region of Turkey and found that the period between 25<sup>th</sup> June and 25<sup>th</sup> July had optimum conditions for sweet corn farming, responses of various genotypes to different planting dates were not examined. For this reason, aim of this study is to investigate seasonal adaptation of five sweet corn hybrids getting widespread at Aegean Region which has Mediterranean climate conditions by using GGE biplot (Yan, 2001) software.

## MATERIAL AND METHODS

Field trials were conducted in 2010 and 2011 growing seasons and experimental field of Ege University Field Crop Department was used as test location. Ege University is placed in Izmir-Bornova and is located (Latitude 38°28' and Longitude 27°13') in the west part of Turkey near Aegean Sea with altitude of 27 m and dominated by the Mediterranean climatic conditions (Ilker, 2011). The experimental area has a heavy soil structure with clay-silt soil at 0-20 cm depth and clay-loamy structure at 20-40 cm depth (Ilker, 2011). 6<sup>th</sup> May (Main Crop) 20<sup>th</sup> July (After Crop) and 20<sup>th</sup> August (Late Crop) planting dates were applied along two years and these planting times were accepted as six environments.

The trial was arranged in the Randomized Completely Block Design under drop irrigation conditions by using Merit, Vega, Sunshine, El Toro and Merkur hybrid cultivars as plant material. Every plot consisted 3 row and every row was 3 meter length and spacing between rows and plants are 70cm, 20cm respectively. Two seeds were planted each hill and then thinned to one plant to have a final plant density of 71420 plants ha<sup>-1</sup>. Standard agronomic practices were performed during vegetation period.

Data set was established by measuring of fresh grain yield of 10 plants which placed in the middle row of each plot. Analysis of Variance (ANOVA) was performed by using obtained data set for determining the effects of treatments and interactions on fresh grain yield. GGE biplot computer software developed by Weikai Yan (2001) was used to perform GGE biplot analysis.

## RESULTS

GGE biplots were defined by Yan et. al., 2000 as biplots based on SVD of environment-centered genotype-by-environment data (GED). ANOVA table of fresh grain yield for 6 different environments and 5 various cultivars were presented at table 1. Table 1 also contained 4 principal components (PC) which are obtained from partitioning of sum squares of GxP. Genotype by Planting Date interaction was significant at P=0.01 and first two PC values explained 85% of G x P interaction (Table 1)

Table 1. ANOVA analysis for fresh grain yields

	d.f.	Sum of squares	Mean squares	(%) GxP Explained
Treatments	29	771,48	26,60	
Genotypes	4	208,50	52,13**	0,27
Planting Dates	5	342,37	68,47**	0,44
G x P	20	220,61	11,03**	0,28
PC1	8	148,27	8,53**	0,66
PC2	6	42,38	7,06**	0,19
PC3	4	27,60	6,89**	0,14
PC4	2	2,21	1,10	0,01
Pooled Error	58	66,29	1,14	

Yan et. al. (2007) indicated that the GEI caused crossovers among superior genotypes and GEI could not be exploited if the crossover GEI patterns were not repeatable across years. In this study it was seen that according to 3 planting dates, there was no changing in mega-environments over two years. The “Which Won Where” view of biplot (Figure 1) was partitioned into 5 sectors. Whereas El Toro is the vertex genotype of the sector which includes 6<sup>th</sup> May and 20<sup>th</sup> August planting dates, Merkur is the vertex genotype of the sector which includes 20<sup>th</sup> July. Thus El Toro is the best genotype for 6<sup>th</sup> May and 20<sup>th</sup> August and Merkur is the best genotype for 20<sup>th</sup> July. In the present case as planting dates of May and August constitute a mega-environment, planting date of July creates a mega-environment separately. Furthermore other cultivars which are not vertex genotype in any sector are not suitable genotypes in any environment which are obtained from different planting dates in different years.

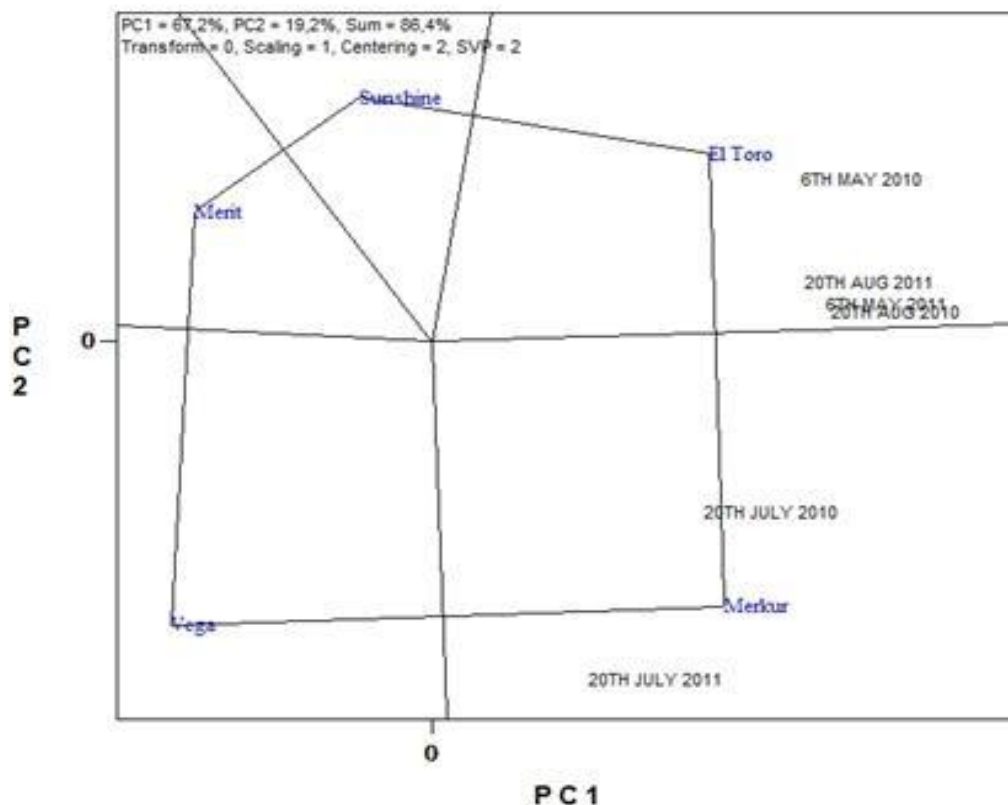


Figure 1. The “which won where” view of GGE biplot

AEC, “Average Environment Coordination” view (Figure 2) of GGE biplot is used to compare genotypes in respect to yield and stability. In figure 2 the line which has one arrow is called AEC abscissa and the line which has two arrows called AEC ordinate. AEC ordinate is perpendicular to AEC abscissa and passes through biplot origin. Because of the inner-products property of biplot, the projections of the genotype markers on AEC abscissa are represent the main effects of genotypes (Yan et. al., 2007). When genotype effects are compared with each other, figure 2 showed that Merkur is considered as the most yielding cultivar in all planting dates. El Toro come after Merkur and the least yielding cultivar is Merit. Since GGE represents G+GE and since AEC axis approximates the genotypes’ contributions to G, the AEC ordinate must approximate the genotypes’ contributions to GE which is measure to their stability or instability (Yan et. al., 2007). When viewed from this aspect, Whereas Merit becomes prominent as most stable cultivar, El Toro and Vega are the cultivars which can be adapted to special environments. An ideal genotype must be both stable and be as above as the average yield so Merkur is the most suitable cultivar with its high productivity and acceptable stability.

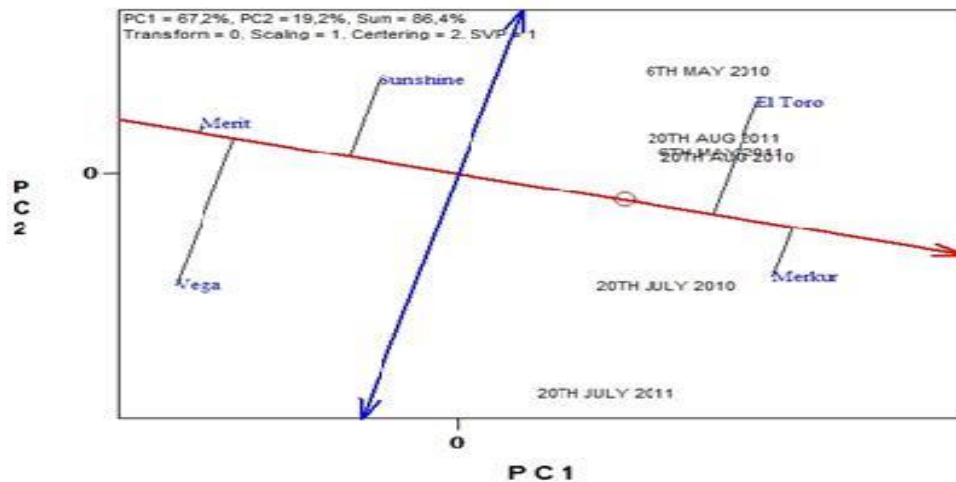


Figure 2. The "average environment coordination" view of GGE biplot

According to Yan et. al. (2007), an ideal test environment should both select the superior genotypes and represent its mega-environment completely. Such an ideal environment is represented by a circle including it (Figure 3). Although such an ideal environment may not exist in reality, it can be used as a reference for genotype selection in the METs (Kaya et. al., 2006). Discriminating power and representativeness view was showed at figure 3. The vector which connects environment markers to origin shows their discriminating power. As the vector getting longer, the discriminating power of that environment increases. Discriminating powers of environments' which are used in this study are generally close to each other. In addition to this, angles between environment vectors and AEC abscissa (single arrowed) showed representativeness of the environments in mega- environments. From this point of view 20<sup>th</sup> August planting date is consistent in both two years and is coming into prominence with May 6<sup>th</sup> 2011 planting date as the most representativeness environments. Besides 6<sup>th</sup> May 2011 and 20<sup>th</sup> July 2011 environments are the less representativeness environments. Considering these results, 20<sup>th</sup> August planting dates (over two years) and 6<sup>th</sup> May 2011 planting date could be reported as optimum test environments because of their discriminating power and representativeness features.

At Figure 3, by the help of rays between test environments, the relevance between test environments can be estimated. When these rays were analyzed, it was seen that there was a small difference between the two years for 20<sup>th</sup> August planting date. This case indicated that environmental conditions were repeatable across two years. However when 6<sup>th</sup> May and 20<sup>th</sup> July planting dates are examined it can be realized that there are relatively more differences among two years.

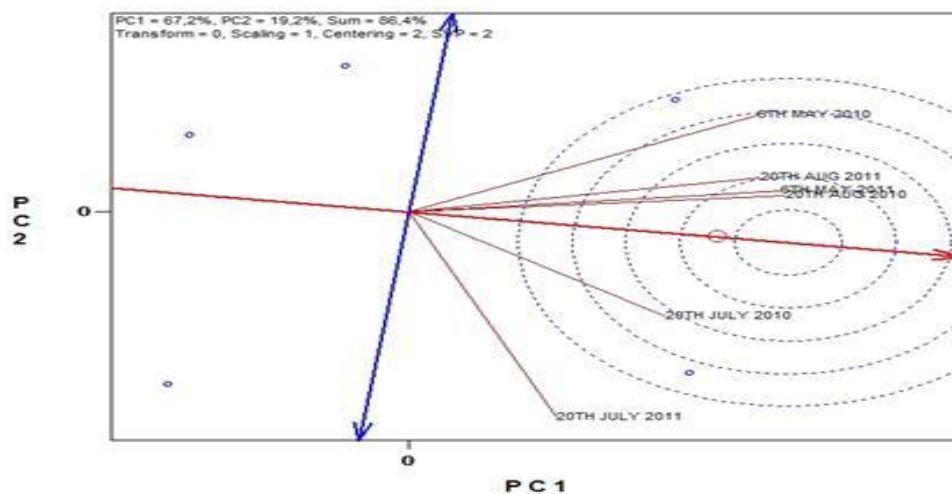


Figure 3. The "discriminating power vs. representativeness" view of GGE biplot

## DISCUSSION AND CONCLUSION

**It has been found that in Mediterranean climatic conditions, Merkur can be suggested to the farmers as high yielding and suitable sweet corn variety at July planting date. In addition El Toro is the best cultivar for May and August planting dates. Although Merit is the most stable genotype across all environments, because of its little productivity, this genotype with Vega and Sunshine cannot be proposed safely to farmers for any planting dates. Environmental conditions of planting dates are repeatable across two years and the analysis showed that planting dates of May and August are quite similar to each other and they constitute a mega environment. This similarity can be a result of climatic conditions.**

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# DETERMINATION OF RELATIONSHIPS BETWEEN YIELD AND YIELD COMPONENTS BY USING CORRELATION AND PATH ANALYSIS METHODS FOR CHICKPEA (*Cicer arietinum* L.)

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## ABSTRACT

Water scarcity is the main factor limiting agricultural productivity. The present study was carried out to determine yield and quality components affecting grain yield and to study the relationships between these yield components and other characteristics. Four chickpea genotypes (CDC Frontier, CDC Luna, Sawyer and Sierra) were grown in pots with three different irrigation levels (a dose of 17.5 ml, 35 ml and 70 ml for each pod per day) for three weeks following sowing. Days from sowing to first flower, days from sowing to pod set, fertile pod/plant, double seed/pod per plant, stem diameter, plant weight, seed yield per plant, 100 seed weight, seed diameter and days to harvest were recorded. Direct and indirect effects of the yield components on grain yield were analyzed using path coefficient analysis. Seed yield per plant was most effected (91.3%) by the number of fertile pod per plant and followed by number of double seed per pod (20.7%).

Key Words: Drought, path coefficient, seed yield, yield components.

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## INTRODUCTION

Water is a primary component of biological processes. Water management is important to obtain high productivity (McPhee et al., 2012). Knowledge of water use efficiency is required to develop new cultivars which are tolerant to drought (Ceyhan et al., 2012). Demand for food has been increasing worldwide as populations continue to increase. Scientists search for solutions in agriculture production systems in an effort to meet rising food needs. The solutions should be environmentally friendly for sustainable agriculture (Kahraman et al., 2012).

Pulse crops are the richest source among plant proteins (Onder and Kahraman, 2009). Chickpea is traditionally a low-input crop and is grown extensively in moisture stressed environments. Global chickpea production has increased only marginally, unlike the many fold increase in cereal production over the last 40 years. There are many constraints to production including diseases, insects, pests, soil properties, environmental stresses and non-adoption of modern management techniques (Yadav et al., 2007).

The aim of this study was to estimate the correlations and path analysis among some important characteristics in chickpeas to determine selection criteria for high yield. It is well known that using correlation alone is insufficient to understand the relative importance of the direct and indirect influence from individual components on seed yield. Therefore, path analysis was used to resolve the mentioned deficiencies.

## MATERIAL AND METHODS

The experiment was carried out to investigate the effects of drought on chickpea grown under different water irrigation conditions. The plants were grown under greenhouse conditions on the campus of North Dakota State University, Fargo, ND, USA. The experimental design was 3x4 factorial with four replications. Plant materials comprised four chickpea genotypes, CDC Frontier, CDC Luna, Sawyer and Sierra. Seeds of each cultivar were sown two per pot in 15cm pot on 16 December 2011. Each pot was filled with 335 g of LC1 potting media (SunGro Horticulture, Canada). Slow release Osmocote 3-month release fertilizer was applied after sowing at a rate of ½ tea spoon per pot. Water was applied at the rate of 120 ml per pot from sowing through day 21 post sowing. The plants were thinned to one per pot. Water was applied at three levels, 17.5, 35 and 70 ml daily beginning 22 days post sowing through

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harvest. Each plant was harvested by hand at maturity. Appropriate pesticides were applied during the growth period to control insects.

Days to first flower, days to pod set, plant height were calculated from the sowing date; fertile pod per plant, double seed/pod per plant and seed yield per plant were determined by counting; stem diameter and seed diameter were measured using a micrometer caliper device (mm); plant weight (air dried plants were cut from soil level and then; leaves+stems+pods were weighed together) at harvest and 100 seed weight were measured using a weigh scale (g). the investigated values was presented in a different paper which is entitled as: Response of Chickpea Genotypes to Drought.

In order to determine the relationships between the investigated characteristics and seed yield per plant, correlation coefficients, direct and indirect effects were performed using "TARIST" computerized statistical program.

This study was presented in "23rd International Scientific-Experts Congress on Agriculture and Food Industry" with the same title of "Determination of Relationships between Yield and Yield Components by Using Correlation and Path Analysis Methods for Chickpea (*Cicer arietinum* L.)" and has been accepted for the publication in "The Journal of Agricultural Faculty of Ege University" by the referees.

## RESULTS

According to Table 1, significant and high ( $P < 0.01$ ) positive relationships were found between fertile pod/plant, double seed/pod, stem diameter, plant weight and seed yield per plant. There was also a positive correlation ( $P < 0.05$ ) between days to harvest and seed yield per plant. Negative (-0.31) and significant ( $P < 0.05$ ) relationship was found between 100 seed weight and seed yield per plant.

Correlation coefficients were calculated to investigate the relationships between seed yield per plant and other examined characteristics. Path coefficients were separated into direct and indirect effects using seed yield per plant as the dependent variable. Table 2 indicates direct and indirect effects.

Number of fertile pods (91.34%) per plant had a high level of direct effect on seed yield per plant beside its high and positive correlation values. Double seed per pod (20.70%) also showed a strong direct effect. Stem diameter (1.58%) and plant weight (0.05%) showed a low direct effect although they were significant ( $P < 0.01$ ) and had high correlation values. The effects of 100 seed weight (1.89%) and days to harvest (1.41%) also had a low direct effect on seed yield per plant despite a significant correlation ( $P < 0.05$ ) with seed yield per plant.

Table 1. Correlations between the investigated characteristics in the chickpeas.

Characteristics	First flower	Pod set	Fertile pod/plant	Double seed/pod	Stem diameter	Plant weight	Seed yield/plant	100 seed weight	Seed diameter	Days to harvest
Pod set	0,3136*	1	-	-	-	-	-	-	-	-
Fertile pod/plant	0,1098	0,0963	1	-	-	-	-	-	-	-
Double seed/pod	-0,2068	0,0695	0,5462**	1	-	-	-	-	-	-
Stem diameter	0,2019	0,0712	0,7211**	0,4159**	1	-	-	-	-	-
Plant weight	0,0554	0,1604	0,8225**	0,4875**	0,8288**	1	-	-	-	-
Seed yield/plant	0,0651	0,1027	0,9929**	0,6402**	0,713**	0,819**	1	-	-	-
100 seed weight	-0,088	0,0335	-0,3076*	-0,1889	0,0045	-0,0356	-0,31*	1	-	-
Seed diameter	-0,0234	0,0647	-0,0778	-0,1305	0,1152	0,2083	-0,0936	0,8117**	1	-
Days to harvest	-0,4231**	-0,1441	0,2944*	0,3794**	0,2562	0,1592	0,3286*	-0,0594	-0,1929	1

**Table 2. Direct – indirect effects and contribution (%) of various characteristics to seed yield per plant in the chickpeas.**

Trait	Correlation	Direct effects		Indirect Effects																	
				1. First flower		2. Pod set		3. Fertile pod/plant		4. Double seed/pod		5. Stem diameter		6. Plant weight		7. 100 seed weight		8. Seed diameter		9. Days to harvest	
		P	%	P	%	P	%	P	%	P	%	P	%	P	%	P	%	P	%	P	%
1.	0,0651	-0,0064	4,45	-	-	0,0024	1,68	0,1018	70,83	-0,0279	19,44	-0,0024	1,66	0,0000	0,01	-0,0005	0,37	0,0002	0,12	-0,0020	1,40
2.	0,1027	0,0077	6,98	-0,0020	1,81	-	-	0,0893	80,63	0,0094	8,48	-0,0009	0,78	0,0001	0,06	0,0002	0,18	-0,0005	0,43	-0,0007	0,62
3.	0,9929**	0,9270	91,34	-0,0007	0,06	0,0007	0,07	-	-	0,0738	7,26	-0,0084	0,83	0,0004	0,03	-0,0019	0,18	0,0006	0,05	0,0014	0,13
4.	0,6402**	0,1350	20,70	0,0013	0,20	0,0005	0,08	0,5063	77,62	-	-	-0,0049	0,75	0,0002	0,03	-0,0012	0,17	0,0010	0,14	0,0018	0,27
5.	0,713**	-0,0117	1,58	-0,0013	0,07	0,0006	0,08	0,6668	90,20	0,0564	7,62	-	-	0,0004	0,05	0,0000	0,00	-0,0008	0,10	0,0012	0,16
6.	0,819**	0,0004	0,05	-0,0004	0,04	0,0012	0,14	0,7628	90,48	0,0658	7,81	-0,0097	1,14	-	-	-0,0002	0,02	-0,0015	0,18	0,0008	0,09
7.	-0,31*	0,0061	1,89	0,0006	0,17	0,0003	0,08	-0,2848	88,03	-0,0255	7,86	0,0000	0,00	0,0000	0,00	-	-	-0,0060	1,85	-0,0003	0,08
8.	-0,0936	-0,0074	7,06	0,0001	0,14	0,0005	0,47	-0,0718	68,58	-0,0176	16,79	-0,0013	1,21	0,0001	0,08	0,0050	4,74	-	-	-0,0009	0,88
9.	0,3286*	0,0048	1,41	0,0027	0,80	-0,0011	0,33	0,2729	80,82	0,5120	15,17	-0,0030	0,90	0,0001	0,02	-0,0004	0,10	0,0014	0,42	-	-

## DISCUSSION AND CONCLUSION

The results of the present study showed positive and significant correlation coefficients between fertile pod/plant, double seed per pod, plant weight, days to harvest and seed yield per plant. A negative (-0.31) and significant ( $P < 0.05$ ) correlation coefficient was found between 100 seed weight and seed yield per plant. Previous studies have reported similar results (Khan and Qureshi, 2001; Muhammd et al., 2002; Noor et al., 2003; Vaghela et al., 2009; Kayan and Adak, 2012).

Path analysis showed that the number of fertile pods per plant was the character that has positive and the highest direct effect (91.34%) on the seed yield per plant. This was followed by double seed per pod (20.70%). These results are in accordance with previously reported data (Hassan et al., 2005; Bakhsh et al., 2006; Atta et al., 2008; Farshadfar and Farshadfar, 2008; Yücel and Anlarsal, 2010; Sharma and Saini, 2010).

The results suggest that selection based on increased seed yield per plant should be based on the number of fertile pods per plant and double seed per pod in chickpeas. In breeding programs, stem diameter, plant weight and days to harvest could be also suggested to improvement of yield because of their positive and significant correlation coefficients.

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# MOUNTAIN MANAGEMENT PLAN WITHIN THE FRAMEWORK OF RURAL DEVELOPMENT: A CASE STUDY OF THE KAZ MOUNTAINS

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## ABSTRACT

Rural development can be defined as a process with economic, social and cultural dimensions. According to another definition, rural development refers to the rural society's receipt of a share from the development and welfare of the country by developing in its place. The concept of rural tourism with an essential place in the sector today as a result of changing understanding and preferences of tourism has become an important pillar of rural development.

Mountains are one of the natural environmental factors that contribute to rural tourism. Mountains, which include rich natural and cultural landscape assets, are at the same time areas with extremely sensitive ecosystems. Therefore, it should be aimed to ensure the permanence of the landscape assets of these areas and to make use of these areas in the most rationalistic way within the framework of rural development. In line with these purposes, it is necessary to prepare the Management Plans.

This study investigates the Kaz Mountains which contain important natural and cultural resources not only on local scale but also on country scale. The present study makes analyses regarding the landscape assets of the study area and determines the framework and essentials of a method plan likely to be implemented in mountainous areas in order to take the long-term benefits, which might be obtained from the Tourism and ecosystem of the Kaz Mountains, under protection.

**Key Words:** Rural development, rural tourism, management plans for mountain, Kaz Mountain

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## INTRODUCTION

"Sustainability or sustainable development" is a widely accepted conception that foresees increasing productivity of natural production resources by protecting and developing, respecting the balance between natural and environmental values in the progress of development, relaying the benefits of natural resources to next generations and providing a secure and stable future in income and life standards. It also contains a quality in a developmental sense not only for urbanized society but also for the rural people. These insights that place improvement of human resources into the focus have the same validations in the objectives of rural development (DPT, 2000).

Rural tourism is a type of tourism that integrates with rural culture, natural environment and agriculture along with the other tourism types. Various local, national and international initiatives are able to draw people from all around the world to rural areas for holiday (Soykan 1999; Soykan, 2003). Rural tourism activities are in increasing demand and have an important place in the "rural development" conception. They are also generally welcomed by the local people because they require less work compared to the agricultural activities and provide relatively more income.

It is seen that rural-based tourism activities are referred to as village tourism, soft tourism, mountain tourism or ecotourism. However, in general since all of the touristic activities took place in the rural areas, in this study tourism in the mountains have been considered as rural tourism concept.

Considering how hard human have tended to live in the mountainous areas under the pressure of increasing population and urbanization on the coasts and lowlands, protection and preservation of sustainable use of the mountainous regions have utmost importance. As explained above, the potential that the mountains have is a natural resource with great interest to world population. Rational use as opposed to excessive and intensive use is a base for long term and nondestructive utilization and benefit. This requires a "Mountainous Areas Management (MAM)" and a planning study for obtaining sustainable use in protect-use balance (Gönençgil et al., 2005).

From this point of view, it is possible to define MAM and planning as "a total of management and planning to determine rational utilization models in accordance with the sustainable development principle that will provide a protect-use balance". Environmental management plans which will be

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prepared for this purpose have to contain terms of use accepted by the local people (Gönençgil et al., 2005).

In this study, rural tourism characteristics of Kaz Mountains were investigated, and the need and the general framework for a MAM for sustainability in the progress of rural development were determined.

## MATERIALS AND METHODS

Kaz Mountains were the main material for this study. In addition, literature, maps, face-to-face interviews, field observations, notes and the photographs were also utilized. As the method, literature were screened for the study area and the objectives, rural tourism aspects of the area were studied, and principles to be used in constructing a management plan applicable to the mountainous areas were put forward.

### Geographic Location and Geomorphologic Characteristics of the Study Area

Kaz Mountains massif located between 39° 30'-39°50' N and 26°15'-26° 35' E longitudes is in the South-east part of Biga peninsula extending East to West showing the most isolated elevation compared to its surrounding. The area is bordered with Ayvacık-Ezine and by the Çanakkale-Izmir intercity road in the west. They reach the Aegean Sea with a slope and continuing hills with not exceeding 500 m. The massive, bordered with Bayramiç and Çan in the north, Kalkım, Yenice and Balya in the east, Edremit and Havran in the south shows a quite rugged structure. South sides, especially northern part of Edremit have steep and broken terrain; on the other hand the slopes tend to soften towards the west. In the southern part, rugged terrain in the northern Havran county descends towards Yenice and Balya in the east. In the summit region rugged and broken structure descends into very broken sites in the vicinity of Bayramiç. Heights located in the west Bayramiç form a boundary between Ayvacık and Bayramiç. In the northeastern part, microclimates can be seen in the valleys formed by the creeks flowing towards east in the basin closed in the north by the Great and Small Katrancı Mountains (Özel, 1998) (Fig. 1).

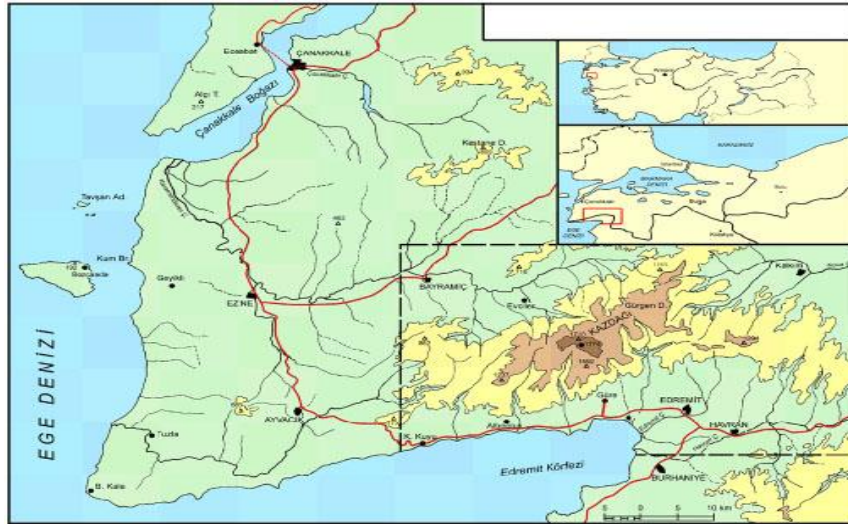


Figure 1. Geographic location of the Kaz Mountain region (Koçman et al., 2007)

Kaz mountains are pinnacles between the grabens of Edremit bay- Havran and Bayramiç-Evciler with an east to west elongation and similar to sheep back. Units that form these elevations are composed of Paleozoic and Mesozoic old sedimentation and magmatic origin rocks at different ages with varying degrees of metamorphism and especially cut with magmatic grooves and tertiary old volcanic and sediment conglomerates (Bozcu and Çalık, 2006).

Surfacing at the highest places on Kaz Mountains old Paleozoic and Mesozoic rocks display an anticlinal structure extending Northeasterly and at the core of this structure the oldest rocks of the area are found. Kaz Mountains can bear resemblance to a relatively visible half cut onion with these geological

and morphological structures (Yılmaz, 2003; Bozcu and Çalık, 2006). They are limited to young normal-oblique faults that are north and south directed cast component and have been exposed to multidirectional tectonic forces (stresses) since Paleozoic era to current times. They are also 1700 m higher than the surrounding planes. The bended, layered and reverse structure of the old rocks at the core show that these area were under the compression forces during the paleotechnic era (different from the current tectonic regime) according to the tectonostratigraphic that surfaced at the north and south sides on the right ascent of the mountains (Bozcu and Çalık, 2006).

#### Natural Plant Coverage

Kaz Mountains are placed not only at the borders of Marmara and Aegean regions but also at the conjunction of the two phytogeographic regions, such as Europe-Siberia and Mediterranean. As a result, they have significant vegetation in which the Mediterranean originated species can be found at the southern slopes and the Black Sea originated species can be seen at the northern and northwestern slopes. High places are covered with European black pine forests, interrupted locally with Kaz Mountain fir and beech forests. Upper zones above 1500 m contain a “high mountain step” specific to Mediterranean mountains. Zoning in the region is still observable in spite of the destruction and microclimatic effects (Özel, 1998).

Approximately 800 taxa grow in the Kaz Mountains, composed of the flora of Mediterranean (24%), Europe-Siberian (17.6%) and Iran-Turan (1.3%). Out of the 75 taxa that are endemics in the region, only 25 are endemic to the Kaz Mountains. Sixty-eight taxa, among which 37 are endemic, on the other hand are endangered and need protection (Akalın, 2006). General vegetation is composed of forest and high-bush vegetation and plants that belong to high mountain step (Özel, 1998).

#### Fauna

Geomorphological characteristics of the Kaz Mountains make home to many mammalian and avian species due to their rich water resources and specific flora. Among the animal species that habit in the mountains are deer (*Capreolus capreo*) fallow deer (*Dama dama*), wild boar (*Sus scrofa*), bear (*Ursus arctos*), hyena (*Crocuta crocuta*), wild cat (*Felis silvestris*), wolf (*Canis lupus*), jackal (*Canis mesomelas*), fox (*Vulpes vulpes*), badger (*Meles meles*), marten (*martes spp.*), weasel (*Mustela nivalis*), rabbit (*Lepus spp.*), squirrel (*Sciurus vulgaris*), dryomys (*Drymys spp.*), porcupine (*Hystrix indica*), bat (*Rhinolophus ferrumequinum*) and mouse (*Microtus spp.*) along with 82 bird species including grey heron (*Ardea cinerea*), sparrowhawk (*Accipiter nisus*), common buzzard (*Buteo buteo*), eagle (*Haliaeetus sp*), vultures (*Cathartes aura*, *Coragyps atratus*), falcon (*Falco peregrinus*) and woodpecker (*Dendrocopos major*) (Ezer et al., 1995; Anonymous, 2001; Yıldırım and Ölmez, 2006).

#### Climate

Kaz Mountains are generally a transition region in which both Mediterranean and Black Sea climate and vegetation are experienced. The most common feature of their climate is variability within a short distance (vertical and horizontal direction) depending on the terrain and due to subtropical and temperate transient zones. This is the causal factor by which pressure system and air mass between the hot and cold periods determine depending on from which side they are introduced, having an effect on the formation and richness of Kaz Mountains ecosystem (Koç, 2006; Ayaşlıgil; 2012).

## RESULTS

Acknowledgement of natural and landscape characteristics of the Kaz Mountains with the increasing communication skills has resulted in accommodation facilities in different types and sizes. Some of these facilities are located on the southern slopes and allow for not only sun-beach-sea tourism but also rural tourism activities, while on the northern sides there are fewer establishments that provide an opportunity for rural tourism only (Figure 2). These facilities have different capacities and facilities are just a few shown in Table 1. Accommodation facilities in the southern hillside of mountain have increased. Therefore infrastructure deficiencies reveals in these areas. There are some daily forest recreational sites (FRS) scattered around the Kaz Mountains connected to the Forest Directorates, (such as the Ayazma FRS in Evciler, Bayramiç (Çanakkale); the Handeresi FRS in the Kalkım, Yenice (Çanakkale); the Pınarbaşı FRS in Güre, Edremit (Balıkesir); Hasanboğuldu FRS in Zeytinli (Balıkesir) and the Talimalanı



FRS in Hanlar region) (Figure 3). Tracking or walking tours bound with certain rules are organized all over the mountains. Additionally, hunting sites are one of the areas preferred especially by the foreign tourists. Kaz Mountains also provide opportunities for photo safari, bicycle and motorcycle tours and camping activities etc. A rich cuisine culture formed around the diverse plant cover and various herbs is also accepted as a different form of tourism. Although health spa culture has not shown the desired development, the Mountains hold a very important potential. On the other hand, Adatepe and Yeşilyurt are the villages where the authentic residential touch has been successfully implemented as an extension of the rich history of the region. It is expected to have this kind of tourism of restoration of old stone houses be extended at other settlements.

Table 1. Facilities on Kaz Mountain

Direction of Facilities On Mount Ida	Location of Facilities	Name	Theme
South	Adatepe Village Küçükuyu	Hünnap Han	Nature and culture tourism
South	Altınoluk	Club Afrodit Resort	Sea, culture and nature tourism
South	Altınoluk	Çeşmeli Konak	Mountain, culture and nature tourism
South	Altınoluk	Hotel O <sub>2</sub>	Sea and nature tourism
South	Altınoluk	Mare and Monte	Hunting, nature, mountain, wellness tourism
South	Çamlıbel Village Edremit	İdaköy Country House	Mountain and nature tourism
South	Çamlıbel Village Edremit	Zeytinbağı	Mountain and nature tourism
South	Güre-Edremit	Manastırhan	Nature and culture tourism
North	Kalkım-Yenice	Hotel İliada	Hunting, nature and trekking tourism
North	Kalkım-Yenice	Kalkım Hotel	Mountain and nature tourism
South	Narlı-Altınoluk	Narçiçeği Köşkü	Mountain, sea and nature tourism
South	Yeşilyurt Village Küçükuyu	Çetmihan Hotel	Mountain and nature tourism
South	Yeşilyurt Village Küçükuyu	Taş Teras Hotel	Mountain and nature tourism
South	Yeşilyurt Village Küçükuyu	Erguvanlı Ev	Sea, thermal and nature tourism
South	Yeşilyurt Village Küçükuyu	Kazdağı Yeşilyurt Evleri	Mountain and nature tourism
South	Yeşilyurt Village Küçükuyu	Manici Kasrı	Mountain and nature tourism
South	Yeşilyurt Village Küçükuyu	Öngen Country Hotel	Mountain, sea, congress and nature tourism

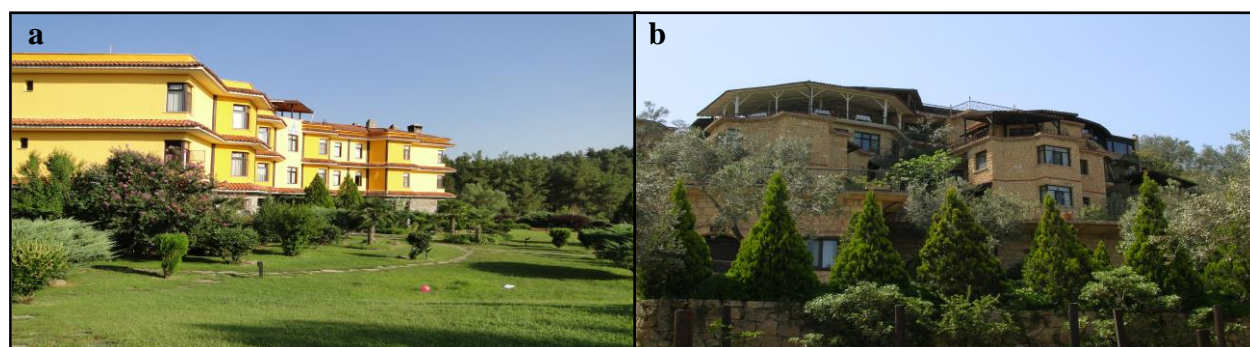


Figure 2. a) Hotel İliada (Kalkım) b) Öngen Country Hotel (Yeşilyurt Village) (Original, 2012)



a

b

Figure 3. a) Ayazma (Bayramiç) FRS b)Kalkım (Yenice) FRS (Original, 2011)

In terms of agricultural activities in the area, is made largely of conventional agriculture, yet sufficiently developed organic farming activities. Local people, the level of consciousness is not sufficient in this regard. Widely grown agricultural products of the region are capia peppers, tomatoes, apples and walnuts.

There are administrative problems because the mountain masses are within in the jurisdiction of two cities. Furthermore, local people are not conscience enough to protect natural and cultural resources. They also need a support on the education in benefiting from the new job opportunities the rural tourism might provide. Anthropogenic effects that surfaced as a result of rural tourism activities have also been a serious setback in the sustainable use of the area. Similarly the rapid increase in the second housing has become an important environmental problem. Lastly, the part of the Kaz Mountains remaining within the Çanakkale city border is not under protection although the part in Balıkesir is a national park. Considering how important the holistic approach is in the protection of natural areas a “mountain management plan” covering all of the Kaz Mountains must be constructed.

## CONCLUSION

After the evaluations made, general principles of a mountain management plan for the Kaz Mountains have been determined as followed:

1. Handling of the administrative management for all of the Kaz Mountains by one authority,
2. Protection and sustainability of flora and fauna,
3. Increasing the quality in rural tourism activities and improving diversity,
4. Protection and improvement of grassland, in order to sustainability of animal products, which important for mountain ecosystem especially for Kaz Mountain,
5. Strengthening of trout and beekeeping activities,
6. Ongoing agricultural activities, which is an important economic activity, especially on the northern hillside of Mount Ida, should be on the basis of the principles of organic farming,
7. Evaluation of medicinal and aromatic plants potential of Mount Ida,
8. As given in Table 1, tourism facilities, which are mostly settled in the southern hillside, expanding and promoting of the ecologically based tourism in northern hillside of mountain. Thus, the establishment of a sustainable tourism model as well as the provision of rural development due to tourism activities in the area,
9. Zoning studies based on science and according to utilization suitability
10. Resolving infrastructure problems that might arise from increasing population with tourism activities
11. Inspection of hunting tourism in the area and ensuring protection of the species

12. Educating and increasing awareness in the local people about sustainable use of natural and cultural resources
13. Support of local fairs and festivities.
14. Providing of sustainable uses of forests,
15. Supporting of existing or planned eco-friendly tourism activities in the region with forestry activities,
16. Providing of branding of region-specific products with marketing strategy and increase market share,

**A "mountain management plan" must be implemented for sustainable use of ecological resources in the Kaz Mountains. During this process, there is a need for a highly disciplined participation. Following a serious inventory study completely covering the Mountains, natural protection areas, national parks, specific environmental protection areas and natural sites must be determined and a collective protection policy must be developed with the applications of absolute protection areas and buffer zones.**

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# ESKISEHIR TRANSITIONAL ZONE AGRICULTURAL RESEARCH INSTITUTE

## STUDIES OF DEVELOPMENT OF BISCUIT WHEAT 2002-2012

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### ABSTRACT

Transitional Zone Agricultural Research Institute has a wide range of breeding material which were both developed in internal breeding programs or transferred from international programs. Soft wheat quality studies were started with a project in the beginning of 2000's in the Institute. In this project, totally 214 soft bread wheat lines and varieties were evaluated in 2003 and 2004 years. Firstly, observation nursery was generated with selecting the genotypes which were soft kernel structure and low alkali water retention capacity, protein content and SDS sedimentation values. Following years while low selection pressure was applied on the selection of general breeding characters such as yield and resistant to diseases, higher selection pressure was used on biscuit quality. The material selected from observation nursery transferred to preliminary yield trial then yield trial and finally regional yield trial in three years in both irrigated and rainfed conditions. In another project started in 2008 selected lines with good morphological characteristics, high yield, disease resistance and promising biscuit-making properties were used. Grain, whole meal, flour, milling, starch, dough, biscuit physical and sensory properties of lines and varieties were determined in rainfed and irrigated conditions. The relationships among the quality properties were investigated. In 2010 and 2011 because of importance of agronomical properties in soft wheat quality the genotypes which are not varied in terms of biscuit-making quality properties with extra nitrogen treatment were selected. Finally, 6 lines in irrigated and 6 lines in rainfed conditions were selected to the pre registration trial for biscuit quality.

**Key Words:** Biscuit, wheat, breeding, Transitional Zone Agricultural Research Institute, quality

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### INTRODUCTION

Turkey is among the important countries in wheat production in the world. The big portion of the wheat produced in Turkey is used in bread-making. On the other hand biscuit production is one of the most important sectors in food industry in Turkey. Turkey's biscuit wheat demand is approximately 600 thousand tones per year. When we think all sectors using biscuit wheat this demand reaches to 1 million tones (biscuit sector communications). Biscuit was started to consume as daily in last decade in Turkey. The average biscuit consumption is about 5-6 kg per person in a year (Doğan and Uğur, 2004).

The wheat breeding studies were started in Transitional Zone Agricultural Research Institute (TZARI) in 1925. Ak702, the genotype selected from local population, was registered first time in 1931 followed by either the varieties selected from local population or improved in the breeding programs (Braun et al. 2002). In last years besides high yield, improving the quality of the grain is also getting important in wheat breeding studies. It is necessary to consider biscuit-making quality criterias in these studies too. If appropriate flour is used in biscuit production it will be easier to control additional substance and process. This causes high quality biscuit production and reduces cost prices. The appropriate flour will be obtained from the production of the wheat varieties which have good biscuit-making quality.

In this study the biscuit wheat breeding efforts which were started in 2002 and have been continued until present time in TZARI wheat breeding program were summarized.

### RESULTS AND DISCUSSION

The evaluation of wheat quality was started to be more important in 2000s in Turkey. Especially after certain yield limit, development of varieties which have high quality properties was one of the most important target in wheat breeding programs. In early studies, bread and pasta-making quality were

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studied and fast tests were used in selection in early generations. In those years while Turkey was struggled with economical crisis, biscuit sector was continuing to export biscuit to especially Middle East and Balconies. But there were some problems which were due to low quality of flour in this export. So the biscuit sector started to look for flour with standard and suitable quality. In those years when we looked at developed countries they had soft wheat breeding programs for flour products such as cake, biscuit, wafer and flat bread and wheat production regions which are suitable to grow soft wheat for certain products. At that years in Turkey the studies on biscuit quality were limited (Karababa and Ozan 1995), there was lack of standard quality wheat for biscuit sector and it was needed to evaluate Turkish wheats for biscuit quality criterias using international standards (Ozan and Karababa, 1997).

For this purpose, in 2002 biscuit wheat breeding studies were started in TZARI to determine the situation and parameters which could be used in breeding programs.

Firstly, 27 varieties and 68 advanced lines (totally 95 samples) in 2003 and 30 varieties and 119 advanced lines (totally 149 samples) in 2004 from regional yield trials in different locations have been analyzed. 1000 kernel weight, test weight, PSI hardness, protein content, SDS-sedimentation value, wet gluten content, gluten index value and Alkali Water Retention Capacity (AWRC) value were examined in samples. After making biscuit; biscuit diameter (D), biscuit thickness (T), diameter/thickness (spread ratio) (D/T) and biscuit top appearance (0-5) were evaluated. Gerek79, Sultan95, Yıldız98 and Çetinel2000 varieties were found to have good biscuit-making quality characteristics. Also, some advanced lines gave good cookie quality characteristics. These lines were used in breeding programs (Figure 1). SDS-sedimentation and AWRC were found as a preliminary tests for evaluating the biscuit-making quality characteristics since increases in these values decrease biscuit-making quality. The correlation coefficients between standard quality characteristics and biscuit-making quality characteristics were calculated.

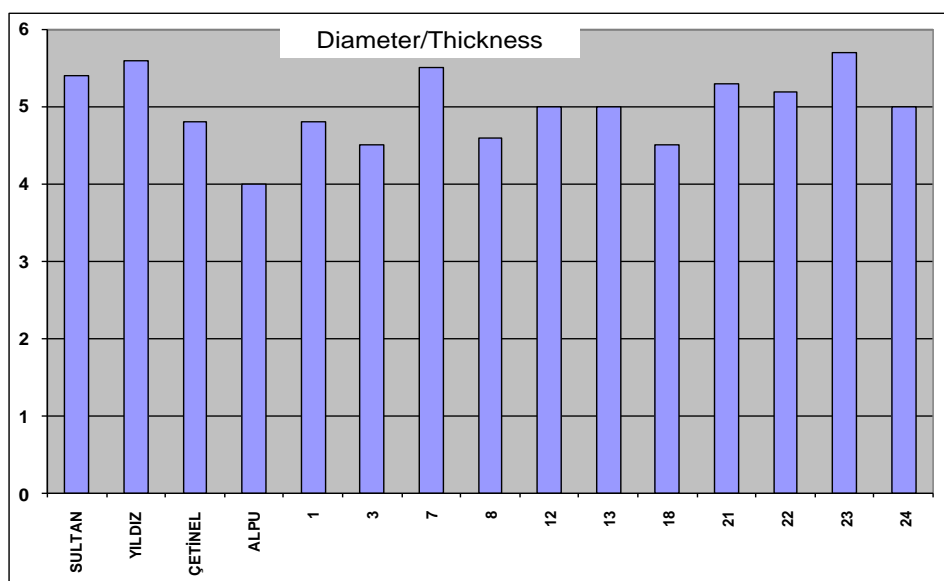


Figure 1. Diameter/thickness (spread ratio) value of standards and some lines evaluated in the project

Following years while low selection pressure was applied on the selection of general breeding characters such as yield, resistant to diseases, higher selection pressure was used on biscuit quality. The material selected from observation nursery transferred to preliminary yield trial, then yield trial, finally regional yield trial in both irrigated and rainfed conditions in three years. The biscuit-making quality parameters were evaluated in the study. In addition to physical properties SDS-sedimentation values, protein content and AWRC values were main quality parameters in selection for biscuit quality (Fig 2 and Fig 3). In observation nursery the approximately 1000 genotypes were evaluated. Sedimentation index (SI) which shows protein content and quality together was used in that evaluation. The lines were low SI value or low SDS sedimentation volume and protein content selected to upper trial.

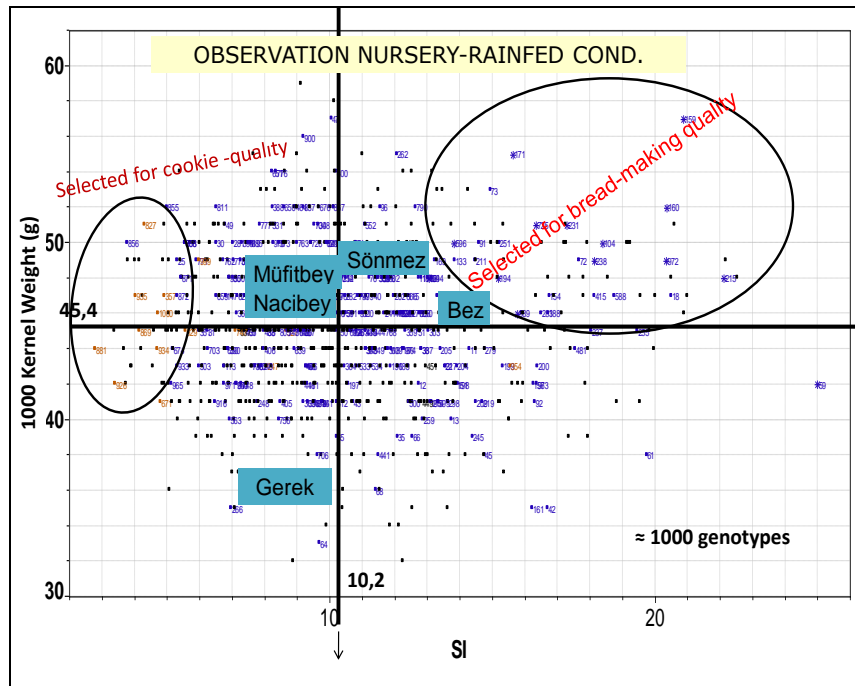


Figure 2. Selection for biscuit and bread-making quality in observation nursery

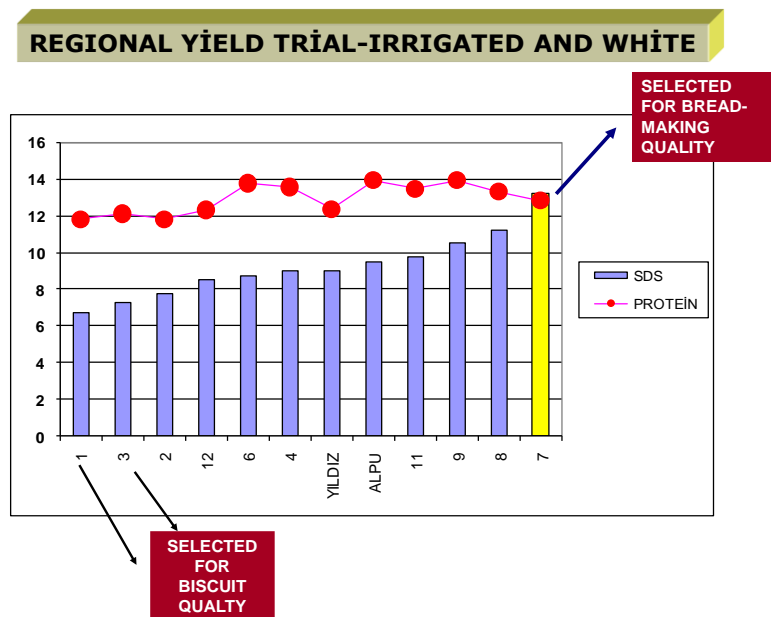


Figure 3. Selection for biscuit and bread-making quality in regional yield trial

In another project which was started in 2008, the selected lines with good morphology, high yield, disease resistance, and promising in terms of biscuit quality properties were used. Grain, flour, dough, starch and product properties of lines and varieties were determined in rainfed and irrigated conditions. For this purpose in the material the physical properties of kernel, whole meal, milling, flour, solvent retention capacity properties, starch gelatinization and thermal properties, proportions of protein fractions (monomeric and polymeric glutenins), dough rheological properties (miksolab, extensograph, farinograph, alveo-consistograph), biscuit physical and sensory properties were determined. Relationships among the quality properties were suggested to breeding studies, milling industry and biscuit production sectors (Figure 4 and Figure 5).

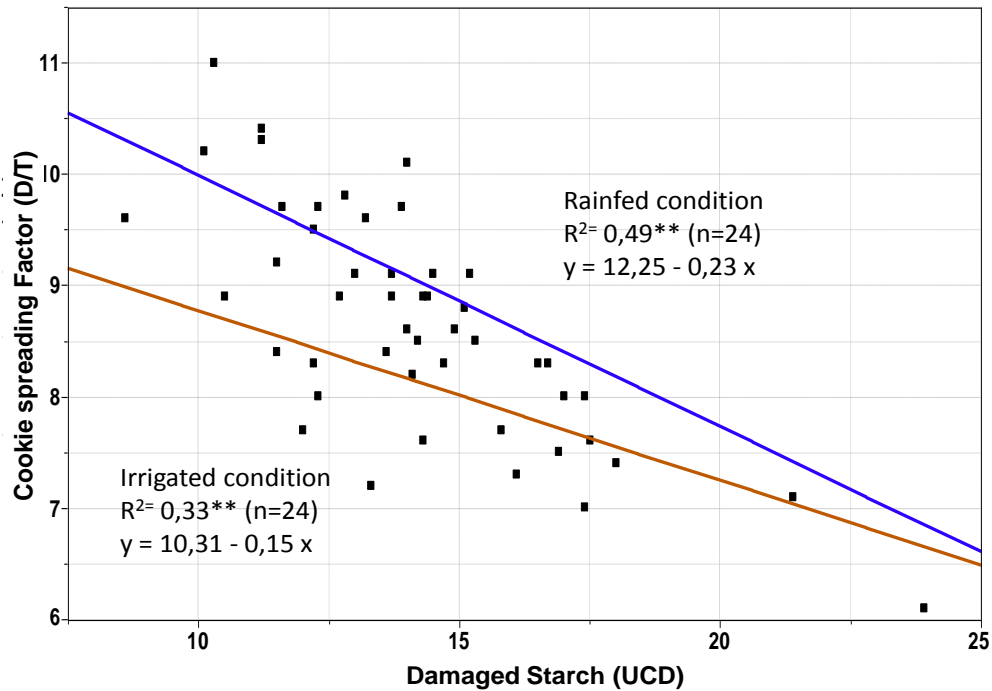


Figure 4. The relationship between damaged starch and biscuit (cookie) spreading factor in rainfed and irrigated conditions

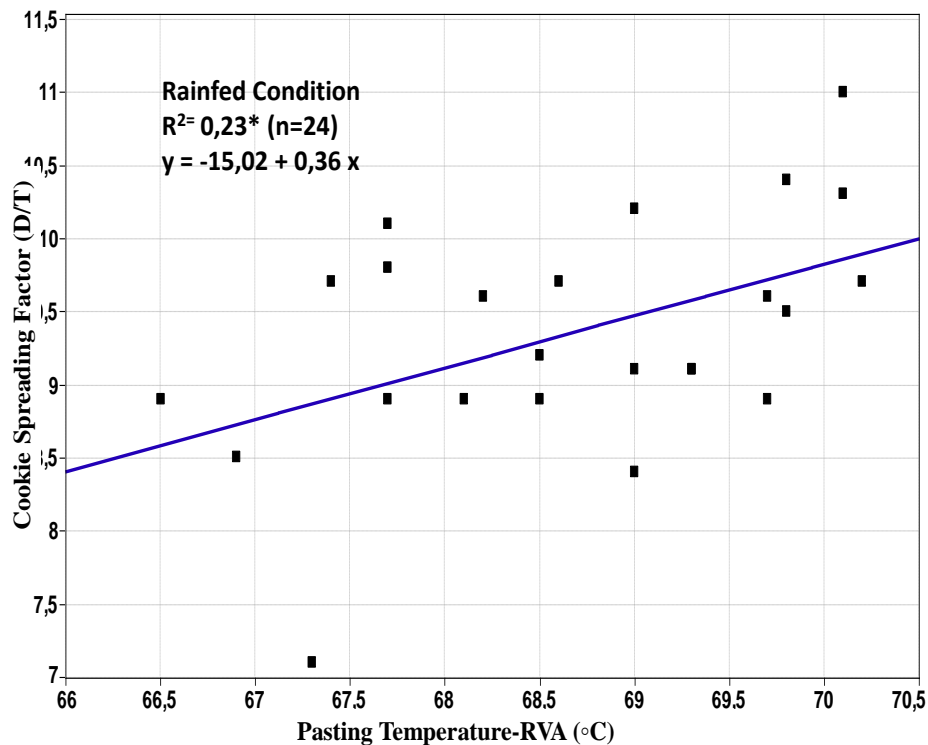
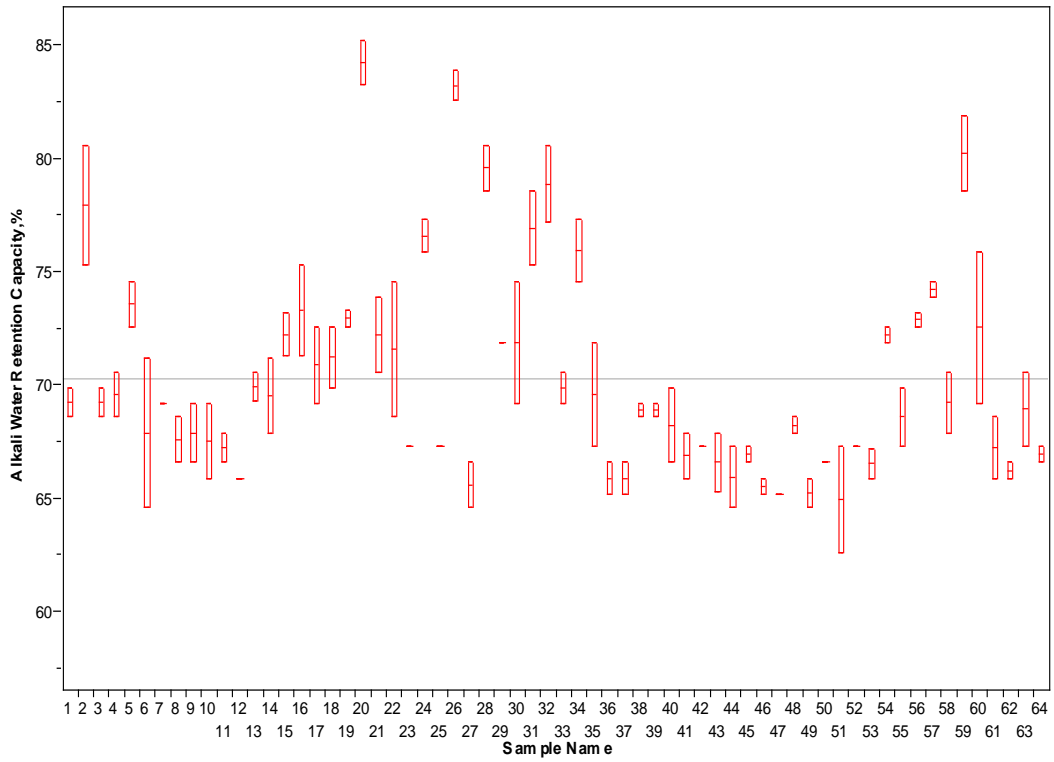
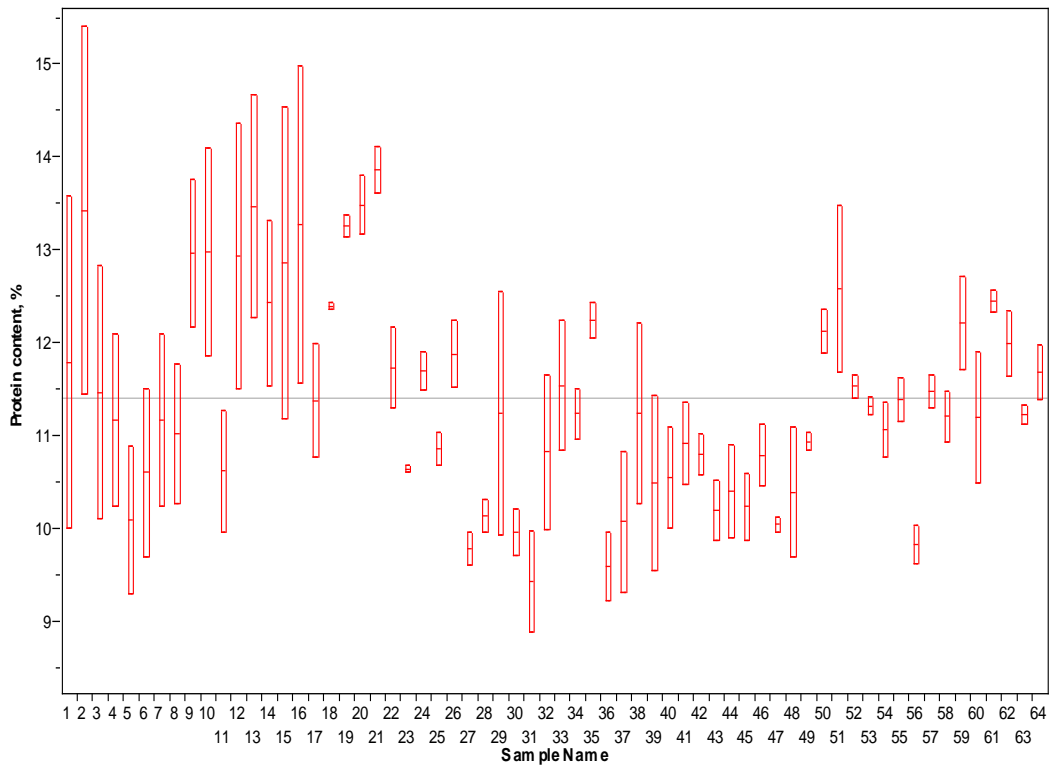


Figure 5. The relationship RVA pasting temperature and biscuit (cookie) spreading factor in rainfed condition

In 2010 and 2011 due to the importance of agronomical properties in soft wheat quality the genotypes which are not varied in terms of biscuit-making quality properties with extra nitrogen treatment were selected. The lines selected for the least variation in quality parameters with N fertilization will be used in breeding programs in the future (Figure 6 and Figure 7).



**Figure 6. Change of AWRC values in standart and additional fertilization in genotypes**



**Figure 7. Change of protein content in standart and additional fertilization in genotypes**



## CONCLUSION

**The biscuit wheat developing studies have been continued for 10 years with a biggest genetic pool of our country in Eskisehir Transitional Zone Agricultural Research Institute. In these studies the quality parameters can be used in biscuit wheat breeding studies and the relationships among them which can be used from breeders and biscuit sectors were determined. With biscuit wheat developing studies 6 lines in irrigated and 6 lines in rainfed conditions were selected to the pre registration trial. 4 lines among them are more promising in both rainfed and irrigated conditions.**

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# OPTIMIZATION OF THE DISTRIBUTION UNIFORMITY PERFORMANCE OF A SINGLE-DISC FERTILIZER BROADCASTER USING RESPONSE SURFACE METHODOLOGY

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## ABSTRACT

The objective of this study was to optimize the distribution uniformity performance of a single-disc fertilizer broadcaster. The performance indicators were considered to be the coefficient of variation (CV, %) and skewing ratio (left to right or right to left ratio of the granular material applied). Central Composite Design (CCD) which is rotatable and one of the designs in Response Surface Methodology (RSM) was used in order to optimize the distribution uniformity. Two different fertilizers (urea and triple super phosphate) were used and a total of 20 experiments for each fertilizer were conducted. In each experiment, three replications were achieved. The independent variables considered in this study were the peripheral speed of the disc (corresponding to power take-off linearly), the fertilizer flow rate and the vane angle. The dependent variables were the coefficient of variation (CV;%) and skewing ratio (either right to left or left to right distribution). Mathematical functions in polynomial form were developed based on the principles of RSM that allowed conducting reduced number of experiments as compared to full factorial design. The optimum levels of the variables were obtained and verification tests were also carried out. It was concluded that the three variables considered in this study affect the distribution uniformity performance of the broadcaster.

**Key Words:** Mathematical modeling, central composite design, Skewing, fertilizer, granular material

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## INTRODUCTION

Rotary spreaders are very simple in terms of structure but their performance in order to provide even fertilizer distribution as characterized by the coefficient of variation (CV, %) will result in net loss as described by Sogaard & Kierkegaard (1994). The lower the CV the more uniform the distribution is and this is why a minimum CV is desired. Skewing ratio is considered to be another indicator for an even distribution. The physical and chemical properties of the fertilizer being used, constructional (the shape and the position of the vanes, design of the disc, drop point of the fertilizer onto disc, etc.) and operational related variables (rpm and the flow rate) affect the distribution pattern and uniformity as it was the case in many studies available in the literature. The dimensions of the disc and the size, shape and the number of vanes vary from one company to another and each construction becomes a case study to find out the best performance. Hence, the objective of this study was to optimize the distribution uniformity performance of a single-disc fertilizer broadcaster manufactured by a local company.

## MATERIALS AND METHODS

The distributor used for this study consists of a hopper, single-disc in the diameter of 480 mm, six type vanes, gearbox and a simple frame and is driven by the power take-off.

The experiments were carried out in outdoor areas on smooth, level pavement under conditions of no wind. Prior to experiments, the flow rate of the fertilizer was adjusted by changing the area of the two orifices located on the bottom of the hopper at corresponding peripheral speed of the disc (as linearly related to power take-off of the tractor). The collection trays were 472 mm long, 312 mm wide, and 110 mm high and the trays were subdivided to reduce granule bounce. Fertilizer particles collected in each tray was weighed using a precision balance with an accuracy of 0.01 g.

Each test run consisted of three replications since three sets of collection trays were placed in a line perpendicular to the direction of travel of the spreader while enough space was left for the tractor tire pass. The distance between each set was 1.5 m. The tests were conducted at a constant forward speed of 8 km h<sup>-1</sup>. Two granular fertilizers were applied during the tests, urea and triple superphosphate. The bulk densities of these materials were 785 and 1025 kg m<sup>-3</sup>, respectively. The pattern analysis in order to determine overlapped patterns to find out CV (%) and skewing ratio was achieved in Excel and the coefficient of variation (CV, as defined by ASAE S341.3, 2004) along with skewing ratio was found. Skewing ratio was also calculated either the ratio of right to left or the left to right, whichever is lower than the unity since in ideal case the amount or the percentage of fertilizers distributed to the right or the

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left side of the spreader must be equal. For this reason Arcsin transformation to the skewing ratio values was applied to create polynomial functions. As a statistical and mathematical technique, RSM was employed in order to optimize the operating (peripheral speed of the disc and flow rate) and constructional related variables (vane angle). RSM designs are not primarily used for understanding the mechanism of the underlying system and assessing treatment main effects and interactions, but to determine, within some limits, the optimum operating conditions of a system (Myers, 1971). It is less laborious and time-consuming than other approaches and effective technique for optimizing complex processes since it reduces the number of experimental trials to evaluate multiple parameters and their interactions (Lee *et. al.*, 2006). The response surface problem usually centers on an interest in some response Y, which is a function of k independent variables  $\xi_{i1}, \xi_{i2}, \dots, \xi_{ik}$ , that is,

$$Y = f(\xi_i, \xi_j, \dots, \xi_k) \quad (1)$$

and response surface can take the different forms according to the function types of response and usually response function is defined in the quadratic polynomial form as follows.

$$Y = \beta_0 + \sum_{i=1}^k \beta_i X_i + \sum \beta_{ii} X_i^2 + \sum_i \sum_j \beta_{ij} X_i X_j + \varepsilon, \quad i \leq j \quad (2)$$

where;

Y : Response (Dependent variable)

$\beta_0$  : Intercept

$\beta_i, \beta_{ii}, \beta_{ij}$  : Regression coefficients

$X_i, X_j$  : Coded independent variables

$\varepsilon$  : Error

The coding of independent variables into  $X_i$  is expressed by the following equation.

$$X_i = \frac{\xi_i - \xi^*}{d_s} \quad (3)$$

where  $\xi_i$ =actual value in original units;  $\xi^*$ = mean value (center point) and  $d_s$ =step value.

For a better understanding and detailed theoretical knowledge on RSM, the reader is referred to read the textbook written by Box and Draper (1987). The design used in this study is a rotatable CCD and it requires five levels for each independent variable. These levels were coded -1.682, -1, 0, +1 and +1.682, respectively. The coded and uncoded levels of the variables as used in CCD are given in table 1.

Table 1. Coded and uncoded values of the independent variables used in CCD

Independent variable	Step value	Coded level				
		-1.682	-1	0	+1	+1.682
Disc peripheral speed ( $\omega$ ; $\text{ms}^{-1}$ )	3.2	11.82	14.01	17.21 <sup>v</sup>	20.41	22.59
Flow rate (Q; $\text{kg min}^{-1}$ )	15	17	28	43	58	68
Vane angle <sup>§</sup> ( $\alpha$ ; degrees)	12	-20	-12	0	+12	+20

<sup>§</sup>Minus and plus signs in angles indicate rearward and forward pitched vanes, respectively, <sup>v</sup>peripheral speed at 540  $\text{min}^{-1}$  power take-off

## RESULTS AND DISCUSSION

The results from the experiments are tabulated in Table 3. The data from 20 experiments with three replications, totally 60 data points were used to develop functions for CV ( $Y_{CV}$ ; %) and skewing ratio as  $\text{Arcsin}\sqrt{Y_r}$ . A general theoretical cubic function for four variables in full was defined and submitted to a statistical package program and stepwise regression procedure was applied in order to select the variables at a probability level of 95 %. The functions developed are given below for each fertilizer.

### Urea functions

$$Y_{CV} = 11.23 + 9.63X_3^2 - 4.68X_1X_2X_3 + 4.07X_1^2X_3 + 4.27X_2X_3 + 2.54X_1^2 + 2.26X_2^2 - 2X_1X_2 + 0.59X_3^3 + 2.19X_1X_2^2 - 0.8X_1^3 \quad R^2 = 94.4 \quad (\%) \quad (4)$$

$$\text{Arcsin}\sqrt{Y_r} = 1.28 - 0.193X_3^2 + 0.129X_1X_2X_3 - 0.137X_3 - 0.046X_2^2 - 0.059X_2X_3 - 0.042X_2 - 0.041X_1X_3 + 0.031X_3^3 - 0.036X_1X_2^2 \quad R^2 = 88.9 \quad (\%) \quad (5)$$

### TSP functions

$$Y_{CV} = 20.94 + 8.62X_1^2X_3 + 5.37X_3^2 + 3.91X_1^2 - 3.91X_1 + 2.46X_1X_2 - 2.25X_1X_3 + 2.25X_2X_3 - 0.66X_2^3 \quad R^2 = 93.9 \quad (\%) \quad (6)$$

$$\text{Arcsin}\sqrt{Yr} = 1.0722 - 0.1227X_1^2X_3 - 0.0787X_3^2 + 0.0498X_1 + 0.0553X_1X_3 - 0.0303X_1^2 - 0.0213X_2^2 \quad R^2 = 88.6 \quad (\%)$$

(7)

The models given above are written in the order that the variables entered into the model so that the significance of each term to the model could be identified from this order and they are valid under the following conditions (in uncoded levels);

$$11.82 \leq \omega \leq 22.59$$

$$17 \geq Q \geq 69$$

$$-20 \leq \alpha \leq +20$$

where;  $\omega$  = disc peripheral speed in  $\text{ms}^{-1}$ ,  $Q$  = flow rate in  $\text{kg m}^{-3}$  and  $\alpha$  = vane angle in degrees.

Some views of the RSM functions developed in this study are depicted in Figure 1 and 2.

Table 3. Performance values as obtained from the experiments based on CCD

Run number	Independent variables (in coded form)			Dependent (Performance) variables					
	Disc peripheral speed ( $X_1$ )	Flow rate ( $X_2$ )	Vane angle ( $X_3$ )	Non-overlapped CV (%) and standard deviation		Lowest overlapped CV (%) and standard deviation		Skewing ratio (either left to right or right to left ratio)	
				Urea	TSP	Urea	TSP	Urea	TSP
1	-1	-1	-1	46.11 (4.52)	29.66 (1.78)	25.72 (1.89)	24.12 (2.92)	0.67 (0.02)	0.76 (0.04)
2	1	-1	-1	43.86 (3.47)	32.12 (2.78)	12.63 (0.59)	18.50 (2.35)	0.93 (0.05)	0.78 (0.04)
3	-1	1	-1	52.03 (0.56)	26.12 (3.39)	21.18 (3.05)	24.06 (3.70)	0.91 (0.05)	0.73 (0.57)
4	1	1	-1	41.21 (2.87)	22.63 (2.84)	19.49 (2.66)	21.80 (2.73)	0.70 (0.03)	0.75 (0.03)
5	-1	-1	1	38.08 (6.01)	54.65 (2.95)	15.04 (2.11)	46.65 (3.15)	0.87 (0.06)	0.42 (0.02)
6	1	-1	1	48.89 (5.18)	53.30 (1.67)	40.11 (3.91)	39.86 (3.96)	0.47 (0.03)	0.457 (0.02)
7	-1	1	1	38.65 (1.62)	58.61 (7.61)	36.16 (4.90)	31.44 (3.06)	0.50 (0.04)	0.63 (0.03)
8	1	1	1	39.85 (2.68)	68.32 (5.09)	31.50 (3.64)	36.85 (1.23)	0.53 (0.42)	0.634 (0.03)
9	-1.682	0	0	35.25 (3.89)	46.56 (2.67)	23.05 (1.42)	38.21 (0.95)	0.91 (0.04)	0.61 (0.01)
10	1.682	0	0	48.05 (6.86)	43.35 (5.65)	15.87 (1.67)	24.43 (2.42)	0.982 (0.55)	0.78 (0.04)
11	0	-1.682	0	33.34 (5.92)	36.33 (2.81)	18.90 (1.57)	25.84 (3.03)	0.86 (0.06)	0.69 (0.01)
12	0	1.682	0	33.45 (3.29)	36.42 (1.75)	20.02 (1.12)	18.80 (1.05)	0.80 (0.05)	0.75 (0.02)
13	0	0	-1.682	65.37 (3.20)	62.02 (1.75)	36.29 (1.76)	35.47 (2.50)	0.59 (0.04)	0.58 (0.04)
14	0	0	1.682	52.29 (3.13)	36.12 (1.23)	44.35 (3.07)	33.07 (1.30)	0.38 (0.03)	0.57 (0.02)
15	0	0	0	34.62 (3.40)	29.35 (4.40)	8.61 (0.47)	19.25 (1.01)	0.95 (0.02)	0.76 (0.31)
16	0	0	0	32.55 (1.08)	31.41 (1.64)	9.80 (0.21)	21.50 (1.44)	0.90 (0.01)	0.74 (0.007)
17	0	0	0	30.02 (1.08)	27.21 (3.03)	10.65 (0.04)	19.43 (3.20)	0.91 (0.02)	0.78 (0.38)
18	0	0	0	28.63 (1.54)	31.90 (3.18)	11.65 (0.63)	20.25 (1.96)	0.91 (0.04)	0.77 (0.07)
19	0	0	0	31.45 (2.13)	27.04 (2.78)	12.73 (0.07)	18.19 (2.26)	0.87 (0.02)	0.81 (0.04)
20	0	0	0	27.62 (0.38)	29.90 (2.20)	13.29 (0.35)	20.68 (2.25)	0.91 (0.46)	0.77 (0.03)

The values in parenthesis in the above table indicate the standard error resulted from three replications.

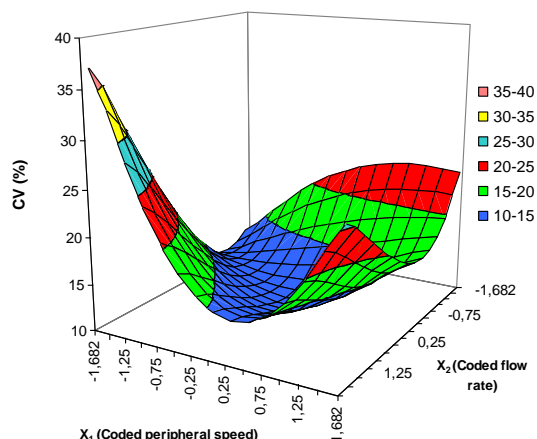


Figure 1. Variations in CV (%) as a function of flow rate and disc peripheral speed for urea

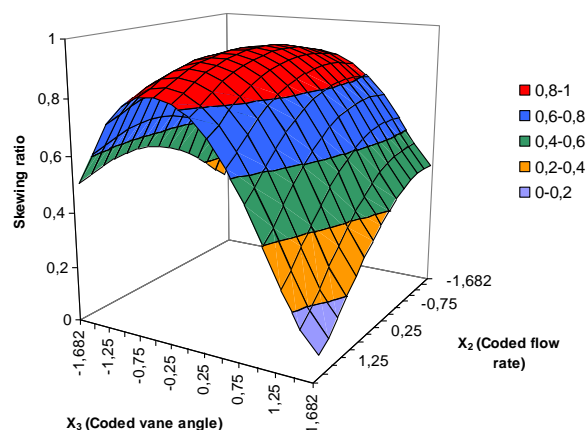


Figure 2. Variations in skewing ratio as flow rate and vane angle for urea

As seen from the polynomial functions, the variables considered in this study affect the distribution uniformity performance of the spreader. But the most significant variable seems to be the vane angle as it was observed during the tests. The other two variables also play a significant role in both, CV and skewing ratio since they were included in the models either as a main variable or as an interaction with other variables. The coefficient of determination ( $R^2$ ) of the CV models is found to be greater than the skewing ratio models and they are at acceptable levels. From the polynomial functions given above, the optimum level of the variables was found using mathematical software, Maple and a special code was written in the program in order to make the necessary calculations. The results for each fertilizer are given in Table 4 and 5.

Table 4. Optimum values of the variables obtained from the prediction functions for urea.

Model	Variables (coded and uncoded values)			Predicted distribution uniformity values
	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	
CV % Model (Equation 4)	0.0223 [17.28 ms <sup>-1</sup> ]	0.803 [55 kg min <sup>-1</sup> ]	-0.0997 [-1.1°]	12.44*
	0 [17.21 ms <sup>-1</sup> ]	0 [43 kg min <sup>-1</sup> ]	[0°]	11.23*
	-0.396 [15.94 ms <sup>-1</sup> ]	-0.684 [32.7 kg min <sup>-1</sup> ]	0.181 [2.1°]	11.46*
Skewing ratio model (Equation 5)	-0.7053 [14.95 ms <sup>-1</sup> ]	0.263 [46.9 kg min <sup>-1</sup> ]	-0.352 [-4.2°]	0.994**
	-0.5663 [15.39 ms <sup>-1</sup> ]	-0.561 [34.5 kg min <sup>-1</sup> ]	-0.1 [-1.2°]	0.993**

\*Calculated CV (%) from the model at optimum levels; \*\* Calculated skewing ratio from the model at optimum levels

Table 5. Optimum values of the variables obtained from the prediction functions for TSP

Model	Variables (coded and uncoded values)			Predicted distribution uniformity values
	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	
CV % Model (Equation 6)	0.581 [19.06 ms <sup>-1</sup> ]	0.633 [52.5 kg min <sup>-1</sup> ]	-0.282 [-3.3°]	20.298*
	0.451 [18.65 ms <sup>-1</sup> ]	0.585 [51.7 kg min <sup>-1</sup> ]	-0.191 [-2.2°]	20.292*
Skewing ratio model (Equation 7)	-0.555 [15.43 ms <sup>-1</sup> ]	0 [43 kg min <sup>-1</sup> ]	-0.435 [-5.2°]	0.892**

\*Calculated CV (%) from the model at optimum levels; \*\* Calculated skewing ratio from the model at optimum levels

One of the steps in this type of optimization problems is to verify the optimum level of the variables and for this purpose some verification tests were achieved after calculating the optimum level of the variables and the findings from these tests are given in table 6 and 7 for urea and TSP, respectively.

**Table 6. Verification test\* results for urea**

Model	Variables	Calculated performance values from the equations	CV values obtained from the verification tests (three replications)	Skewing ratio values obtained from the verification tests (three replications)
CV % Model (Equation 4)	X <sub>1</sub> =0.0223	CV=12.44 %	13.84	0.94
	X <sub>2</sub> =0.803		14.29	0.96
	X <sub>3</sub> =-1.1°		14.57	0.99
CV % Model (Equation 4)	X <sub>1</sub> =0	CV=11.23 %	12.73	0.9
	X <sub>2</sub> =0		13.25	0.91
	X <sub>3</sub> =0		13.54	0.99
CV % Model (Equation 4)	X <sub>1</sub> =-0.396	CV=11.463 %	14.81	0.92
	X <sub>2</sub> =-0.684		13.30	0.93
	X <sub>3</sub> =0.181		11.68	0.96
Skewing ratio model (Equation 5)	X <sub>1</sub> =-0.705	Skewing ratio: 0.994	13.88	0.90
	X <sub>2</sub> =0.263		13.10	0.98
	X <sub>3</sub> =-0.352		13.65	0.96
Skewing ratio model (Equation 5)	X <sub>1</sub> =-0.5663	Skewing ratio: 0.993	16.37	0.91
	X <sub>2</sub> =-0.561		14.15	0.90
	X <sub>3</sub> =-0.1		15.57	0.99

\*Swath width in all verification tests was found to be 10.16 m

**Table 7. Verification test\* results for TSP**

Model	Variables	Calculated performance values from the equations	CV values obtained from the verification tests (three replications)	Skewing ratio values obtained from the verification tests (three replications)
CV % Model (Equation 6)	X <sub>1</sub> =0.581	CV=20.29 %	19.63	0.81
	X <sub>2</sub> =0.633		20.05	0.75
	X <sub>3</sub> =-0.282°		17.46	0.85
Skewing ratio model (Equation 7)	X <sub>1</sub> =-0.555	Skewing ratio:0.892	18.20	0.77
	X <sub>2</sub> =0		18.00	0.77
	X <sub>3</sub> =-0.435		15.90	0.81

\*Swath width in all verification tests was found to be 10.16 m

As seen from the tables, the optimum levels of the variables found from the CV models are in good agreement as they were verified by the verification tests. It should be kept in mind that this study should be considered as a case study since any changes in constructional variables or the size and the shape of the vanes will significantly affect the distribution uniformity.

## CONCLUSIONS

**This study demonstrated that the vane angle is a significant constructional variable while the two operational related variables (disc peripheral speed and flow rate) affect the distribution uniformity. The CV (%) and skewing ratio as the indicators of the distribution uniformity are very sensitive and vary within a wide range once a small change is made in vane angle. The performance tests for any manufactured fertilizer distributor can be tested by conducting an RSM based study since standard test procedures may not help finding the optimum level of the variables and the lowest CV (%) and a skewing ratio of unity.**

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# ASSESSING CLIMATIC STRESS EFFECTS ON APPLE (*Malus domestica* Borkh.) USING VARIOUS PLANT BASED METHODS

Endrit KULLAJ<sup>1</sup> Fadil THOMAJ<sup>1</sup>

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## ABSTRACT

Apple cultivation in Albania is spreading beyond its typical areal toward the hot coastal areas, where lack of water makes compulsory accurate scheduling and precise irrigation management. The object of this study was to study the effect of multiple climatic stresses of high radiation and temperature under this cultivation regime with high radiation and temperatures for the purposes of programming its Regulated Deficit Irrigation. The study was conducted during 2011 – 2012 on a commercial orchard of 3 ha, central leader system, on the 6th year, in the area of Lushnja, one of the hottest spots in Albania. Sap flow sensors and dendrometers were installed on trunks of 5 trees of this cultivar, measuring sap flow and trunk diameter variation during the hottest period of the year. Meteorological variables were also measured to calculate evapotranspiration (ET) and vapour pressure deficit (VPD). Analysis of data showed a relatively homogenous fluctuation of meteorological variables during the studied period. Global radiation levels were constant. Although of little difference, air temperature was higher during 2011 in the first part of the studied period reaching levels close to 36°C. During 2012, air humidity was more variable during the day compare to the same period during 2011. VPD, ET as well as the difference between air and leaf temperatures were high, leading to significant stress.

Key Words: Sap Flow, Trunk Diameter Variation (TDV), Evapotranspiration (ET), Vapour Pressure Deficit (VPD)

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## INTRODUCTION

Apple (*Malus domestica* Borkh.) is the most important fruit species cultivated in Albania. The typical areal of cultivation is the North- and Central-Eastern part of the country, with a continental climate. There, apple is found on large mountainous plains at 800 m altitude. However, to benefit from the advantages of earliness and vicinity with the markets of main cities, there is a growing trend of cultivating it in the coastal lowlands, outside of its typical and optimal areal of cultivation (Kullaj et al. 2012). In this new areal, apple trees are subjected to high levels of radiation and temperatures, therefore multiple climatic stresses, affecting their carbon balance and therefore productivity. The main cultivar in the Western Plain is Golden Delicious (GD) on M9 (EMLA).

The lack of water makes compulsory accurate scheduling and precise irrigation management (Feres and Evans, 2006; Fernandez, et al. 2011) and a body of research is recently invested into new irrigation technologies, efficient scheduling approaches and assessment of the onset and severity of water stress (Jones, 2004; Naor, 2006; Fernandez, 2011). Moreover, slight plant water deficits can improve the partitioning of carbohydrate to reproductive structures such as fruit and also control excessive vegetative growth (Chalmers et al., 1981), giving rise to 'Regulated Deficit Irrigation' (RDI) (Chalmers et al., 1986) as 'regulated deficit irrigation' (RDI). Achievement of successful RDI depends on accurate soil moisture or plant 'stress' sensing, and requires an ability to irrigate 'little and often' on demand (Jones, 2004).

There are various plant based methods for assessing water stress, among them Sap Flow (SF) and Trunk Diameter Variations (TDV) applied in a variety of fruit tree species (Fernández and Cuevas, 2010; Ortuño et al., 2010). Several authors have explored the relations between SF, TDV and several other indicators of plant water status such as the plant water potential and gas exchange (Goldhamer et al., 1999; Cohen et al., 2001; Remorini and Massai, 2003; Conejero et al., 2007), (Ortuño et al., 2006a,b), (Intrigliolo and Castel, 2006).

As other authors (Drew and Downes, 2009; Fernández and Cuevas, 2010; Steppe et al., 2006, 2008a,b), Čermák et al., 2007 and Sevanto et al., 2008), we have assumed that the water-flow dynamics within a plant can be better assessed by combining information from SF and TDV records.

The object of this study was to assess the effects of multiple climatic stresses of high radiation and temperatures for the purposes of implementing a RDI regime.

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## MATERIALS AND METHODS

The study was conducted during 2011 and 2012 on a 3 ha commercial apple orchard, central leader system, with M9 EMLA rootstock, on the 6th year, located in Lushnja, one of the hottest spots in Albania. Sap flow sensors (SF) EMS 51 (EMS Brno, CZ [www.emsbrno.cz](http://www.emsbrno.cz)), used to measure sap flow based on THB (trunk heat balance) method (Lindroth et al. 1995, Čermák et al. 2004), were installed on trunks of 5 trees following instructions of the manufacturer. The measuring interval was every minute with 1 s warm-up and storing interval every 15 minutes. Day-to-day variability in sap flow was smaller than tree-to-tree variability. In the same trees, two dendrometers DR 26 (EMS Brno) measured the TDV, at 20 cm from soil and at the central leader (2.4 m). Both SF and TDV are important for irrigation decision-making. Gypsum block's sensors were used to measure Soil Water Potential (SWP) at two different depths, 10 and 20 cm respectively. A portable leaf porometer (Decagon Devices) was used to measure leaf temperature (LT) and conductance (LC) during selected days on ten leaves with exposed and non-exposed to the sun. A portable meteorological station Minikin RTHi (EMS Brno, CZ) measured the global radiation, temperature and relative humidity. Programmed calculation of PET (Penman – Monteith) and VPD was implemented into Mini32 software (EMS Brno). Irrigation was applied every 2 – 4 days at 100 ET in order to do not subject the trees to water stress. Biometric measurements of canopy elements were used to relate them to the sap flow and dendrometer measurements, as trunk cross-sectional area (TCSA) for branches. Length of branches was measured too. Changes in microclimatic variables separated by a paired  $t$ -test at  $\alpha = 0.01$  and their correlation using Pearson's correlation coefficient ( $r$ ). Sap flow and climatic data (SP, TDV, LT, LC) were subject to linear regression analysis for their relationship.

## RESULTS

Figures 1, 2 and 3 show the intra- and inter-annual variation in meteorological variables driving sap flow and transpiration of apples trees.

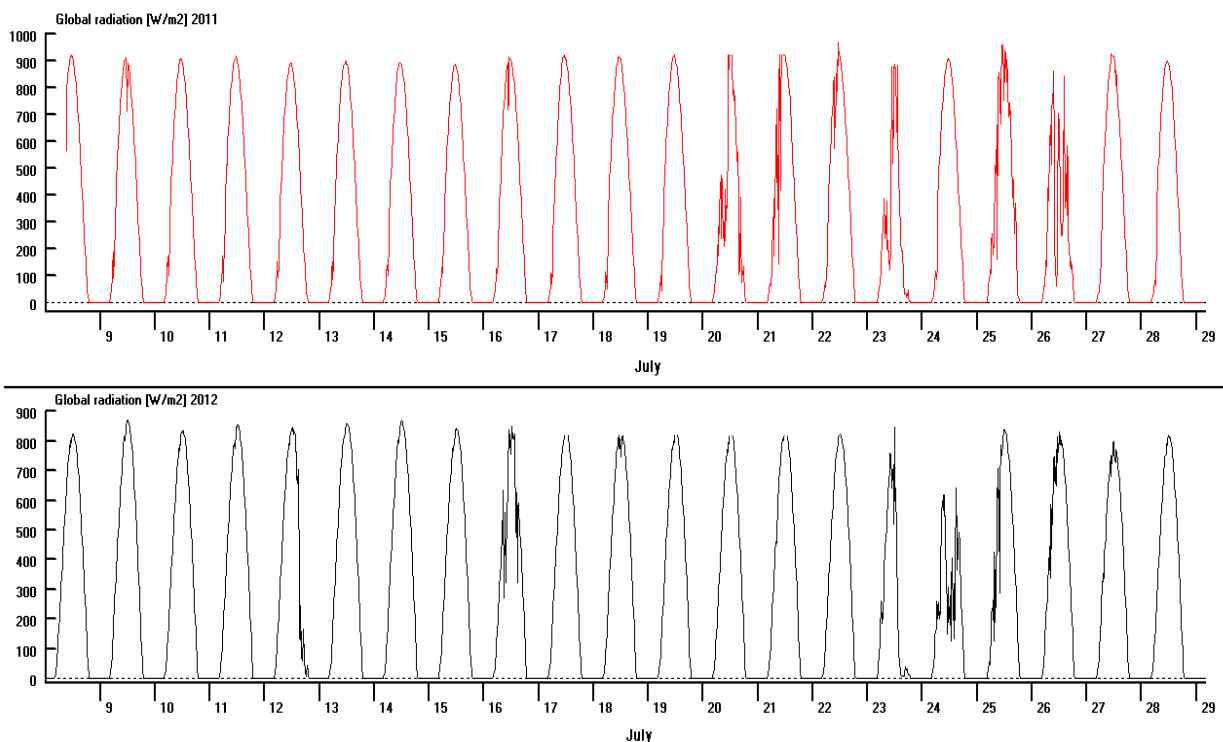


Figure 1. Global radiation in the orchard site during the study (2011 – 2012)

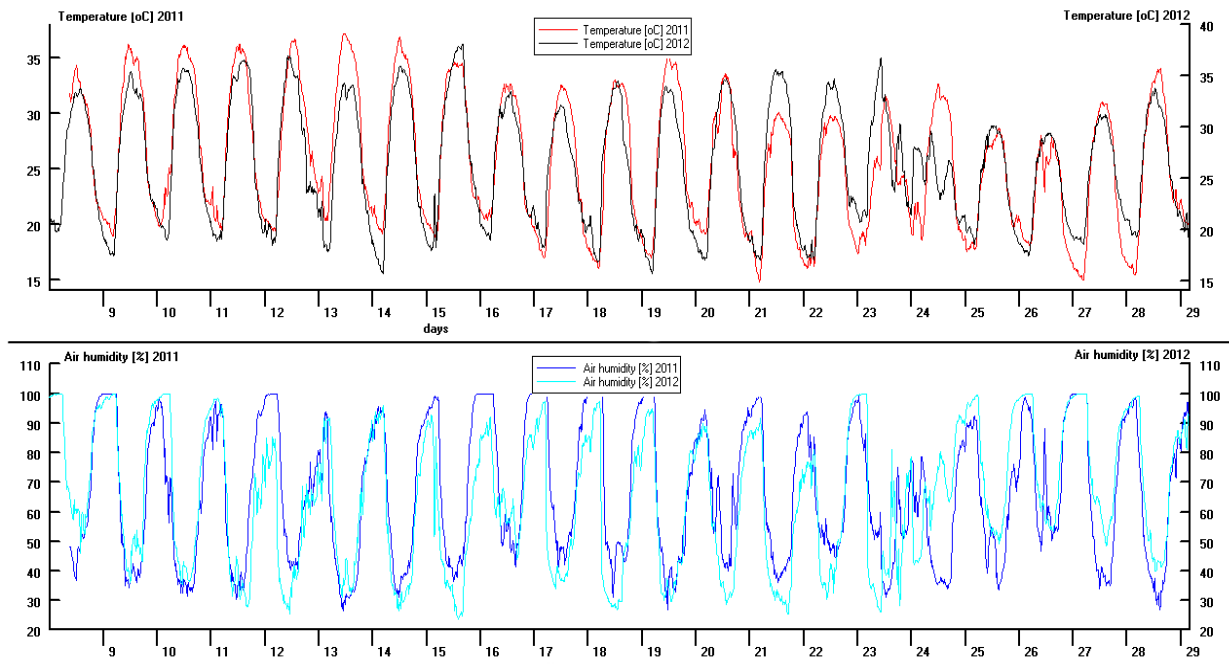


Figure 2. Air temperature and humidity in the orchard site during the study (2011-2012)

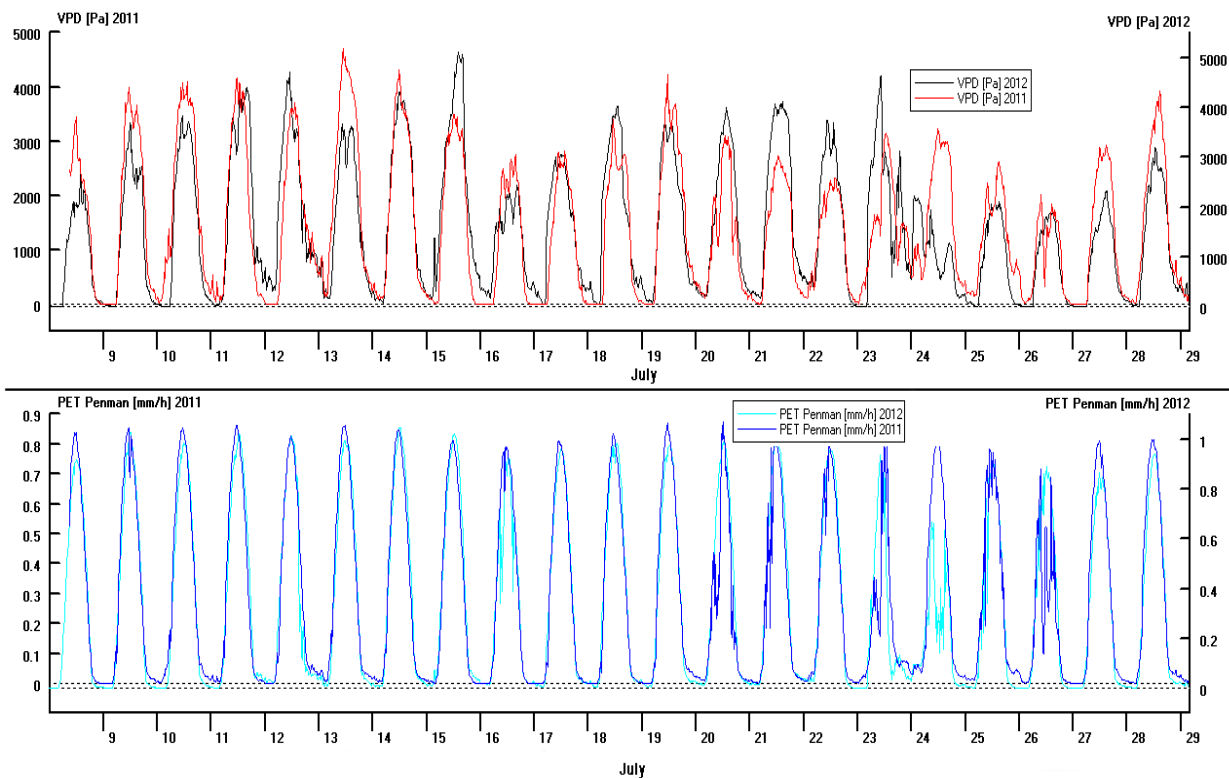


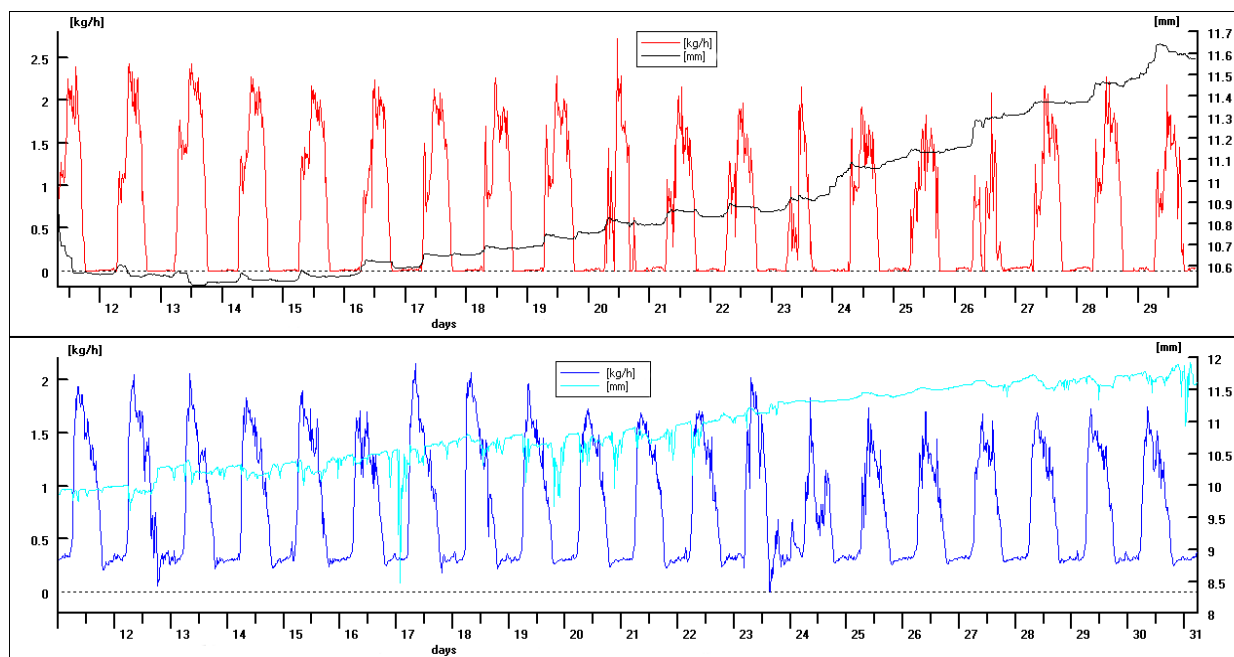
Figure 3. Vapour Pressure Deficit (VPD) and Potential Evapotranspiration (PET) in the orchard site during the study (2011 - 2012)

Other plant microclimatic variables are shown in Table 1, in particular the difference between the air temperature and leaf temperature, which is a good plant-stress based indicator of water stress.

Microclimatic parameters shown in Table 1 varied within and between trees, especially leaf conductance. However, changes between sunny and shadow leaf positions were significant ( $t_{\text{observed}} = 7.33$ ,  $t_{\text{critical}} = 3.25$ ). Leaf temperature and conductance were not highly correlated ( $r = 0,62$ ).

**Table 1. Microclimatic parameters of Golden Delicious apple canopies**

Date and hour	Global radiation (W/m <sup>2</sup> )	Air Humidity (%)	Air Temperature (°C)	Leaf Temperature (°C)	Leaf Conductance (mmol/m <sup>2</sup> s)	Leaf position (L-sunny; D-shadow)
<b>June 1<sup>st</sup></b>						
10:21 AM	767.2	51.96	25.88	33.5	567.8	L
10:22 AM	769.2	51.87	25.76	33.0	883.4	L
10:23 AM	770.5	51.66	25.81	32.5	372.6	L
10:24 AM	771.4	51.57	25.91	32.2	551.2	L
10:25 AM	773.1	51.48	26.12	32.0	683.4	L
10:27 AM	774.2	51.12	26.32	31.7	381.7	D
10:28 AM	776.5	50.87	26.43	31.1	462.6	D
10:29 AM	777.7	50.67	26.21	30.4	327.1	D
10:30 AM	778.3	50.55	26.18	29.9	181.4	D
10:31 AM	779.5	50.95	26.38	29.5	234.5	D
<b>June 15<sup>th</sup></b>						
11:44 AM	515.31	60.21	27.94	32.1	599.2	L
11:46 AM	510.02	61.56	27.61	32.9	701.9	L
11:47 AM	510.01	61.65	27.70	32.7	418.2	L
11:48 AM	509.45	61.87	27.53	32.7	487.8	L
11:50 AM	507.98	61.84	27.34	32.6	460.9	L
11:51 AM	506.35	61.93	27.23	32.2	199.4	D
11:52 AM	504.98	62.23	27.30	31.8	122.7	D
11:53 AM	503.35	62.38	27.18	31.4	143.4	D
11:54 AM	502.18	62.57	27.11	31.2	126.3	D
11:55 AM	501.02	62.83	27.03	31.1	133.3	D



**Figure 4. Sap flow (kg/h) and trunk diameter variation (mm) during the study (2011-2012)**

**The data in Figure 4 demonstrates that apple trees respond to relatively mild water stress.**

## DISCUSSIONS AND CONCLUSIONS

Analysis of meteorological variables shows a relatively homogenous diurnal fluctuation during the studied period without meteorological events like rains or cloud cover. Global radiation levels were constant around 900 W/m<sup>2</sup> (Figure 1). Although of little difference, air temperature was higher during 2011 in the first part of the studied period reaching levels close to 36°C (Figure 2). During 2012, air humidity was more variable during the day compare to the same period during 2011 (Figure 2).

Although informative, global radiation, air temperature and air humidity separately doesn't offer us too much information about the stress, in particular water stress, under which the apple trees are subjected. Better indicators are VPD and ET which show relatively high values for apple growing (Figure 3).

VPD drives the outflow of water from the leaves to the air and under this hot growing regime the values of leaf conductance are high.

Sap flow values were highly correlated with evapotranspiration ( $R^2 = 0.86$  for 2011 and  $R^2 = 0.82$  for 2012), indicating the potential use of the technique for irrigation scheduling. This is confirmed by other similar studies using other apple cultivars (Domi et al. 2012).

In the field, sap flow measurements were highly correlated with micrometeorological parameters ( $R^2 = 0.92$  for 2011 and  $R^2 = 0.95$  for 2012), indicating that water use could possibly be estimated directly from micrometeorological data. In situ measurements of whole-plant water use in apple trees by sap flow methods are useful for understanding whole plant physiology and potentially invaluable to irrigation management in apple orchards. The results reported here proved that minimal changes of the plant water status caused by changes in the weather variables or soil water content can be monitored by the sap flow sensors.

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# A SURVEY OF STORAGE PESTS PARASITIDS (HYMENOPTERA) IN IRAN

Hosseinali LOTFALIZADEH<sup>1</sup> Farnaz HOSSEINI<sup>2</sup>

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## ABSTRACT

Agricultural stored products threaten by several storage insect pests with about 6-10% reduction in Iran. These storage pests mostly belong to Coleoptera and Lepidoptera that be attacked by several species of natural enemies especially hymenopterous parasitoids. This survey was carried out to identify the species of Hymenoptera associated with storage pests. Ten parasitic wasps belong to three superfamilies Bethyloidea (two species on small beetles), Chalcidoidea (six species on coleopterous pests) and Ichneumonoidea (two species on lepidopterous pests) were listed for Iranian fauna. These parasitoids are as follow: Two bethylids species *Cephalonomia tarsalis* (Ashmead) and *Laelius anthrenivorus* Trani; two braconids *Bracon hebetor* Say and *Bracon brevicornis* (Wesmael); six pteromalids species *Anisopteromalus calandrae* (Howard), *Dinarmus vagabundus* (Timberlake), *Lariophagus distinguendus* (Förster), *Pteromalus* sp., *Theocolax elegans* (Westwood), *T. formiciformis* Westwood. Within these parasitoids, *A. calandrae* is a well known cosmopolitan parasitoid of Anobiidae and Bruchidae (Coleoptera) associated with stored products in Iran that is widely distributed. Biological associations for the Iranian species are presented, and geographical distribution and biological data are summarised.

**Key Words:** Insects, biological control, stored products, natural enemy.

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## INTRODUCTION

Agricultural products attack by different groups of pests that cause a huge drop off it. These pests destruction may be happened in different stages of plant phenology. One of important groups are post harvesting pests that may infests products in storage condition. This group mostly belongs to the coleopterous and lepidopterous orders. Based on available literatures this damage may be reaches about 6 to 10% (Bagheri-Zenouz, 1986; Maroof, 2002). Stored products commodities are vulnerable to infestation by many species of arthropods and insects cause great losses in stored grain and milled cereal products. The activity of stored-product pests may be associated with weight losses and presence of allergens or toxinogenic fungi in the infested stored products.

Contact insecticides and fumigants are the primary ways used for controlling these pests. However, the chemical control of these pests has many limitations because of pesticide residues that can occur in stored edible products. On the other hand, high mammalian toxicity of Phosphine (Willers, 1999), and a pending ban of Methyl bromide, therefore studies on possibilities of biological control of these pests are of great need to develop an integrated pest management approach.

The use of biocontrol agents to control of pests is well established in agricultural and horticultural ecosystems but in post-harvest condition is limited. Due to many reasons especially its compatibility with other IPM methods, this technique gradually occupied stored product IPM (Haines, 1974, 1984; Schöller and Flinn, 2000; Flinn and Hagstrum, 2001; Eliopoulos *et al.*, 2002).

Insect pests of stored products are attacked by a variety of natural enemies especially hymenopterous parasitoids that are natural components of storage ecosystems. The use of predators and parasitoids for biological control of stored product pests has been studied by many authors (Waterston, 1921; Haines, 1991; Anonymous, 1995; Johnson *et al.*, 2000; Flinn and Hagstrum, 2001; Fursov, 2002), and an overview is given by Schöller and Flinn (2000). During the last 100 years more than 1000 publications have dealt with biocontrol agents of storage pests (Schöller, 1998; Eliopoulos *et al.*, 2002). To date, 58 species of predators and parasitoids of 79 stored-product pests have been studied experimentally (Schöller, 1998).

In Europe, however, only few of these species are available on a commercial level such as *Trichogramma evanescens* Westwood, *Bracon hebetor* (Say) and *Lariophagus distinguendus* Förster that are mass-produced in Germany (Adler, 2004).

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Esmaili *et al.* (1994), Eslami (1998), Habibpour *et al.* (2002), Assemi and Shojai (2004), Kazemi *et al.* (2004) have reported some parasitoids on stored product pests in Iran. But in order to develop biological control methods sufficient knowledge must be gained on biotic regulators of stored product insect populations. Therefore, this research aimed to identify parasitic wasps of stored products in Iran and support some biological and geographical data.

## MATERIALS AND METHODS

The survey was conducted during 2008 to 2012 on a wide range of products stored in varying quantities and different types of storage facilities. It was also belong to low to high quantities in different storages conditions such as farm store, flourmills, household, warehouse and silos. Samplings were made from different stored products such as grains, flour, legumes, dried fruits from different localities in Iran. Insects were originally collected from storage areas in East-Azarbaijan, Kermanshah, Kurdistan, Qazvin, Mazandaran, North-Khorasan and Sistan-Baluchestan provinces.

Infested samples of different localities were conserved separately in a plastic container of 2 litter. Rearing was made at  $25\pm 2^{\circ}\text{C}$  and  $70\pm 10\%$  RH. The containers were examined daily to separate emerged parasitoids.

Identification of reared Hymenoptera were done using Bouček and Rasplus (1991), Graham (1969), Terayama (2003) and Tobias (1995). Previously reported species were included in this list.

## RESULTS AND DISCUSSION

In this study eight parasitic wasps were identified from three hymenopterous superfamilies: Bethyloidea, Chalcidoidea and Ichneumonoidea (Table 1). Most of them includes to second superfamily that attacks coleopterous storage pests. The family Pteromalidae include 60% of identified species (Figure 1).

Table 1. Parasitoids of storage pests in Iran.

Superfamily	Family	Species
Bethyloidea	Bethylidae	<i>Cephalonomia tarsalis</i> (Ashmead)
		<i>Laelius anthrenivorus</i> Trani
Chalcidoidea	Pteromalidae	<i>Anisopteromalus calandrae</i> (Howard)
		<i>Dinarmus vagabundus</i> (Timberlake)
		<i>Lariophagus distinguendus</i> (Förster)
		<i>Pteromalus</i> sp.
		<i>Theocolax elegans</i> (Westwood)
		<i>Theocolax formiciformis</i> Westwood
Ichneumonoidea	Braconidae	<i>Bracon brevicornis</i> (Wesmael)
		<i>Bracon hebetor</i> Say

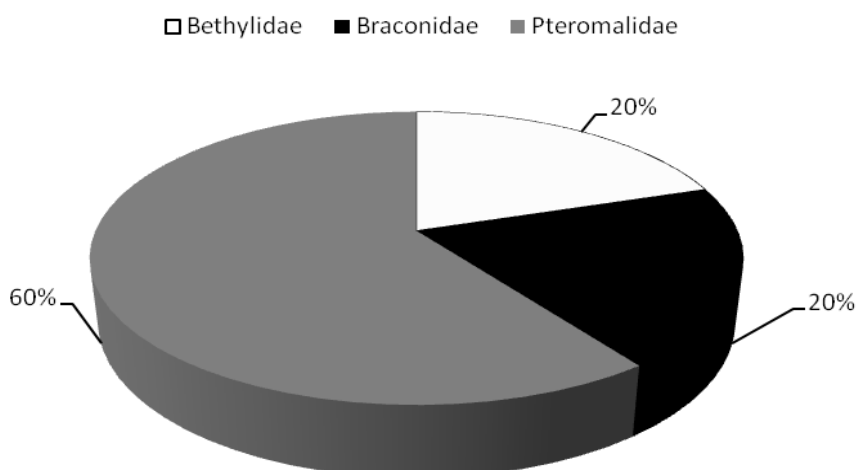


Figure 1- Composition of storage pests parasitoids (Hymenoptera) in Iran.

### I- Family Bethylidae

The family Bethylidae, belonging to Bethyloidea and known as a group of primitive aculeate Hymenoptera, is widely distributed from the tropics to the subarctic regions of the world (Terayama, 2003). Most species are external parasites of lepidopterous and coleopterous larvae.

Two species of this genus was reared on stored products pests in Iran.

#### 1- *Cephalonomia tarsalis* (Ashmead)

Material examined: East-Azarbaijan, Marand, 1.i.2010, ex *Oryzophilus surinamensis* on rice, H. Lotfalizadeh leg., 4 ♂♂. North-Khorasan province, Esfarayen, ii.2011, ex *Callosobruchus maculatus*, M. Lal-Haghi leg. 1 ♀ & 4 ♂♂.

*Cephalonomia tarsalis* can parasitize either larvae or pupae of the sawtoothed grain beetle, *O. surinamensis*; but the larvae are more commonly attacked. Although this species reportedly uses several different stored product beetle hosts (Powell, 1938).

*Cephalonomia* is a genus of parasitoids of the larvae and pupae of small cryptic beetles that feed upon stored products, bark and fungi. This can be distinguished by following characters: Antenna with 12 segments; notauli absent; radial vein absent, median vein almost with the same width from anterior to posterior end, not broaden at the mid-length, or median vein obscure, anal vein obscure to absent.

#### 2- *Laelius anthrenivorus* Trani

This species was reported from Iran (Habibpour *et al.*, 2002), France and Italy (Vikberg and Koponen, 2005) as parasitoid of the family Dermestidae (Coleoptera). It can be distinguished by yellowish red femora; lacking notauli; infumate fore wing apically (Vikberg and Koponen, 2005).

The genus *Laelius* Ashmead, 1893, is represented worldwide by 30 species, 20 of them recorded from the Palaearctic region, six from the Nearctic region, two from Afrotropical region and two from the Oriental region (Barbosa and Azevedo, 2010).

### II- Family Braconidae

Generally braconids are solitary endoparasitoids that attack young host larval instars and leave their host before it reaches maturity. The genus *Bracon* Fabricius, which is one of the largest genera in the subfamily Braconinae, has about 800 species world widely and of those 300 species are Palaearctic species (Tobias, 1995). It is a difficult genus of the Hymenoptera need a modern revision. Two species of this family have been found in Iran as parasitoids of lepidopterous storage pests.



### 3- *Bracon brevicornis* (Wesmael)

This species is closely related to another common species, *Bracon hebetor*, from which it can be identified by the following characters: Antenna of female with 15-18 segments, slightly longer than length of head and mesosoma combined; antennal segments of male 22-27. Setae of vertex more adpressed, mostly not reaching above upper level of posterior ocellus; vein 3-SR of fore wing 1.2-1.8 times vein r.

This species was reported by Habibpour *et al.* (2002) from Iran.

### 4- *Bracon hebetor* Say

Material examined: East-Azarbaijan, Marand, ex *Ephestia kuehniella*, H. Lotfalizadeh leg., 3 ♀♀ & 2 ♂♂.

*Bracon (Habrobracon) hebetor* is a common ectoparasitoid reported on 72 host species. The first report of this species from Iran dates back to 1973 as a parasitoid of Indian meal moth (Lep.: Pyralidae) (Bagheri-Zenouz, 1973). *Bracon hebetor* is widely distributed in the Australasian, Palaearctic, Ethiopian, Nearctic, Neotropical, Oriental and Oceanic regions (Yu *et al.*, 2005).

It can be identified by the following characters: Antenna of female with 13-14 segments, shorter than length of head and mesosoma combined or of equal length; antennal segments of male 20-23. Setae of vertex erect, reaching above upper level of posterior ocellus; vein 3-SR of fore wing 0.9-1.2 times vein r, rarely up to 1.4 times.

## III- Family Pteromalidae

The family Pteromalidae with 618 genera is one of the largest families among parasitic Hymenoptera of the superfamily Chalcidoidea. It includes important natural enemies of many harmful insects widely distributed in major insect orders such as Coleoptera, Diptera, Lepidoptera, Hymenoptera and Homoptera. This family is one of well known parasitic group in Iran with more than 80 species (Lotfalizadeh and Gharali, 2008). It belongs most of storage pests parasitoids (six species).

Table 2 shows parasitic wasps of this family attack wide range of hosts of the coleopterous families Anobiidae, Bostrychidae, Bruchidae, Dryophthoridae, Silvanidae, Tenebrionidae and lepidopterous family Gelechiidae.

### 5- *Anisopteromalus calandrae* (Howard)

Material examined: Kermanshah province, Kanghavar, viii.2009, ex *Callosobruchus maculatus*, M. Kahrarian leg. 5 ♀♀ & 4 ♂♂. Qazvin province, vii.2009, ex *Bruchus piosrum*, A. Zarnegar leg., 8 ♀♀ & 3 ♂♂. North-Khorasan province, Esfarayen, ii.2011, ex *Callosobruchus maculatus*, M. Lal-Haghi leg. 10 ♀♀ & 9 ♂♂. Mazandaran province, Babolsar, vi.2011, ex *Lasioderma serricorne*, N. Vakhideh, 7 ♀♀ & 7 ♂♂. Sistan-Baluchestan province, Sarbaz, vii.2009, ex *Callosobruchus maculatus*, N. Khiabani leg. 5 ♀♀ & 4 ♂♂.

*Anisopteromalus calandrae*, as parasitoid of *Callosobruchus maculatus* F. (Col.: Bruchidae), is a well-known cosmopolitan parasite of various beetles in stored grains pests (Bouèek and Rasplus, 1994). This common species has a wide distribution and reported from all arctics.

### 6- *Dinarmus vagabundus* (Timberlake)

This species parasitizes three bruchids in Iran (Eslami, 1998). Some of important morphological characters are as follow: Head and mesosoma black without metallic reflection, head finely and closely reticulate, anterior margin of clypeus weakly emarginate, scape reaching median ocellus, pedicel as long as F1, forewing without marginal fringe, post marginal vein as long as stigmal vein.

#### 7- *Lariophagus distinguendus* (Förster)

Material examined: East-Azarbaijan province, Tabriz, 30.i.2010, ex *Tribolium* sp., 10 ♀♀ & 4 ♂♂. Same locality, ix.2008, *Sitophilus granarius*, H. Lotfalizadeh leg., 5 ♀♀ & 2 ♂♂. Mazandaran province, Babolsar, vi.2011, ex *Oryzophilus surinamensis*, N. Vakhideh, 10 ♀♀ & 7 ♂♂. Qazvin province, ix.2008, ex *Bruchus piosrum*, N. Jalilvand, 6 ♀♀ & 2 ♂♂.

This is common species is widely distributed world widely. It parasitises various beetle species of the families Bruchidae, Dryophthoridae, Silvanidae and Tenebrionidae. It can be separated by combination of following characters: having two spurs, convex thorax, swollen lower face, emarginate clypeal margin.

Reppchen *et al.* (2001) believe *L. distinguendus* is a promising candidate for the biological control of *Sitophilus granarius* and other stored-product pest beetles. It is a generalist, solitary ectoparasitoid of larvae and pupae of at least 11 beetle species that develop mostly inside grains and seeds including the granary weevil *S. granarius*, one of the economically most important pests of stored grain. Based on the literatures this polyphagous species shows distinct preferences for older hosts in general and fertilized eggs are laid in host larvae older than 15 days. During parasitism, the female of *L. distinguendus* lays one egg beside the host into the grain. The female parasitoid is able to discriminate between healthy grains and grains infested by its host. Its commercial products are available for the biological control of stored product pests, especially of the granary weevil in some countries such as Germany. This potential natural enemy is able to significantly suppress the population growth of stored-product pest weevils and reduces 79-94% of *S. granarius* during a period of seven months. It is widely distributed in all of arctics (except Afrotropical region) (Noyes, 2012).

#### 8- *Pteromalus* sp.

In the family Pteromalidae, the genus *Pteromalus* includes 502 species that have not a reliable identification key. The indetimed species was reported by Habibpour *et al.* (2002).

#### 9- *Theocolax elegans* (Westwood)

Material examined: East-Azarbaijan province, Tabriz, 30.i.2010, ex *Oryzophilus surinamensis*, M. Balavar leg., 10 ♀♀. Mazandaran province, Babolsar, ex *Lasioderma serricorne*, N. Vakhideh, 10 ♀♀ & 7 ♂♂.

The genus *Theocolax* Westwood belongs to subfamily Cerocephalinae and has eight described species in the World (Noyes, 2012). *Theocolax elegans* is a cosmopolitan parasitoid of stored products and it was reported from south-west of Iran (Khuzestan province) (Habibpour *et al.*, 2002; Lotfalizadeh and Gharali, 2008). It was applied for biological control of pest species of families Anobiidae, Bostrichidae, Chrysomelidae, Curculionidae and Gelechiidae (Graham, 1969).

#### 10- *Theocolax formiciformis* Westwood

This species has been reported by Assemi and Shojai (2004) from Mazandaran province as parasitoid of rice weevil (*Sitophilus oryzae*). *Theocolax formiciformis* is from the subfamily Cerocephalinae and known from Australia, Europe (Belgium, Czeck Republic, Germany, Netherland, Poland, Russia, Sweden, UK) and Caucasus (Noyes, 2012).

### CONCLUSION

Within reared parasitic wasps on storage pests in Iran, there are some different species comparing with previously reported hosts (see Table 2).

Table 2. Parasitoids of storage pests and their hosts in Iran and reported.

Parasitoids	Hosts in Iran	Known hosts
<i>Anisopteromalus calandrae</i>	Bruchidae <i>Bruchus piosrum</i> <i>Callosobruchus maculatus</i>  Anobiidae <i>Lasioderma serricorne</i>	Anobiidae <i>Anobium</i> sp. <i>Catorama herbarium</i> <i>Lasioderma serricorne</i> <i>Stegobium paniceum</i>  Bostrychidae <i>Rhizopertha dominica</i>  Bruchidae <i>Acanthoscelides obtectus</i> <i>Bruchus chinensis</i> <i>B. obscurus</i> <i>B. piosrum</i> <i>B. quadrimaculatus</i> <i>B. rufimanus</i> <i>Callosobruchus analis</i> <i>C. chinensis</i> <i>C. maculatus</i> <i>C. phaseoli</i> <i>C. quadrimaculatus</i> <i>Zabrotes subfasciatus</i>  Silvanidae <i>Oryzaephilus surinamensis</i>  Tenebrionidae <i>Tribolium castaneum</i>
<i>Bracon brevicornis</i>	Pyralidae <i>Ephestia kuehniella</i>	Pyralidae <i>Ephestia kuehniella</i> <i>Galleria mellonella</i>
<i>Bracon hebetor</i>	Pyralidae <i>Plodia interpunctella</i> <i>Ephestia kuehniella</i>	Pyralidae <i>Ephestia elutella</i> <i>E. kuehniella</i> <i>Plodia interpunctella</i> <i>Galleria mellonella</i>  Gelechiidae <i>Phthorimaea operculella</i>  Tineidae <i>Tineola bisselliella</i>
<i>Cephalonomia tarsalis</i>	Bruchidae <i>Callosobruchus maculatus</i>  Silvanidae <i>Oryzaephilus surinamensis</i>	
<i>Dinarmus vagabundus</i>	Bruchidae <i>Callosobruchus maculatus</i> <i>C. chinensis</i> <i>C. analis</i>	Bruchidae <i>Bruchus chinensis</i> <i>B. quadrimaculatus</i> <i>Callosobruchus analis</i> <i>C. chinensis</i> <i>C. maculatus</i>
<i>Laelius anthrenivorus</i>	Dermestidae <i>Anthrenus</i> spp.	Dermestidae <i>Anihrenus muscorum</i> <i>A. verbasci</i>
<i>Lariophagus distinguendus</i>	Bruchidae <i>Bruchus piosrum</i>  Dryophthoridae <i>Sitophilus granarius</i>  Silvanidae <i>Oryzaephilus surinamensis</i>  Tenebrionidae <i>Tribolium</i> sp.	Anobiidae <i>Lasioderma serricorne</i> <i>Stegobium paniceum</i>  Bostrychidae <i>Rhizopertha dominica</i>  Bruchidae <i>Bruchus brachialis</i> <i>Callosobruchus chinensis</i> <i>C. maculatus</i>
<i>Pteromalus</i> sp.	Bruchidae	Bruchidae <i>Bruchus brachialis</i> <i>Bruchus chinensis</i> <i>Bruchus lentis</i> <i>Callosobruchus maculatus</i>
<i>Theocolax elegans</i>	Anobiidae <i>Lasioderma serricorne</i>	Anobiidae <i>Lasioderma serricorne</i>

	<b>Silvanidae</b> <i>Oryzophilus surinamensis</i>	<b>Stegobium paniceum</b>  <b>Bostrychidae</b> <i>Rhizopertha dominica</i>  <b>Bruchidae</b> <i>Acanthoscelides obtectus</i> <i>Bruchus quadrimaculatus</i> <i>Callosobruchus analis</i> <i>C. chinensis</i> <i>C. maculatus</i> <i>Zaobrotes subfasciatus</i>  <b>Cucujidae</b> <i>Cryptolestes ferrugineus</i>  <b>Dryophthoridae</b> <i>Calandra granaria</i> <i>C. oryzae</i> <i>Sitophilus granarius</i> <i>S. linearis</i> <i>S. oryzae</i> <i>S. zeamais</i>  <b>Gelechiidae</b> <i>Sitotroga cerealella</i>
<i>Theocolax formiciformis</i>	<b>Dryophthoridae</b> <i>Sitophilus oryzae</i>	<b>Anobiidae</b> <i>Anobium domesticum</i> <i>A. punctatum</i> <i>A. striatum</i>  <b>Dryophthoridae</b> <i>Calandra granaria</i>

Within these parasitoids, *A. calandrae* is a well known cosmopolitan parasitoid of Bruchidae (Coleoptera) associated with stored products in Iran that is widely distributed. This species were found in Kermanshah (Kangavar), Qzvin, North-Khorasan (Esfarayen), Mazandaran (Babolsar) and Sistan-Baluchestan (Sarbaz) provinces.

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# EFFECTS OF WATER STRESS ON THE YIELD AND WATER USE EFFICIENCY OF CANOLA

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## ABSTRACT

This research was carried out to evaluate the effects of deficit irrigation regimes on yield, total biomass, evapotranspiration, and yield response factor to water stress, water use efficiency and irrigation water use efficiency of canola (*Brassica napus* L.) in Agricultural Research Station of Tabriz University, Iran. Spring type of canola was planted in furrows and irrigated during the year 2011 growing season. Four irrigation treatments (applied water at the ratios of 1.0, 0.8, 0.65, and 0.5 of canola potential water requirements as I1, I2, I3, and I4 treatments, respectively) were tested. Results showed that spring canola growth was significantly affected by water stress. The highest grain yield, biomass, plant height and leaf area index (LAI) were obtained from the treatment I1. Considering irrigation treatments, seasonal evapotranspiration varied from 369.5 to 602.6 mm. Water use efficiencies were between 2.97 and 3.13 kg ha<sup>-1</sup>mm<sup>-1</sup>. Also, grain yields were in the range of 1124.83 - 1788.1 kg ha<sup>-1</sup> and the average seasonal yield response factor value was obtained as 0.93.

Key Word: Canola, water stress, yield, water use efficiency, yield response factor

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## INTRODUCTION

Because of increasing food requirements, limited water resources, and continuous droughts, deficit irrigation merits consideration in Iran. Rapeseed, subsidized by the government because of its good characteristics such as suitable placement in crop rotation, desirable quality, high value of oil and protein, has become an increasingly popular part of the crop rotation and so production of spring and winter types of it has been expanded recently throughout the country. Oilseed rape, as a member of the mustard (*Brassicaceae*) family, is one of the main sources of vegetable oil in the world. It has also a great potential in developing biodiesel market. In addition to oil production, the leaves and stems of oilseed rape provide high quality forage suitable for animal feeding because of their low fibre and high protein contents (Banuelos et al., 2002). Because of limited annual precipitation, many regions of Iran suffer from water deficit. Water deficit more than other stresses, like salinity and heat, limits growth and crop production. Therefore, understanding of the effects of irrigation scheduling and water use efficiency (WUE) on canola production under deficit irrigation condition is becoming increasingly important. Identifying a relationship between water use efficiency and seed yield under deficit irrigation condition has been a major concern of agricultural research in semi-arid regions (Sun et al., 2006; Sinaki et al., 2007; Faraji et al., 2009). However, one of the greatest challenges for agriculture is to develop technological or agronomic options to improve WUE. The objective of this research is to investigate the effects of different irrigation treatments on evapotranspiration, irrigation water requirement, crop water production functions, water use efficiency, and growth components and yield response factor of spring canola during its growing season.

## MATERIAL AND METHODS

This research was carried out during the growing season of 2011 in the agricultural research station of Tabriz University (Karkaj), Iran (latitude, longitude and elevation of the station are 37° 03' north, 46° 37' east and 1567.3 m above the sea level, respectively). The long-term average annual precipitation of the area is 288.9 mm. The research farm has a non-saline and alkali sandy-loam soil with 0.98% organic matter content and rich in calcium carbonate. The average values of the soil pH, field capacity, permanent wilting point, and bulk density in the depth of 0 - 30 cm were measured as 7.65, 0.28 m<sup>3</sup>m<sup>-3</sup>, 0.125 m<sup>3</sup>m<sup>-3</sup> and 1.58 g cm<sup>-3</sup>, respectively. The water retention capacity of the soil was determined as 140

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mm in its 0 - 90 cm profile. The planted cultivar was RGS003, spring type of canola. The experimental design was based on a randomized complete block with four replicates. Seeds were sown on 23th April 2011 with 5 cm spacing on the ridge of furrows having a length of 5 m and a width of 0.25 m. The plot size was 20 (4×5) m<sup>2</sup>. The application of fertilizers was based on the soil analysis. Phosphorus in the form of ammonium phosphate was applied at a rate of 100 kg ha<sup>-1</sup> before planting and nitrogen as urea form was added to the soil at a rate of 200 kg N ha<sup>-1</sup>. The 70% portion of urea was applied at 21 day after planting and the rest was applied at the beginning of the flowering period. During the experiment, the necessary cultivation practices such as maintenance, fertilization, and agricultural protection were carried out.

Four irrigation levels at a seven - day interval were applied. The irrigation treatments of canola were based on the soil water depletion/replenishment. The control treatment (full irrigation - I1) was designated to compensate 100% of soil water depletion during the seven - day period. For the remaining treatments (I2, I3 and I4), the amounts of irrigation water were 20%, 35% and 50% of the total water volume applied at the full irrigation treatment (I1). Volumetric soil water content were measured by PR2 (Profile Probe Delta-T) at the depths of 0.1, 0.2, 0.3, 0.4, 0.6 and 1 m at different treatments before each irrigation. The pumped water was conveyed by a PE pipeline and delivered to the experimental plots by taking advantage of a flow meter. A perforated pipe was used to ensure uniform delivery of water to each blocked - end furrow in plots. The crop was harvested on 8th August and then the total top dry matter production, grain yield, and some other yield components were measured for the all treatments.

Crop evapotranspiration (*ET*) of each treatment was determined using the soil water balance equation (Jensen et al., 1990). In the water balance equation runoff/runon was considered to be zero because the experimental plots were surrounded with dikes. Soil water depletion was calculated as the difference between soil water contents at the beginning and the end of each irrigation for the 0 - 90 cm soil profile. Drainage below the root zone was assumed to be zero, since the maximum water applied with each irrigation was equal to the soil moisture deficit in the root zone for the fully irrigated treatment (I1). The Stewart model, which is frequently used to define relationship between yield and *ET*, has been used to determine the yield response factor as follow (Doorenbos and Kassam, 1979):

$$\left(1 - \frac{Y_a}{Y_m}\right) = K_y \left(1 - \frac{ET_a}{ET_m}\right)$$

where  $Y_a$  is the actual yield under water deficit conditions,  $Y_m$  is the maximum yield under full irrigation regime,  $ET_a$  is the actual *ET* under water deficit condition,  $ET_m$  is the maximum *ET* related to the full irrigation treatment and  $K_y$  is the yield response factor to water stress.

Water use efficiency (*WUE*) was calculated from ratio of grain yield and seasonal evapotranspiration. Also, irrigation water use efficiency (*IWUE*) was calculated from ratio of grain yield and total irrigation water depth (Feres and Soriano, 2007). The data were evaluated by SPSS software to determine any statistically significant differences.

## RESULTS AND DISCUSSION

### *Irrigation water and evapotranspiration*

Because of the rainfall occurrence at the beginning of the growing seasons, desirable levels of water stress were not easily achieved. In the experimental year, the total rainfall during April and May was measured 128.2 mm while the months June, July and August were almost dry. The total number of irrigations during the experiment was 12. Accumulated irrigation water amounts for the treatments I1, I2, I3 and I4 were 501, 406.8, 329.5 and 262 mm, respectively. The seasonal *ET* of each treatment was computed by using soil water content, applied irrigation water amount, and precipitation. The seasonal *ET* increased with increasing number and amount of irrigations. The highest seasonal *ET* occurred at the full irrigation treatment obviously owing to an adequate soil water supply during the entire growing season. The lowest *ET* occurred at the continuous stress treatment for which the seasonal *ET* varied between 602.6 and 369.5 mm, as expected. Canola *ET* values under similar climatic conditions were reported by several researchers. Niyazi and Fuladmand (2007) reported winter canola potential evapotranspiration as 740, 709 and 700 mm in three years experiment in the south west of Iran. Zarei et

al. (2010) obtained the highest seed yield for irrigation water of 675 mm in the experimental farm of Karaj, Iran. Istanbuluoglu et al. (2010) found *ET* of oilseed rape in the range of 465 - 715 mm at different deficit irrigation regimes in Turkey. They reported that the seasonal *ET* of different oilseed rape varieties under different climatic and soil conditions varied from 300 to 1150 mm.

#### *Yield, yield components and biomass*

The mean value and standard deviation (*SD*) of biomass, grain yield, plant height, and *LAI* (when 80% flowers were opened) are presented in Table 1. In this study grain yield of spring canola was found in the range of 1.12 - 1.78 t ha<sup>-1</sup>. In comparison with the winter type of canola, grain yield of spring type decreased in response to the short - term growing season. Rahnama and Bakhshandeh (2006) and Hamzei et al. (2007) found grain yield in the range of 1.0 – 5.3 t ha<sup>-1</sup> and Zarei et al. (2010) found grain yield of three winter species of canola in the range of 2.09 - 3.95 t ha<sup>-1</sup> in the E. Azarbaijan (Tabriz), Khuzestan and Yazd provinces of Iran, respectively. Sinaki et al. (2007) reported grain yield of three winter types of canola under normal and water stress conditions in the range of 0.97 - 3.98 t ha<sup>-1</sup> in Alborz (Karaj) province.

*Table 1. Mean value and standard deviation (the numbers outside and inside the brackets respectively) of irrigation treatment effects for some traits of spring canola in the combined ANOVA.*

Treatments	Biomass (t ha <sup>-1</sup> )	Yield (kg ha <sup>-1</sup> )	Plant Height (cm)	<i>LAI</i> (m <sup>2</sup> m <sup>-2</sup> )
*Treatments				
I1	9.87 (0.35)a	1788.1 (235.6)a	98.75 (8.54)a	4.28 (0.65)a
I2	7.91 (0.50)b	1595.74 (261.4)ab	78.25 (5.38)b	3.51 (1.16)b
I3	5.82 (1.14)c	1248.32 (181.3)bc	62.17 (2.06)bc	2.36 (0.49)c
I4	4.60 (0.90)d	1124.83 (60.9)c	58.25 (2.17)c	2.03 (0.35)c

\* Means in each column followed by the similar letter(s) are not significantly different at 5% probability level, using Duncan's Multiple Range Test.

There was significant difference in grain yield between the irrigation treatments at 0.05 probability level using Duncan's Multiple Range test (Table 1). The highest canola grain yield was obtained at the treatment I1 and the lowest at the continuous stress treatment. The treatments I1 and I2 produced significantly higher seed yields (1788.1 kg ha<sup>-1</sup> and 1595.74 kg ha<sup>-1</sup>, respectively) than I4 (1124.83 kg/ha) and were at the same statistical group. In comparison with I1, the yield reduction percentages in I4, I3 and I2 were 37, 26 and 11%, respectively. The obtained grain yields at different irrigation treatments were comparable with those reported by Hassanzadeh et al. (2005). The analysis showed significant differences between *LAI* (when, more than 80% of flowers are open) in I1, I3 and I4 treatments. The higher grain yield in oilseed rape might be associated with higher leaf area (Howell, 2000). Significant differences in the plant height and biomass were observed amongst the different irrigation treatments. The plant height increased significantly with increasing irrigation water amounts. Treatments with limited water amounts and controlled soil water deficits caused biomass reductions compared to those with higher irrigation amounts and soil water contents. The relation between grain yield and biomass is presented in Figure 1. The mentioned ratio was interpreted as a quadratic function. It could be deduced from the developed equation that the highest grain yield could not be obtained at maximum biomass value. Further investigation showed that the maximum grain yield was obtained from 9.43 t biomass, while the highest value of biomass was more than 10 t in some replication of the treatment I1.



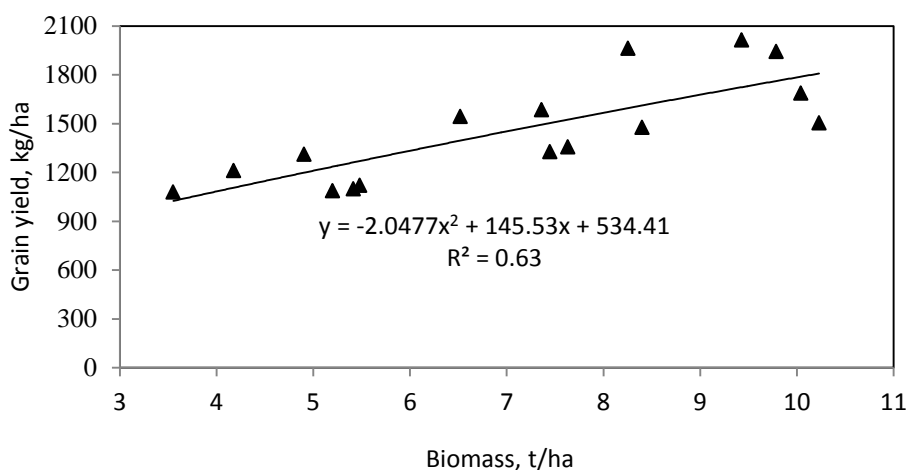


Figure 1. Relationship between grain yield and biomass for spring canola in Karkaj.

### Crop water production functions

The relationship resulting from the regression analysis of grain yield and seasonal evapotranspiration is best described by a quadratic equation (i.e.  $y = -0.0037x^2 + 6.5304x - 792.25$ ) with a determination coefficient of 0.99. The amounts of yield response factor ( $K_y$ ) in total growing period is shown in Figure 2.

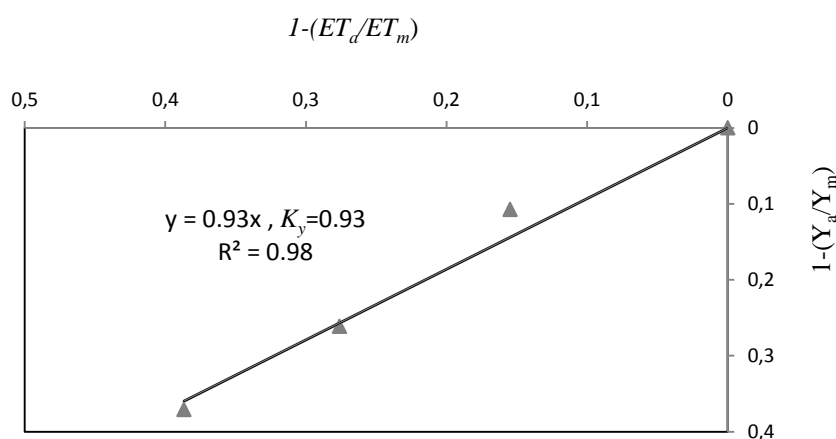


Figure 2. Relationship between relative evapotranspiration deficit and relative yield decrease.

The amount of  $K_y$  in the whole growing period was 0.93, the slope of the regression line. Considering the values of  $K_y$  being smaller than 1, it was concluded that canola was a water stress tolerant crop and could be cultivated in arid and semi arid regions such as Iran. Results of the present study on canola were in agreement with the results reported by Istanbuloglu et al. (2010). They found values of 0.56 and 0.99 for  $K_y$  in two - year experiments in Trakya region of Turkey. Also, the  $K_y$  value of the present study was close to the  $K_y$  values of some other oil crops such as sunflower. Doorenbos and Kassam (1979) reported the value of 0.95 for  $K_y$  of sunflower in its total growing period.

### Water use efficiency and irrigation water use efficiency of canola

The mean and standard deviation ( $SD$ ) of water use efficiency ( $WUE$ ) and irrigation water use efficiency ( $IWUE$ ) for different irrigation treatments are presented in Table 2. This could be justified by the fact that the values of the seasonal irrigation water were smaller than the seasonal evapotranspiration. According to Table 2, values of  $WUE$  and  $IWUE$  except for the treatment I2 followed water stress amounts and showed increasing trends at other treatments from I1 toward I4. Regression analyses indicated quadratic equations for  $WUE$ - seasonal crop evapotranspiration ( $ET$ ), i.e.  $WUE = -6E-06$

$ET^2 + 0.0058 ET + 1.7249$ ,  $R^2 = 0.52$ , and  $IWUE$  - seasonal irrigation water ( $IW$ ) relationships, i.e.  $IWUE = -7E-07 IW^2 - 0.0023 IW + 4.921$ ,  $R^2 = 0.96$ .  $WUE$  reached its maximum value at a seasonal evapotranspiration of 483 mm, and then started to decrease with increasing evapotranspiration. However, the maximum value of  $WUE$  did not correspond to the maximum grain yield because the evapotranspiration value was 602.6 mm when the maximum grain yield occurred. When evapotranspiration was relatively low, water availability was the limiting factor for grain yield and an increase in evapotranspiration resulted in significant increase in both grain yield and  $WUE$ .  $IWUE$  reached its maximum value at minimum applied irrigation water, i.e. 262 mm, and then started to decrease with increasing applied water. Sinaki et al. (2007) reported that  $WUE$  values were significantly influenced by the irrigation programs. They obtained the highest grain yield at normal irrigation treatment and the highest  $WUE$  under stress conditions for three species of canola in Alborz province (Karaj), Iran. Banelos et al. (2002) showed that  $WUE$  values of canola and kenaf decreased as the level of irrigation increased from 25 to 150% of potential evapotranspiration in Fresno. Istanbuluoglu et al. (2010) reported the occurrence of the highest and lowest values of  $IWUE$  at minimum and maximum applied irrigation water, respectively in Turkey.

Table 2. The mean and standard deviation (SD) of water use efficiency ( $WUE$ ) and irrigation water use efficiency ( $IWUE$ ) for different irrigation treatments.

Parameter Kg ha <sup>-1</sup> mm <sup>-1</sup>	Irrigation Treatments			
	I1	I2	I3	I4
$\overline{WUE}$ (SD)	2.97 (0.39)	3.13 (0.51)	3.03 (0.42)	3.05 (0.16)
$\overline{IWUE}$ (SD)	3.57 (0.47)	3.92 (0.64)	4.00 (0.55)	4.29 (0.23)

## CONCLUSIONS

This study was carried out to investigate the effects of deficit irrigation regimes on canola (*Brassica napus* L.) growth in the agricultural research station of Tabriz University (Karkaj), Iran. Results showed that there were significant differences in yield and some yield components, biomass, plant height, and LAI between the irrigation treatments. Evapotranspiration,  $WUE$  and  $IWUE$  of spring canola were all affected by controlled volumes of irrigation water. Grain yield response to irrigation varied considerably due to the differences in soil moisture contents and irrigation scheduling. Values of grain yield, evapotranspiration, and biomass followed decreasing trends from full irrigation toward maximum stress treatment for which the applied water volume was 50% of the canola potential water requirement. Maximum values of  $WUE$  (3.13 kg/ha/mm) and  $IWUE$  (4.49 kg/ha/mm) occurred at the treatments for which the applied water volumes were 80% and 50% of the canola potential water requirement, respectively. Also the highest daily evapotranspiration happened during the ripening period under the full irrigation treatment conditions. Noting the value of the yield response factor obtained, it can be said that canola is a water stress tolerant crop that can be cultivated in arid and semi - arid regions.

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# EFFECTS OF THE EUROPEAN UNION COMMON AGRICULTURAL POLICIES ON THE TURKISH SECTOR OF AGRICULTURAL MACHINERY

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## ABSTRACT

The objectives of this study, in the course of full membership to the European Union, were;

- To explore the potential effects of the adaptation of the agricultural sector to the Common Agricultural Policy on the sector of agricultural machinery,
- To find out the outcomes that would occur in mechanization planning due to the transition to the Common Agricultural Policy.

Having a simulation in the structural conditions is of great importance to provide a harmony between Turkey and EU. In this study, the analysis of agricultural structure in Turkey and in EU was done by the dimensions of farm structure, production and yield. Existing agricultural mechanization levels of the EU and Turkey were examined and by evaluating agricultural machinery manufacturing industry, the position of the competitiveness of firms has been manifested. The most important results of the study highlighted that although the Turkish agricultural sector has a high potential, it has a poor competitive qualification. Thus, the greater size of farms and the higher level of agricultural mechanization of EU will be the most expected compelling change for Turkey in the process of adaptation.

**Key Words:** Common Agricultural Policy, Agricultural Machinery, Competitive Capacity.

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## INTRODUCTION

EU stipulates the compliance of Turkish Agricultural Sector with Common Agricultural Policy for full membership. Common Agricultural Policy (CAP), the oldest and the most comprehensive policy of EU, was formed to integrate economies of the member countries in agriculture. Although the share of CAP is only 1,2% in Gross National Product (GNP) of the EU-27, the fact that 41,3% of the Union Budget belongs to CAP, clearly sets out the importance of the policy.

Although Common Agricultural Policy over the years changed through reforms, while Common Agricultural Policy in general ensures the development of production standards and agricultural technology, effective usage of agricultural production inputs, increase in the productivity of agriculture in Europe, stability of the markets, security of supply of products, optimum utilization of labour force which is one of the most important factors of agriculture, food security, sustainable agricultural production, environment-friendly production model, the Policy aims at increasing income of the groups living on agricultural products, offering affordable prices to consumers, equalizing prices of agricultural products and preventing prices from causing unfair competition in all member countries (Kilit, 2012).

As of 2010 there are approximately 5,7 million people employed in agriculture in Turkey. The share of agriculture in total employment is 25,2%. Such a large agricultural sector in Turkey has created a strong Agricultural Machinery Manufacturing Industry. Positive and negative developments in agriculture directly affects this sector. Therefore, it is important that in the process of full membership in European Union, the compliance of Turkish Agricultural Policy with Common Agricultural Policy in general, and its possible effects on Agricultural Machinery Manufacturing Sector in particular should be evaluated together.

## MATERIAL AND METHODS

In order to evaluate possibility of harmonisation between Turkey and EU, some structural indicators about agriculture, were examined comprehensively, and data was compiled taking into account effects on agriculture. (Sources: European Commission Agriculture and Rural Development Statistics and Indicators, FAOSTAT, TUGEM/General Directorate of Agricultural Production and Development, TUIK/Turkish Statistical Institute). Level of mechanization in EU and Turkey was computed by using FAOSTAT data. Market Access Database, the VDMA (German Machinery Association)

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Agricultural Machinery Economic Reports were utilized for evaluating agricultural machinery manufacturing sector.

## RESULTS

Table 1. The Comparison of some Agricultural Sector Data (of EU-Turkey)

Indicators	Turkey	EU-15	EU-25	EU-27
Total Land Area (km <sup>2</sup> ) 2009	783.560	3.241.309	3.979.859	4.329.249
Utilized Agricultural Area (1000 ha) 2010	18.433	132.196	165.134	183.875
Irrigated Agricultural Area (1000 ha) 2009	5.215	14.477	14.954	18.213
Areas of Organic Farming (ha) 2009	175.790	6.966.403	8.420.302	8.600.911
Number of Holdings (1000 holdings) 2007	3.021	5.662	9.276	13.700
Number of Organic Enterprises 2009	11.211	177.157	208.683	212.471
Agricultural Area Per Holding (ha) 2007	6,1	22	16,8	12,6
Average Size of Organic Enterprises (ha/farm) 2009	16	39	40	40
Total Population (thousands) 2010	72.752	398.995	473.679	502.659
'Persons Employed' in Agriculture (1000 persons) 2010	5.683	5.350	8.122	11.110
Share of Agriculture in Total Employment (%) 2010	25,2	3,1	4	5,2
Output of the Agricultural Industry (Mio EUR) 2010	26.445	299.024	336.400	355.573
Share of Agriculture in the Gross Domestic Product (Gross Value Added/Gross Domestic Product) (%) 2010	9,5	1,2	1,1	1,2
Per Capita Agricultural Production Value (Euro) 2010	4.653	55.892	41.418	32.005
Employment Per Holding (person) 2010	1,9	0,9	0,9	0,8
Share of Exports of Food and Agricultural Products in Total Export (%) 2010	10,5	10,7	10,4	10,6
Share of Imports of Food and Agricultural Products in Total Import (%) 2010	5,4	9,7	9,8	9,7
External Trade Balance in Food and Agricultural Products (Mio EUR) 2010	1.461	-6.827	-7.013	-6.832
Transfers to Agriculture ( Mio-EUR) 2010	2.569	47.033	55.392	58.190
Per Farmer Transfer (Euro) 2010	452	8.791	6.820	5.238
Number of Cattle (1000 head) 2010	10.724	74.067	84.000	86.540
Number of Sheep (1000 head) 2010	21.795	77.969	80.631	84.614
Number of Goats (1000 head) 2010	5.128	11.452	12.090	13.231
Milk Yield of Dairy Cows (kg/head) 2009	2.847	6.709	6.288	6.054
Adult Bovine Animals Average Carcass Weight in kg 2010	216,6	344,2	338,2	337,5
Sheep and Goats Average Carcass Weight in kg 2010	15,6	14,5	14,6	14,5
Wheat Yield (kg/da) 2010	244	658	586	553
Barley Yield (kg/da) 2010	241	473	441	432
Maize Yield (kg/da) 2010	726	908	828	702
Sunflower Yield (kg/da) 2010	206	186	189	190
Number of Tractors Per Agricultural Area (Tractor/1000 ha) 2007	42	86	85	78
Cultivated Area Per Tractor (ha / tractor) 2007	24	12	12	13
Number of Tractors Per Farm (Tractor/1000 holdings) 2007	350	1.264	998	692

Source: Compiled by utilizing data from (Anonymous 2012 a, Anonymous 2012 b, Anonymous 2012 d, Anonymous 2012 e).

Table 1 shows indicators related to agriculture. The most important indicator among the data is average size of enterprise. Average size of enterprise is 22 ha for EU-15, 6,1 ha for Turkey. With this scale, it is not possible to compete with producers of EU especially for cereals, industrial crops, tuber crops and oil seeds. However, due to EU enlargement, this scale decreased to 12,6 ha in EU-27. This means that agricultural structure of the countries recently added to EU is different from EU-15. Indeed, average size of enterprise of last EU-12 is 6,4 ha. On the other hand there seems no problem about competition between the enterprises which have tendency to enlarge in Turkey and those enterprises in EU countries.

As far as number of enterprises is concerned, it is noticeable that along with new members there is a considerable increase in the number of enterprises. While total number of enterprises was 5,7 million for the EU-15, the number increased to approximately 9,3 million together with accession of 10 countries in 2004, then approximately 13,7 million together with the accession of Bulgaria and Romania in 2007. In excess of 3 million enterprises, Turkey has the highest number of enterprises among EU member countries and candidates after Romania.

As well as SMEs have a density in agriculture in Turkey, the employment per enterprise is higher than EU. Indeed, while 0,8 person per enterprise is employed in EU-27, this number is 1,9 person for Turkey. This situation causes decrease in per capita production value, in other words decrease in labour productivity. While per capita production value in agriculture of Turkey is 4653 Euro, it is 55892 Euro for the EU-15, 41418 Euro for the EU-25.

In Turkey, amount of product obtained per animal for animal products like milk and meat is far below EU average. A similar situation applies to the vegetable products. These data suggest that Turkish farmers have no chance to compete with EU farmers.

In addition to these structural differences, a big contrast is noteworthy in agricultural subsidies. Indeed, while the amount of subsidy per farmer is 452 Euro for Turkey, it is 8791 Euro for the EU-15. When analysed in conjunction with the production value per farmer, a Turkish farmer is provided subsidy at a rate of 9,7% of his contribution to the production, the EU-15 farmer 15,7%.

From the data in the above table, it could be seen that Turkish agriculture had high potential but its competitive quality proved to be weak. When this structure is evaluated together with relatively small, quite inadequate rural infrastructure investments and low educational level of farmers, Turkish agriculture will face hard times both in the process of harmonisation with EU regulations and global competition.

When mechanization level of Turkey and EU is compared, improvements cannot be underestimated, but the current level is not sufficient for sustainability of global competition. Majority of the problems derives from common issues like unsuitability of the agricultural structure. For this reason, resolution of mechanization problems firstly depends on the solution of structural problems of agriculture.

#### ***Current Status of Agricultural Machinery Manufacturing Industry in Turkey***

According to data from Turkish Agricultural Equipment and Machinery Manufacturers Association (TARMAKBIR) in our country there are about 1000 agricultural machines manufacturer and approximately 130 different agricultural machines are produced. Just 40% of the manufacturers are higher than a certain scale. More than half of firms in the sector employ less than 10 employees without a technical staff. Abundance of number of firms creates excess capacity. Some companies could not protect their market position and faced close-down case and had to downsize. Market for the majority of small firms is their residential areas and their close surrounding (Evcim and Ulusoy, 2006).

Exports of Turkey to EU countries which are themselves major producers of agricultural machinery are at a level of 29,1% (Table 2). Turkey's export should be directed more towards developing countries. Given the large exporting countries, great changes in export figures are observed from year to year.

Due to both the excessive demand for tractors and zero-interest agricultural loans for irrigation and animal production equipment with the support of grants, along with revival in the market, import increased considerably, export figures doubled approximately (Table 2). The main reason for this is that demand for machinery such as harvesting, baling machine, cotton harvesting machine, milking facilities, milk cooling tanks can be met by domestic production. A large part of these imported machines are those which have no domestic production capacity or those with the models and capacity which are suitable for large parcels and enterprises. Import from EU countries to Turkey is at a level of 53,9%. In 2011, the amount of import of tractor from the EU-27 to Turkey was 138,2 million Euro and equipment 169,9 million Euro.

Table 2. Turkey Tractor and Agricultural Machinery Export and Import (Euro), 2011 (1 USD = 0,814671 EUR)

GTIP (Customs Tariff Statistics Position)/ Harmonized System (HS) Description	Total Exports	Export to EU-27	Share of Turkey's Export to EU-27 in Total Export (%)	Distribution of export to EU-27 according to GTIP Codes (%)	Total Imports	Import from EU-27	Share of Turkey's Import from EU-27 in Total Import (%)	Distribution of Import from EU-27 according to GTIP Codes (%)
Irrigation Equipment	4122822	172760	4,2	0,2	21712387	7876690	36,3	2,6
Plant Protection Equipment	7956594	837980	10,5	1,0	27704527	2980510	10,8	1,0
Soil Cultivation & Sowing Equipment	51301474	16697710	32,5	20,0	41422982	34672560	83,7	11,3
Harvest Equipment	36600598	21267790	58,1	25,4	163887218	100667790	61,4	32,7
Milking Equipment	10273592	1992220	19,4	2,4	19231032	11516310	59,9	3,7
Livestock Equipment	17203852	4712760	27,4	5,6	14866752	11444840	77,0	3,7
Tractor	173343118	37141100	21,4	44,4	278056764	138210270	49,7	44,9
Motoculteur	2144458	764800	35,7	0,9	4286819	768110	17,9	0,2
Total	302946508	83587120	27,6	100	571168481	308137080	53,9	100

Source: Calculated using (Ileri, 2012, Anonymous 20012 c).

The biggest problem for the future of the sector is the power of competitiveness which is not considered as important nowadays and consequently the scale problem. The companies operating in the agricultural machinery manufacturing sector are SMEs, and in the mean time, they are clients of sub-industry which have the nature of the SME. The structure that manufactured the components as much as possible in the past was transformed to sub-industry cooperation since it could provide more qualified component with less cost. Structure and the financial means of SMEs are not enough to expand the technical staff or to use by purchasing improved technology. Since high technologies increase the competitiveness, SMEs which apply low and medium technology cannot live on only the price advantage. This is because of the fact that developing countries in terms of industry are in this segment as a serious competitor for the future (Evcim and Ulusoy, 2006).

#### *Agricultural Machinery Production Sector in European Union*

Machinery Manufacturing Industry is a sector of particular importance which is especially given great importance in the European Union and identified as a priority sector. This sector has lost employment in recent years in EU. It has two basic reasons;

- Mergers and close-downs of firms and efforts for increasing efficiency;
- Companies turn to countries where labour is cheaper in component purchase and new investment (Anonymous, 2007).

Firm structures have four important traits (Anonymous, 2007):

- SMEs have dominant position in the sector and these institutions meet great part of sector manufacturing.
- These are specially-designed machines which are in line with customer demands, run as relatively small parties on a just-in-time basis.
- Seller/customer relations are rather complicated.
- Firms operating in machinery sector are global companies including SMEs.

Agricultural machinery industry's total production in 12 countries added latest to EU is just 9,6% of the EU-15, but their level of competitiveness is weak (Table 3). These countries generally became the market of the old EU member states' machine manufacturers.

**Table 3. European Union, Equipment and Tractor Production, Export, Import and Internal Market Sales Values**

Country	Production (Million Euro)		Exports (Million Euro)		Imports (Million Euro)		Market Volume (Million Euro)	
	2011	Changes in 2010-11 (%)	2011	Changes in 2010-11 (%)	2011	Changes in 2010-11 (%)	2011	Changes in 2010-11 (%)
EU-15*	23.990	20	8.054	27	3.766	23	20.232	17
EU 12* (Entry 2004 and 2006)	2.296	21	1.654	32	3.220	33	3.971	24
EU 27*	26.285	20	6.398	24	3.191	22	24.203	18

\* excluding EU intra trade.

Sources: Anonymous, 2012 f.

Germany is the most important country about world tractor total export with share of 18,3%. This country is followed respectively by USA by 13,1%, Japan 10,4%, Italy 10,3%, UK 8% and France 7% (İleri, 2012). In terms of agricultural machinery ranking is as follows; Germany, USA, Italy, China, Holland, France and Belgium. Two-thirds of the sales of European manufacturers have been to European Union, the rest to the other countries other than European Union. In addition to this, at least 15% of turnover comes from the other countries in Eastern Europe and about 10% of it comes from North America (Anonymous, 2012 f).

## DISCUSSION AND CONCLUSION

Trends in the agricultural sector, when the particularly developed markets like USA, EU and Australia are taken into account are towards the growth of enterprises and increase in mechanisation. These markets are not developing markets, rather they are the markets where renewal purchases take place and the most of the machines sold replace old model machinery with low efficiency and power. The number of machines sold decreases in line with the growth of farm land and the increase of capacity and size of the machines used in cultivation. However, this situation does not negatively affect turnover as more expensive machines will be sold.

At the level of subsidy of today, compliance of Turkish agriculture with CAP can provide some financial opportunities. However, since it is expected that there will be a reduction of support provided to agriculture in the near future within the framework of CAP reform, CAP might not be adequately supportive for Turkish agriculture may not be protective (Özoğul, 2009).

Within the framework of EU legislation, more stringent control over actions against industrial property rights and application of sanctions may prevent machinery being copied and placed on the market to a considerable degree.

More effective market surveillance decreases manufacture, import and placing on the market of machinery which is not inline with usage requirements of CE mark to a minimum degree.

It is expected that compliance works realized by firms about compliance with occupational health and safety, environmental regulations will have some negative effect upon costs.

In line with the expectations of manufacturers, equalizing taxes to which firms are subject to, and taxes and premiums to which workers are subject to, with EU average levels shall decrease unrecorded transactions, shall increase the chances of foreign competition and shall prevent unfair competition in the internal market.

An increase in the value of Turkish Lira lowers profit margin of export sector. In the long run due to low profit margins, withdrawal of firms from international markets could cause market shares of firms to shrink.

Sector firms' cooperation with local and international firms plays an important role in sector's going towards greater projects. Especially, partnerships with foreign companies may contribute to access for markets and developments in product, production and management. In terms of foreign companies, it



might be advantageous to invest in the infrastructure of a dynamic and entrepreneurial sector which proved to reach a remarkable level of power with its own resources and to make use of the possibilities of logistics and possibilities of industrializing Turkey's internal market, geographical position (Özoğul, 2009).

It is inevitable that those companies which will not be able to adapt to technical requirements will be eliminated with the effect of increasing domestic and foreign competition in the coming years. However, given the market expectations of growth and consequent increase in total production, it is expected that the reduction in the number of companies would increase production per company, as a result, the surviving firms maintain a healthy presence in the market structure, and their competitiveness would be positively affected (Özoğul, 2009).

In line with World Trade Organization's projections, both abolition of applications like imposing high taxes on import and having different tax rates among different countries, by the countries perform such applications and decreasing customs duties gradually by them in accordance with the agreements entered into, will have positive effect on the export of agricultural machinery. Moreover, an increase in the number of countries with which free trade agreements are signed will enable the development of share in these markets in the medium-term.

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# CHARACTERISTICS OF THE LAND PARCEL IDENTIFICATION SYSTEM (LPIS) AS THE MAIN SUBCOMPONENT OF THE AGRICULTURE INFORMATION SYSTEM

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## ABSTRACT

Land Parcel Identification System (LPIS) is one of the main GIS part within the EU Common Agricultural Policy. It is core element of the Integrated Administration and Control System (IACS) which is used for subsidy payments. LPIS is a spatial register of agricultural parcels maintaining the exact information on position, size, and unique identifier for each parcel. One of the main functionalities of the LPIS register is to prevent subsidy payments to the farmer for non-eligible areas and to avoid double payments on the same areas. LPIS is also a tool for efficient management of the utilized agricultural areas used by many different users, not only for the country administration.

In this article the authors researched the LPIS methodology used in some member states (SI) with the approach proposed in the candidate (FYROM) or potential candidate countries (BiH). Different models are analyzed and its main characteristics described. A possible solution for the appropriate LPIS model in Bosnia and Herzegovina has been analyzed, taking into account the current situation of available registers, cadastral data, national payments, agricultural parcel structure and other elements of the Agricultural Information System (AIS) in the country.

**Key Words:** LPIS, Agricultural information system, Common Agricultural Policy, payment control, accession to the European Union.

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## INTRODUCTION

The Common Agricultural Policy (CAP), since the 2003 reform, aims to provide for a stable farmer's income, decoupled from production, within a framework of sustainable development of the rural areas while respecting environmental and other societal needs. There are three main categories of player in the process of direct payments under the CAP: the European Union (EU) Institutions, Member State (MS) Administrations (including some MS Regions) and farmers (Sagris V., Devos W., 2008).

An agricultural information system (AIS) is an information technology system that manages information dealing with agricultural data. The main AIS subcomponents include, *inter alia*, Integrated Administrative Control System (IACS) and Land Parcel Identification System (LPIS) (McNeill H.W., Ljuša M. et al., 2011). IACS is the most important system for the management and control of payments to farmers made by the MS in application of the CAP. LPIS is one of the most important elements of the IACS system.

MS in the EU have been using IACS in order to administer agricultural subsidies since 1992 (Krug, 2000; Delincé, 2001; van der Molen, 2002). Over time, IACS experienced some major changes triggering the use of concrete spatial reference systems. In this context, LPIS emerged in order mainly to spatially represent the activities of farmers on their land (JRC, 2001; Kay, 2002). In order to manage data of farmers' applications, IACS should (Council Reg. No 73/2009, Art. 17) contain the following components: (1) a computerized database; (2) an identification system for agricultural parcels also known as LPIS; (3) a system for identification of entitlements; (4) register for aid applications; (5) an integrated control system; and (6) identification system for farmers.

LPIS is a GIS (Geographic Information System) system providing the location and physical measurements of land parcels and the maintenance of a unique set of identifiers for the land parcels. The

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LPIS records production system types, areas utilized and provides a basis for assessing risks associated with payments.

The LPIS as a concept was developed already in 1992 (Council Reg. No 3508/1992), when the need for identification of the agricultural parcels to support IACS had emerged. At that time, there was no restricting regulation and so the data model in many MS was purely alphanumerical without any spatial reference. It was in the Council Reg. No 1593/2000 that the spatial LPIS based on GIS was first promoted. The 2003 CAP Reform (Council Reg. No 1782/2003 replaced by No 73/2009) forced the MS to establish LPIS in digital and geo-referenced format by December 1<sup>st</sup> 2004. As a result, the first year of an operational GIS-based LPIS was 2005 (Sagris et al., 2008).

LPIS, part of IACS GIS, has two roles: 1) protect the EU financial interests by quantifying area, 2) increasingly safeguard the broader CAP objectives for environmental sustainability and rural development by recording eligible features for these schemes (Devos W., 2008).

An Agricultural parcel is a key concept applied in relation to area-based payments which determines the subject of the aid application, geographic location and extent (area) of agricultural activity. Article 6 of the Commission Reg. No 1122/2009 stipulates that, for the purpose of identification of the agricultural parcel referred in Article 17 of the Council Reg. No 73/2009, Reference Parcel (RP) should be the basic unit of the LPIS. Commission Reg. 1122/2009, Art 2 (27) defines the reference parcel as: 'reference parcel' means a geographically delimited area retaining a unique identification as registered in the GIS in the Member State's identification system referred to in Article 15 of Regulation (EC) No 73/2009.

Unfortunately, there is a confusion in use of terms which exists when one refers to the term "agricultural parcel". In IACS database, Agricultural parcel corresponds to unit of agricultural activity relevant for aid application, definition of Agricultural parcel in IACS can change when different types of payments, crops (eligible for payment) and crop groups are concerned. In LPIS context Agricultural parcel has a different meaning: a reference parcel which by definition contains only one declared object "agricultural parcel".

The statement of Art 6.1 of the Commission Reg. No 796/2004 created the opening for a diverse practice among MS of 'reference parcel' representations as: Cadastral parcel, Agricultural parcel, Farmers' block/ilot and Physical block.

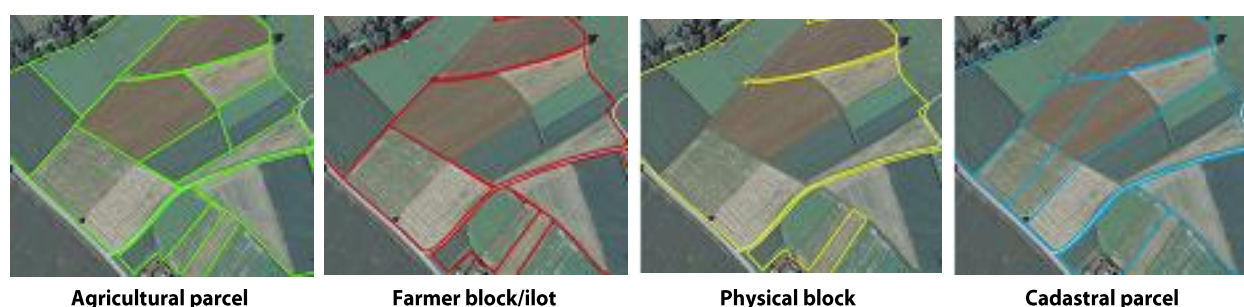


Figure 1. Type of reference parcel

The cadastral parcel is based on ownership, whilst the other LPIS reference parcels are based on land cover delineated by topographical boundaries and/or agricultural land use.

These four different kinds of spatial units have different characteristics, yet all of them may be used as Reference Parcels (RP) of the LPIS. Even so, each LPIS can function properly to meet the needs for the management of agricultural subsidies. However, they are lacking of a standardized structure. Different IACS/LPIS structures even in different regions within the same country will definitely hamper implementations of National Geographic Information Infrastructure for each MS. Data interoperability at the EU level will definitely be another aspect of this issue in the future (Inan H. I., Sagris V. et al, 2010).

Almost all the MS relied on the existing or new orthophoto coverage to create the reference parcels. It was done mainly by computer – assisted photo interpretation (CAPI) or through a contact with the farmers, who assisted by an operator, delineate on screen or printed copy the blocks they are cultivating.

The Joint Research Center, a Directorate General of the European Commission (JRC) defined technical requirements and recommendations on the accuracy, geometry, radiometry and temporal resolution for orthophotos, to be implemented in the LPIS (Léo, O., Lemoine, G., 2001). In few MS, archive or new VHR satellite data was extensively used for the creation of LPIS as a backup of the aerial orthophoto, delayed for various reasons (GR, PL, CY, RO and BG). The use of VHR data is considered very appropriate to cover border or other areas where flight restrictions are applied (JRC, 2012).

The process of updating of the geographic databases is a very important element of the system maintenance and should be adjusted to the type of data stored. The role of farmer in the LPIS update is clearly defined in the Regulation (Art 12.4 of Commission Reg. 1122/2009) which states that, when submitting the application form, shall correct the pre-printed graphic materials if any changes occurred on his land or if any information contained in the graphical materials is incorrect or outdated. Furthermore, if the correction relates to the area of the reference parcel, then the farmer must declare the up-to-date area of each agriculture parcel concerned and if necessary indicate the new boundaries of the reference parcel.

Nowadays LPIS systems are expanding their scope towards the so-called CAP second pillar - sustainable rural development, which respects environmental and societal needs. However, the domain is not well-known for the general geo-information public, there are only a few scientific publications covering geo-informatics aspects in this sector (Milenov and Kay, 2006; SAGRIS et al., 2008).

Bosnia and Herzegovina (BiH) as a potential candidate for EU membership is currently involved in the process of designing and implementing some subcomponents of an AIS. Preparations for LPIS and IACS are in early stage. Following that the agricultural holdings in BiH are still very small (3.3 ha on average) and fragmented, usually divided into 7-9 smaller parcels, establishment of LPIS presents a complex task.

## **MATERIALS AND METHODS**

This paper is based on an analysis of existing models of LPIS and their basic characteristics in the EU countries and Balkan countries as well in which this system has been developing. The exception is BiH, where preparatory phase for implementation of pilot is ongoing.

Significant source of information and data were existing analysis and studies regarding the LPIS, mainly conducted by the European Commission institutions. In addition to this, the analysis of EU legislation, studies and policy papers has been performed.

Valuable inputs in the present analysis of AIS development in BiH were provided by officers and IT personnel from the Ministry of Foreign Trade and Economic Relations of BiH that is responsible for sector of agriculture and rural development in BiH.

However, it is important to note that this paper analyze and present the experience of developing and maintaining LPIS systems in Slovenia and Former Yugoslav Republic of Macedonia. LPIS models of the above mentioned countries are certainly applicable also in BiH, and this was one of our reasons for its presenting in this paper. Another reason for this selection, when it comes to LPIS systems in these two countries, is to demonstrate experience of the author in establishing the system in these two countries.

## **RESULTS AND DISCUSSION**

The process of defining suitable LPIS model is rather complex and consists of a few phases. This includes analysis of existing data and current land administration system in the country. It is also important to know traditional agriculture practice and agricultural policy. The last is important

particularly in terms of defined measures for subsidy support. Based on that, and if these measures are very diverse and based on the level of separate crops, it is most suitable to keep records on the level of agriculture parcel. However this is not the best option from the budget perspective and management perspective as this model is highly affected to any changes on the ground that needs to reflect in the LPIS database.

To date, different LPIS in different MS greatly differ in concepts and models of representation and spatially identification of the agricultural land use unit (Sagris et al., 2008). The approaches used for the creation of the LPIS differ from country to country. They depend on the reference parcel defined, the reference data available (orthophotos, cadastre, topomaps), local agriculture conditions, etc.

The most simplified reference model, Physical block, does not have any link with the farmer and crops which require more work every year during the subsidy application campaign, when every farmer need to put on the map his agricultural parcels. The cases with many agricultural parcels in one physical block can again cause a lot of problems where the boundaries between the agricultural parcels are not harmonized and can come to overlaps and double declarations. This can be partly overcome by using digital application process where farmers actually digitize their boundaries based on orthophoto.

Another model which is most common is Farmer block, where parcel boundaries represent an area of one user. These boundaries are usually very fixed and do not change as much as agriculture parcel boundaries. However this model have also disadvantage of delineating Farmer block into agriculture parcels, particularly when country uses many different measures for subsidy. These diverse measures are very in common in countries with diverse landscape where many rural development measures are applied, which is the case in the Balkans.

Then there is another possible reference model which uses cadastral parcels. This is usually avoided as cadastre is not maintained regularly and situation on the ground is much different from what is in the cadastral maps.

There is also combination of these models where it is difficult to distinguish between the basic models according to the above definition. So it is quite in common to have model that is something between the agriculture parcel and farmer's block system. The reason behind is mainly because of the combination of measures that suits well to such model and various national decisions on most suitable approach.

The combined model between the agriculture parcel and farmer's block is also the case in the Republic of Slovenia. This model requires intensive regular yearly maintenance to ensure that the changes from the ground are always reflected in the system. The definition of the reference system is a continuous area of land which covers one single land use class and is used by one single user. There are many cases where these parcels match a definition of agriculture parcels, but there are also many reference parcels that need further delineation during the application process every year, to match the agriculture parcel definition for subsidy purpose.

The LPIS system in Slovenia is relatively young, but it has gone through several revisions so far, mainly to improve its quality and enhance usability. Once the LPIS is established and operational the main concern remains its maintenance and upgrading, all in terms of improving quality and satisfying the EU requirements. It is an ongoing challenge to keep it up to date, to reflect the real situation on the ground, to satisfy the agricultural policy changes and related measures and to satisfy many other users who found it useful in so many other fields than CAP.

The very similar model has been used also in the candidate country Republic of Croatia and in the Former Yugoslav Republic of Macedonia (FYROM).

In FYROM the process of establishing LPIS is now in the advanced stage, where the methodology, web based GIS software and infrastructure are in place and the process of digitalization is ongoing. The operators together with assistance from farmers define LPIS parcel boundaries, using background layers (land cadastre, topographic maps, land use layer).

In the Republic of Croatia the LPIS and IACS are already efficiently used for the subsidies for national measures, paid from the national budget, and it has proved to be excellent tool not to satisfy just the EU policy requirements but also national requirements.

BiH, the former Yugoslav republic has very much in common with the other Balkan countries in terms of land management in the past. This current land management has remain more or less unchanged with some new approaches which has proven as most suitable in the also in the neighboring countries. This is mainly introduction of digital orthophoto maps, digitalization and harmonization of land cadastre maps, setting up GIS environment, etc. This process highly improves the existing quality of the data and availability of such data. But it has proven in most member states (SI, CZ) and candidate countries (CRO, FYROM) that the cadastral maps does not represent very well the current agricultural situation on the ground. The overview of approaches adopted by the EU MS based on surveys from 2006 to 2008 indicated that only a few of the EU countries opted for the use of the cadastral parcel for their LPIS (Milenov and Kay, 2006; Zielinski and Sagris, 2008). Reasons for that are mainly due to lack of maintenance of the cadastre maps in the past, where on the other side agricultural activities represent dynamic changes on the ground every year which does not reflect in land cadastre. This gap between the agricultural practice on the ground and land cadastre maps can be in some places so big that is not possible to recognize any link with the register and current situation on the ground.

The main difficulty of the cadastral parcel as reference parcel, in contrast to other systems, is that it may contain both agricultural and non-agricultural land. So, the area eligible for the CAP payments cannot be directly quantified (Inan H.I., S. Valentina, 2010). However in most cases land cadastre maps represent good basis for identification of agricultural parcels, where assistance from the farmer is always needed.

Good approach for defining most appropriate LPIS model is to test the proposed methodology on a pilot area where analysis of existing data and cartographic material should be performed. It is important to incorporate into this process the current land management practice, where existing data like cadastral maps, topographic material and other available land records can help defining most suitable approach and LPIS model. Therefore, the best approach for establishing LPIS in B&H is to start with small pilot project where different elements need to be tested:

- availability of data,
- quality of land cadastre,
- changes on the ground,
- current trend of developing agricultural policy in the country,
- available infrastructure and possibilities for development.

Such pilot project should provide results such as optimal methodology for LPIS data capturing, most appropriate model to be adopted for reference parcel, needed resources, budget and time frame for full implementation.

## CONCLUSIONS

It became evident recently that the LPIS data is no more strictly dedicated to support the aid declaration and subsequent control. In fact the information stored in the LPIS is already broadly used by other external users. This is because, the reference parcels, together with the orthophotos and the attribute information on the land use, form the basic set of components, necessary for any decision regarding the land management. In addition, apart from the reference parcels themselves, the LPIS database contains other layers of information (or at least is able to overlay them on-the-fly), which together could be made broadly available through simple Web interface. In some MS, the LPIS is not more only a supporting tool for the IACS. The reform of CAP and the development of the 2nd pillar also put new requirements on the LPIS content. It is becoming in fact a Land Management Information System, providing data to many domains (JRC, 2012).

**A review of the current status of development of identified core AIS subcomponents in BiH shows that something like 15% of the required core AIS functionality is planned, being implemented or has been implemented. The current status of the general AIS shows that something less than 2% of functionality has been implemented (McNeill H.W., Ljuša M. et al., 2011). Development of LPIS system is very complex, time consuming and expensive. It usually takes few years before it became operational. Preparations for LPIS and IACS are in early stage. For these reasons, in case of BiH it is recommended to start with the initial activities as soon as possible to be able to use already for national policy and to be ready also for IPARD and CAP when it becomes relevant.**

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# QUANTIFYING THE EFFECTS OF ADVECTION PHENOMENON ON CANOLA EVAPOTRANSPIRATION IN EAST AZARBAIJAN REGION, IRAN

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## ABSTRACT

For this research canola was planted in a lysimeter located in the middle of the 1.6 hectare experimental field. Evapotranspiration rate, leaf area index and plant height were determined inside the lysimeter. The advection phenomenon was investigated using the energy balance in the field surface and Priestley-Taylor parameter ( $\alpha$ ), the ratio of evapotranspiration obtained from advection energy to vegetation surface evapotranspiration ( $R_{ad}$ ) and Bowen's ratio ( $\beta$ ) on different days after planting in the canola field were also determined. Negative values of sensible heat flux confirmed the advection occurrence from 39 days after planting and Values of  $\alpha$  showed that advection had affected evapotranspiration process in this region, significantly. The values of  $R_{ad}$  was reached to more than 60 percent in some days of the growing season. This issue clearly proved the influence of advection energy on canola field evapotranspiration. In the study region except regional advection, local advection could occur across large fields due to small parts of farms, different timings and amounts of irrigation and fallow duration of some farms.

Key Words: Advection, canola, energy balance, evapotranspiration,

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## INTRODUCTION

In wet regions, the maximum rate of evapotranspiration can be estimated using the received net radiation to vegetation surface. In arid and semi arid regions rather to the net radiation, advection by horizontal movement of sensible heat from around area has an important role on evapotranspiration energy supply. Advection occurs when sensible heat is high enough to produce a mass flow next to the ground (McNaughton, 1983; Diaz-Espejo, 2005). This phenomenon may take place in small local or large regional areas and is expected to have a significant effect on energy exchange of heterogeneous surfaces (Rosenberg, 1983). The heterogeneity may be caused with different application of irrigation regimes, climatic conditions and land use. The two kinds of local and regional advectons can be occurred due to different irrigation practices of the adjacent fields (Lee, 2004). Evapotranspiration from irrigated farms are considerably affected by advection in arid and semi arid areas (Rosenberg, 1969; Hanks, 1971; Brakke, 1978). Rosenberg (1969), using a lysimeter found that the equivalent energy of measured evapotranspiration in an alfalfa field was twice larger than the received solar radiation energy, as the access energy was supplied via movement of the sensible heat from the surrounded dry lands. A significant role of advection on supplying the available energy at the field has been approved by Diaz-Espejo (2005), using a set of installed micro lysimeters in the experimental plots. Kochendorfer (2011) noted the importance of advection in heterogeneous surfaces boundary condition and estimated its effects near 20% of the energy balance budget. An under estimation about 30 to 40 percent in calculation of evapotranspiration due to advection ignorance has been reported by Hanks (1971) and Howell (1997). Advection occurrence changes the energy equilibrium in a region and increases the evaporation rate. This excess evapotranspiration is independent of net radiation and is related to the evaporation latent and sensible heat exchange in the region (McNaughton, 1976). Different procedures have been used by researchers in advection studies. Li (2007) considered ET as the sum of evapotranspiration which could be resulted from the equilibrium of available and advection energies ( $ET_{eq}$  and  $ET_{ad}$ ). Similar concepts for advection have been used by McNaughton (1983) and Smith (1997). When the ET amount due to warm air entrance is greater than  $ET_{eq}$ , the air sensible heat changes to the evaporation latent heat and evapotranspiration energy increases to more than the available energy at the field. Some investigators (Jury, 1975; Flint, 1991; Pereira, 1992; Stannard, 1993; Li 2007; Lei, 2010) use the coefficient of Priestly and Taylor (1972) and some other (Li, 2007; Suyker, 2008; Lei, 2010) use Bowen ratio as the criteria to identify the advection occurrence in arid and semi arid areas.

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The goals of this research is: 1-Study of the advection phenomenon in Tabriz area by using different methods and 2- Investigation of the advection effect on energy equilibrium and evapotranspiration process in a canola field in this area.

## MATERIAL AND METHODS

This experiment was carried out during the growing season of 2010 at the experimental farms of the Agriculture Faculty, University of Tabriz, Iran (latitude, longitude and elevation of station are 37° 03' north, 46° 37' east and 1567.3 m above sea level, respectively). The climate in the experimental area is terrestrial, summers are mild and dry, and winters are cold and snowy. The soil of the research area has a sandy-loam texture. The average values of field capacity, permanent wilting point and bulk density of the soil in effective root depth are 0.28 (m<sup>3</sup>m<sup>-3</sup>), 0.125 (m<sup>3</sup>m<sup>-3</sup>) and 1.58 g cm<sup>-3</sup>, respectively. The water holding capacity of the experimental site was observed as 140 mm in 0-90 cm profile (Majnooni-Heris, 2012a).

The planted cultivar was RGS003, spring type of canola and the crops were sown in 20 April 2010 in a drainable lysimeter located in the middle of the experimental field and surrounded by the same crops. The crop was harvested on early August in experimental year. The surface area of the lysimeter was 7.065 m<sup>2</sup> and its depth was 2 m. planting and all other treatments inside the lysimeter and in the surrounding field were the same. Seeding density was controlled to be 80 plants per m<sup>2</sup>. Volumetric soil water contents were measured by PR2 (Profile Probe, Delta-T) at the depths of 0.1, 0.2, 0.3, 0.4, 0.6 and 1 m in seven-day intervals before irrigation events. The required irrigation water was measured based on soil water depletion replenishment of canola in a period of 7 days.

The daily reference evapotranspiration, ( $ET_o$ ), was calculated according to the FAO Penman-Monteith equation (Allen, 1998). Crop evapotranspiration estimated by day after planting based on crop coefficient equation (Majnooni-Heris, 2012a). Meteorological data including, temperature, relative humidity, wind speed, sunshine hour, solar radiation and rain were measured in the weather station of Agriculture Faculty.

The advection phenomenon was investigated using the energy balance in the field surface and Priestley-Taylor parameter ( $\alpha$ ), the ratio of evapotranspiration obtained from advection energy to vegetation surface evapotranspiration ( $R_{ad}$ ) and Bowen's ratio ( $\beta$ ) on different days after planting in the canola field.

Considering the effects of advection on evapotranspiration, McNaughton (1976) introduced the concepts of advective enhancement and advective depression of evapotranspiration rates. Evapotranspiration from crop fields ( $ET$ ) can be expressed as the sum of an equilibrium term ( $ET_{eq}$ ) contributed by the available energy at the site, and an advective term ( $ET_{ad}$ ) due to the extra energy made available at the site through advection. Hence,  $ET_{ad} = ET - ET_{eq}$ , where  $E_{ad}$  is positive for advective enhancement or negative for advective depression. Equilibrium evaporation can be computed as (McNaughton, 1976; Pereira, 2004):  $ET_{eq} = \frac{\Delta}{\Delta + \gamma} (R_n - G)$ , where  $\Delta$  is the slope of the temperature-saturation vapour pressure relationship,  $\gamma$  is the psychrometric constant,  $R_n$  is the net radiation above the canopy, and  $G$  is the soil heat flux at the ground surface. If local or regional advection occurs, actual evapotranspiration deviates from the equilibrium point and shows enhancement or depression. This effect does not depend on net radiation but on exchanges of latent and sensible heat energy fluxes at the canopy-air interface (McNaughton, 1976). When  $ET$  is greater than  $ET_{eq}$  due to warm and dry air entering the canopy, the sensible heat is converted to latent heat and canopy evapotranspiration is enhanced without consuming additional available energy. The ratio of  $R_{ad}$  is usually used to describe the percentage contribution of advection to  $ET$  as  $R_{ad} = \frac{ET_{ad}}{ET} \times 100$  (Smith, 1997). Priestley and Taylor (1972) proposed that  $ET$  can be computed by  $ET = \alpha \frac{ET_{eq}}{ET_{eq}}$ , where  $\alpha$  is called the Priestley-Taylor parameter. The Priestley-Taylor approach is based on the assumption that the effect of turbulence is small compared to the effect of radiation, so the aerodynamic and canopy resistances are considered as zero. This estimation of  $E$  depends on the accurate determination of the value of  $\alpha$ , which is a function of the

Bowen's ratio and temperature and expressed as  $a = \frac{\Delta + \gamma}{\Delta(1 + \beta)}$ , where  $\beta$  is the Bowen's ratio, which is the ratio of sensible heat flux ( $H$ ) to latent heat flux ( $LE$ ). In this research  $H$  was calculated from energy balance equation. Also all other parameters such as  $\Delta$ ,  $\gamma$ ,  $R_n$  and  $G$  calculated by FAO-56 recommendation methods (Allen, 1998).

## RESULTS

Variation of energy balance equation factors including the difference of net radiation with soil heat flux ( $R_n - G$ ), latent heat flux ( $\lambda ET$ ) and sensible heat flux ( $H$ ) are shown in Figure 1. The advection occurs when the sensible heat flux is negative in a region (McNaughton, 1983). The negative value of sensitive heat flux as showed in Figure 2 proved the advection occurrence in the study canola field. At the beginning of the study period, due to ground uncompleted vegetation cover there is no considerable sensible heat gradient in the region but, by developing the growth and cover of the plant and consequently increasing of temperature gradient between the canola field and surrounding lands, advection performs.

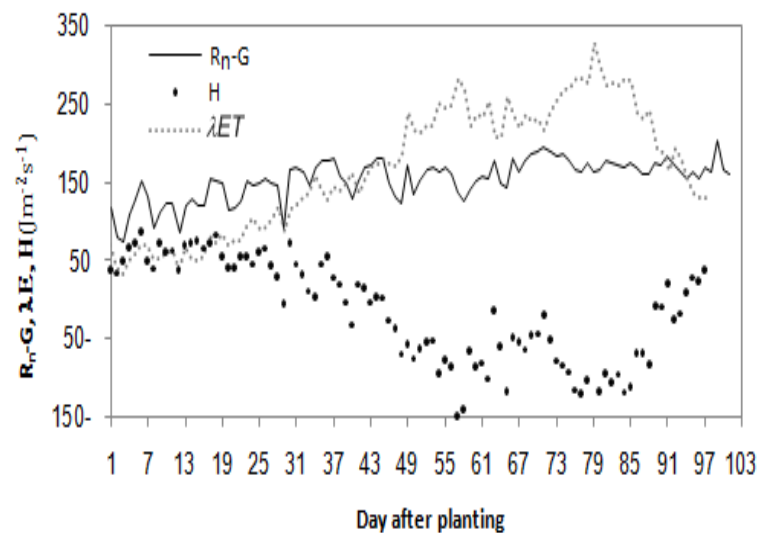


Figure 1: Available energy ( $R_n - G$ ), latent heat flux ( $\lambda ET$ ) and sensible heat flux ( $H$ ) over the study period.

The minimum value of sensible heat flux was  $-150$  in two months after planting and its' maximum was  $97 \text{ Jm}^{-2}\text{s}^{-1}$  at early stage of growing season. Li (2007) obtained the sensible heat flux value between  $-100$  to  $120$  in a wheat farm. Lei (2010) determined the minimum and maximum values of the sensible heat flux between  $-57.87$  and  $92.6 \text{ Jm}^{-2}\text{s}^{-1}$  in a wheat farm.

The Priestley-Taylor parameter ( $\alpha$ ) was calibrated for the study site based on measured data. The standard value for Priestley-Taylor parameter is reported  $1.26$  (Priestley-Taylor, 1972; Stannard, 1993). Pereira (1992) showed that the value of  $1.26$  for  $\alpha$  is suitable at potential condition of evapotranspiration occurrence, but it is not valid in presence of the advection. Jury and Tanner (1975) reported values around  $1.57$  under strongly advective conditions. The trend of this parameter is illustrated in figure 2 in different days after planting. Considering the horizontal dash-lines in this figure that present the values of  $1.26$  and  $1.57$  for Priestley-Taylor parameter, it can be concluded that the evapotranspiration rate is affected by advection from  $29^{\text{th}}$  to  $92^{\text{th}}$  days after canola planting in this location.

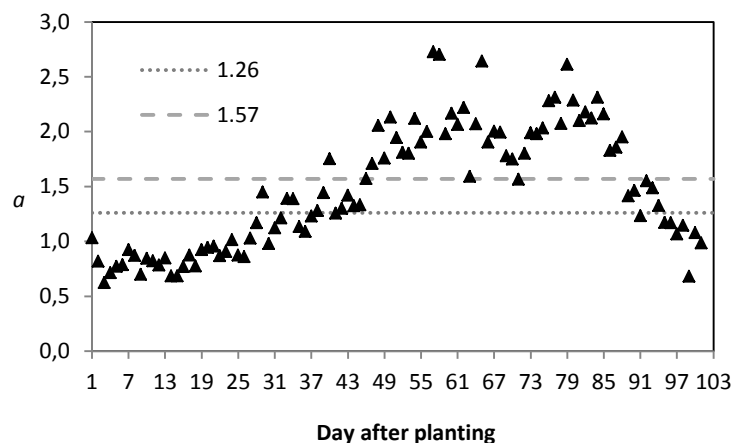


Figure 2: Trend of computed Priestly-Taylor parameter ( $\alpha$ ) in the days after planting of canola.

At the end of growth period and probably due to plant maturity and irrigation cut-off and consequently decreasing the trend of evapotranspiration rate, again the heat gradient between the farm and surrounding area is decreased and Priestley–Taylor parameter falls below 1.26. The range of Priestley–Taylor parameter is determined as 0.62-2.73 at the experimental field. The results almost have a good agreement with the values reported by Li (2007), Lei (2010) and Flint (1991). Variation of the sensible heat flux versus the Priestley–Taylor parameter ( $\alpha$ ) showed that, for the values less than 1.4, the estimated sensible heat flux is positive and it is negative for the values higher than 1.4. This finding has a good accordance with Diaz-Espejo (2005) reported results. They reported the parameter ( $\alpha$ ) value 1.4 as a threshold value for advection occurrence in small experimental farm plots.

Variation of advection ratio to rate of vegetation cover evapotranspiration ( $R_{ad}$ ) during the study period is shown in Figure 3. Positive value of  $R_{ad}$  shows that the value of ET is greater than  $ET_{eq}$  indicating advection occurrence in the region. As depicted in Figure 3 in some days of growth season the values of  $R_{ad}$  are reached to more than 60 percent. This issue clearly shows the effect of advective energy on canola evapotranspiration. Li (2007) reported the daily and hourly values of  $R_{ad}$  up to 50 and 300 percent for a wheat farm in north of China, respectively.

Bowen's ratio values ( $\beta$ ) in wet areas are small and in the range of 0-0.1 but it can be increased to 10 in dry areas. If there is a heat flux displacement through the vegetation cover, the values of  $\beta$  become negative and may decrease to -0.03 in strongly advective conditions (Rosenberg, 1983). The Bowen's ratio is calculated for different days after planting date at a canola farm, using the ratio of sensible heat flux to the evaporation latent heat. The negative value of this ratio proves the occurrence of sensible heat flux and advection through the experimental farm. At the initial stage of growing season, when the canopy development is not full and there is no a considerable temperature gradient between the farm vegetation cover and its surrounding areas, this ratio is positive. In the days of 29<sup>th</sup> and 40<sup>th</sup> after planting date and continuously from the day of 46<sup>th</sup> to the day of 93<sup>th</sup>, the values of  $\beta$  ratio are negative. The Bowen ratio is reached to its minimum value (-0.53) in the day of 57<sup>th</sup> after planting date and its maximum value 1.52 is obtained in initial stage of growing season. At the end stage of growing season, this ratio ( $\beta$ ) is increased to positive value of 0.94 due to decrease of advection effect. Suyker (2008) determined the values of Bowen ratio in the range of -0.3 to 0.3 for soya and maize farms. Also Suyker (2009) obtained this ratio as 1.8 for the end stage of maize growing period at the agricultural research center of Nebraska. In total, the average seasonal evapotranspiration ( $ET$ ) and equilibrium evaporation ( $E_{eq}$ ) were 582 and 390 mm respectively, showed 33% rise in evapotranspiration due to advection phenomenon in the study field. This may be due to effects of the field surrounded bare ground, almost 20% of this plain was cultivated. Similar rises in evapotranspiration values are reported by Majnooni-Heris (2012b; 2013), for maize and grass, 24% and 19.48% at the same study area, respectively.

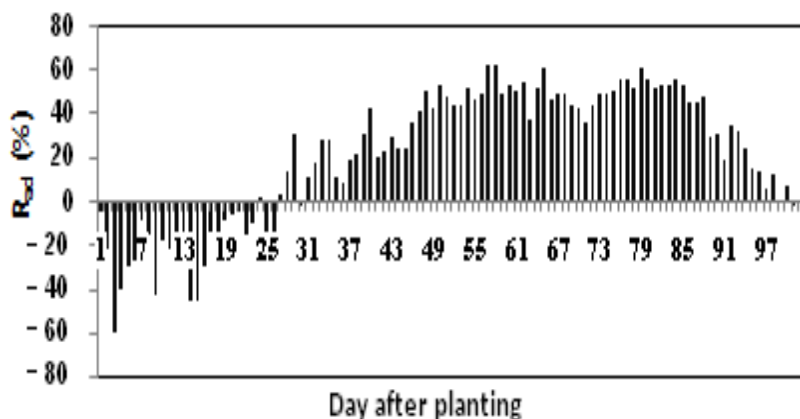


Figure 3: Computed daily  $R_{ad}$  during the canola growing season.

## CONCLUSION

In this paper we have tried to evaluate advection occurrence with different methods in the North West of Iran. It was found enhanced canopy evapotranspiration induced by enhanced advection in the canola crop field. Results showed advection had raised 33% the total seasonal canola evapotranspiration. Negative values of sensible heat flux confirmed advection occurrence from 39 days after planting and values of  $\alpha$  showed that advection had affected evapotranspiration process in this region, significantly. The values of  $R_{ad}$  was reached to more than 60 percent in some days of the growing season. This issue clearly proved the influence of advection energy on canola field evapotranspiration. In the study region except regional advection, local advection could occur across large fields due to small parts of farms, different timings and amounts of irrigation and fallow duration of some farms. It is well known that the effects of advection on evapotranspiration are controlled by the canopy conductance. The effects of advection on evapotranspiration have important implications for the large-scale estimation of evapotranspiration in irrigated fields of arid and semi arid regions and irrigation water management. The enhanced evapotranspiration by advection should be considered in estimation of irrigation requirement, otherwise desirable irrigation efficiency and adequacy could not be achieved in large scale irrigated fields.

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# THE EFFECTS OF OLIVE LEAVES ADDITION BEFORE EXTRACTION ON OILS QUALITIES OF "AYVALIK" AND "MEMECIK" OLIVE CULTIVARS

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## ABSTRACT

This research aimed to study the effects of olive leaves addition (0, 1, 3 %) on quality parameters, fatty acid composition and sensorial properties of Aegean olive oils during 18 months storage, in Turkey. The olives were conducted from Olive Research Station orchard, 2008/09 and 2009/10 crop seasons. In each year, "Ayvalik" and "Memecik" olive fruits harvest dates were decided according to maturation index. The leaves were collected from the same trees at the same times with the fruits and added during crushing of olive fruits. Quality parameters, fatty acid composition and sensorial properties were evaluated. The olive oil free fatty acidity 0.60 % and 0.26 %, 0.81 % and 0.50 % (oleic acid %), peroxide value 5.19 and 4.98 meqO<sub>2</sub>/kg oil, 4.86 and 5.79 meqO<sub>2</sub>/kg oil, K232 value 1.736 and 1.871, 1.633 and 1.752, K270 value 0.142 and 0.164, 0.142 and 0.186, the major fatty acid of oleic acid content 67.40 % and 74.20 %, 70.48 % and 72.97 %, linoleic acid 12.92 % and 8.59 %, 10.16 % and 7.70 % and linolenic acid 0.70 % and 0.86 %, 0.66 % and 0.92 % were determined in "Ayvalik" and "Memecik" olive oils, 2008/09 and 2009/10 crop seasons, respectively. With addition of olive leaves olive oil free fatty acidity not changed in 2008/09, but significantly changed in 2009/10 (p<0.001), peroxide value was significantly increased in 2008/09 (p<0.001), but not changed in 2009/10, K232 and K 270 values significantly changed both years, oleic and linoleic acid changed significantly in 2008/09 (p<0.001), but not changed in 2009/10, linoleic acid changed significantly in both years.

**Key Words:** Quality parameters, fatty acid composition, shelf life, sensorial properties, olive oil.

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## INTRODUCTION

Olive tree is one of the most important fruit trees in Mediterranean countries. In Turkey, "Ayvalik" and "Memecik" are the most widespread and dominant olive cultivars in the Egean Region. Harvest time is the most important aspect for obtaining high quality olive oils. Olive oils early harvested have usually of good quality, with low free acidity, peroxide value, K232 and K270 values. Those oils have also very superior sensorial attributes olive oils extracted from maturity olives show lower resistance to oxidation and loss of sensorial attributes with chemical composition (Malheiro et al., 2011).

Several studies handle with the antioxidant activity and chemical composition of the olive fruits and oil have been researched. Only a few works have been focused on the olive leaves. Antioxidant compounds can improve shelf life by restrain the process of lipid oxidation, which is the major reason for deterioration of food products and oils during processing and storage. For that reason, alternative natural and safe sources of food antioxidants have been created (Bouaziz and Sayadi, 2005). In recent years, especially natural antioxidants, which are plant origin, research has increased (Zainol et al., 2003). Olive leaves are one of them. It has been shown potent antioxidant properties, because of high oleuropein content (Garcia et al., 2000; Briante et al., 2002; Visioli et al., 2002; Bouaziz and Sayadi, 2005).

The aim of this research is to investigate of "Ayvalik" and "Memecik" olive oils chemical and sensorial quality that are enhanced with olive leaves (0 %, 1 % and 3 %) during extraction. The extracted olive oils were characterized for quality parameters, fatty acids composition and sensorial attributes during 18 month storage.

## MATERIAL AND METHODS

### Materials

### Olive Leaves and Fruit Sampling

The research was conducted in Ministry of Food, Agriculture and Livestock Directorship of Olive Research Station "Memecik" olive orchards in Izmir/Turkey, during the harvest seasons of 2008/09-2009/10. Harvest dates were decided according to olive maturity index (MI). The MI values was 3,9 for the

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olives which picked by hand in November. Olive leaves were also collected from the same trees at the same time as the fruits. The following percentages of olive leaves by weight were added (w/w) to olives before crushing: 0 % (control), 1 % and 3 %.

## Methods

### *Maturity Index (MI)*

Maturity index, which method proposed by the International Olive Oil Council (2007), based on the color of the olive skin, is calculated by collecting approximately kg of olives.

### *Oil Extraction*

Olives and leaves were washed and then were extracted by using Abencor System which has include fruit crushing, malaxation and centrifuge parts in the laboratory urgently. All oil samples were filtered and stored at room temperature in darkness using amber glass bottles (100 ml). Oil samples were analysed as soon as they extracted. After their analyses, they were kept for 6, 12 and 18 months (stored) for next analysis.

### *Olive Oil Analyses*

Free fatty acidity (FFA), the peroxide value (PV), and  $K_{232}$  and  $K_{270}$  were measured, following the analytical methods described in European Regulation EEC 2568/91 (Anonymous, 1991).

For the determination of fatty acid composition, the methyl-esters were prepared by the standard method (Anonymous, 1996) and analyzed by GC with a HP 6890 (Hewlet Packard Inc., USA) chromatograph equipped with an FID detector. A DB-23 capillary column (30m\*0.25 mm id \* 0.250  $\mu$ m film thickness. J&W Scientific, Folsom, CA, USA) was used. Helium was employed as a carrier gas with a flow of 0.5 ml/min. The temperature of the injector and detector were set at 250 °C and the GC oven temperature was initiated at 170 °C. This temperature was maintained for 8 min, and then increased to 210 °C and kept for 10 min. The injection volume was 1  $\mu$ l.

### *Sensory Analysis*

The sensory analysis of olive oil was done by TARIS, following the methods described International Olive Oil Council (method for the organoleptic assessment of virgin olive oil COI/T.20/Doc. No 15/Rev. 2) (Anonymous, 2007).

### *Statistical Analysis*

All data for each year were subjected to analysis of variance (ANOVA) with SPSS for Windows v 11 (SPSS Inc., USA) separately. For oil data the experimental design was completely randomized split split plots with storage period as the main, cultivar as the sub, and leaf ratio as the micro plots with three replications. The differences between the means were determined with the Fischer's Least Significant Difference (LSD) test.

## RESULTS AND DISCUSSION

The results obtained in the free fatty acidity of cv. Ayvalık and Memecik olive oils, from 2008 and 2009, extracted with different percentages of olive leaves presented in Table 1. In our research, free acidity was not affected by leaves added in any percentage to the olives in 2008. But in 2009, significant difference was determined with addition of leaves ( $P < 0.001$ ) (Table 1, Figure 1) Results agreed with the findings of other authors (L. Di Giovacchino et al., 1996; Malheiro et al., 2011). During the storage, an increase was observed in free acidity ( $P < 0.001$ ), in agreement with the data reported in literature (Gambacorta et al., 2010). We determined that the free acidity was not affected at the storage periods (0,

6, 12 and 18 months) and leaves percentage interaction in both years. In both years, cv. Ayvalik olive oil free acidity is higher than cv. Memecik olive oil (Figure 2) ( $P<0.001$ ).

Table 1. Changes in free fatty acidity (oleic acid %) of olive oils obtained with different leaf additions during 2008 and 2009 years.

Years		Storage Period (Months)				P value	LSD*
		0	6	12	18		
2008	0%	0.4±0.25**	0.41±0.25	0.44±0.23	0.46±0.23	n.s.	0.02
	1%	0.39±0.23	0.41±0.21	0.45±0.23	0.44±0.23		
	3%	0.39±0.26	0.41±0.24	0.45±0.24	0.47±0.28		
	SP	0.39±0.01 <sup>B</sup>	0.41±0.00 <sup>B</sup>	0.45±0.00 <sup>A</sup>	0.45±0.02 <sup>A</sup>	<0.001	
2009	0%	0.61±0.21	0.66±0.18	0.69±0.21	0.77±0.23	n.s.	0.03
	1%	0.54±0.18	0.58±0.23	0.63±0.27	0.71±0.28		
	3%	0.62±0.19	0.65±0.19	0.66±0.20	0.74±0.25		
	SP	0.59±0.05 <sup>D</sup>	0.63±0.04 <sup>C</sup>	0.66±0.03 <sup>B</sup>	0.74±0.03 <sup>A</sup>	<0.001	

Least Significant Difference ( $\alpha=0.05$ ) \*\*Standard deviation, A,B,C,D: Shows differences between the samples, n.s. not significant

Peroxide value was increased with enhance of olive leaves in 2008 ( $P<0.001$ ) from 4.66 to 5.41 meqO<sub>2</sub>/kg oil, respectively 0 % and 3 %. However in 2009, significant difference was not determined (Table 2, Figure 1). Peroxide value of oils were significantly increased during the storage peiods ( $P<0.001$ ), from 4.10 to 6.32 meqO<sub>2</sub>/kg oil, from 3.62 to 7.16 meqO<sub>2</sub>/kg oil, in 2008 and 2009, respectively. The authors have reported that during the storage periods, peroxide value was increased because of oxidation (Gomez-Alonso et al., 2007; Gambacorta et al., 2010). We determined that, in 2008 cv. Ayvalik olive oil peroxide value is higher than cv. Memecik olive oil, but in 2009 cv. Memecik olive oil peroxide value is higher than cv. Ayvalik olive oil (Figure 2) ( $P<0.001$ ).

Table 2. Changes in peroxide value (meqO<sub>2</sub>/kg oil) of olive oils obtained with different leaf additions during 2008 and 2009 years.

Years		Storage Period (Months)				P value	LSD*
		0	6	12	18		
2008	0%	3.86±0.52**f	3.98±0.38 <sup>f</sup>	4.76±0.19 <sup>d</sup>	6.06±0.94 <sup>b</sup>	<0.001	0.16
	1%	3.99±0.61 <sup>f</sup>	4.76±0.25 <sup>d</sup>	5.49±0.30 <sup>c</sup>	6.47±0.75 <sup>a</sup>		
	3%	4.44±0.23 <sup>e</sup>	4.84±0.14 <sup>d</sup>	5.93±0.70 <sup>b</sup>	6.44±0.078 <sup>a</sup>		
	SP	4.10±0.31 <sup>D</sup>	4.53±0.48 <sup>C</sup>	5.39±0.59 <sup>B</sup>	6.32±0.23 <sup>A</sup>	<0.001	
2009	0%	3.55±0.31 <sup>f</sup>	4.91±0.27 <sup>d</sup>	5.45±0.50 <sup>b</sup>	7.18±0.67 <sup>a</sup>	<0.05	0.31
	1%	3.32±1.00 <sup>f</sup>	5.22±0.79 <sup>bc</sup>	5.49±0.43 <sup>b</sup>	7.18±0.76 <sup>a</sup>		
	3%	4.00±1.09 <sup>e</sup>	5.07±0.63 <sup>cd</sup>	5.37±0.46 <sup>b</sup>	7.13±0.93 <sup>a</sup>		
	SP	3.62±0.35 <sup>D</sup>	5.07±0.16 <sup>C</sup>	5.44±0.06 <sup>B</sup>	7.16±0.03 <sup>A</sup>	<0.001	

\* Least Significant Difference ( $\alpha=0.05$ ) \*\*Standard deviation, a,b,c,d,; A, B,C,D: Shows differences between the samples,

The values of K<sub>232</sub> and K<sub>270</sub> are one of the most important indicators of the extension of oxidation, K<sub>232</sub> is related to the primary oxidation and K<sub>270</sub> is related to the secondary oxidation of oil (Baccouri et al., 2007). The value of K<sub>232</sub> extinction coefficients showed decrease with addition of olive leaves in 2008 ( $P<0.001$ ). In 2009, the highest K<sub>232</sub> value was detected in the olive oils with 1 % of leaves, nearly 4.9 % above the control and 3 % ( $P<0.01$ ) (Table 3, Figure 1). During the storage, the index increased significantly ( $P<0.001$ ), but it did not exceed the limits established by Regulation EEC/1989/2003 of the European Comission for extra virgin olive oil (<2.5), in both years. Results agreed with the findings of



other authors (Gomez-alonso et al., 2007; Mendez and Falque, 2007; Gambacorta et al., 2010). As for interaction between storage periods and leaves percentage, at the end of the 18 months the highest  $K_{232}$  values were detected in control and in the olive oil with 1 % olive leaves, in 2008 and 2009, respectively.  $K_{232}$  and  $K_{270}$  values were significantly higher in cv. Memecik olive oil, in both years (Figure 2) ( $P < 0.001$ ).

Table 3. Changes  $K_{232}$  values of olive oils obtained with different leaf additions during 2008 and 2009 years.

Years	Storage Period (Months)				P value	LSD*
	0	6	12	18		
2008	0%	1.513±0.10 <sup>**hi</sup>	1.586±0.05 <sup>g</sup>	1.951±0.24 <sup>cd</sup>	2.396±0.36 <sup>a</sup>	
	1%	1.473±0.09 <sup>i</sup>	1.644±0.05 <sup>f</sup>	1.971±0.09 <sup>c</sup>	2.130±0.02 <sup>b</sup>	<0.001 0.048
	3%	1.522±0.09 <sup>h</sup>	1.657±0.01 <sup>f</sup>	1.882±0.13 <sup>e</sup>	1.915±0.15 <sup>de</sup>	
	SP	1.503±0.03 <sup>D</sup>	1.629±0.04 <sup>C</sup>	1.934±0.05 <sup>B</sup>	2.147±0.24 <sup>A</sup>	<0.001 0.036
2009	0%	1.527±0.02 <sup>g</sup>	1.657±0.12 <sup>e</sup>	1.748±0.17 <sup>c</sup>	1.825±0.14 <sup>b</sup>	
	1%	1.511±0.08 <sup>g</sup>	1.638±0.09 <sup>e</sup>	1.773±0.04 <sup>c</sup>	1.955±0.05 <sup>a</sup>	<0.01 0.042
	3%	1.537±0.01 <sup>f<sup>g</sup></sup>	1.577±0.05 <sup>f</sup>	1.701±0.17 <sup>d</sup>	1.857±0.11 <sup>b</sup>	
	SP	1.525±0.01 <sup>D</sup>	1.624±0.04 <sup>C</sup>	1.741±0.04 <sup>B</sup>	1.879±0.07 <sup>A</sup>	<0.001 0.038

\* Least Significant Difference ( $\alpha=0.05$ ) \*\*Standard deviation, a,b,c,d; A,B,C,D: Shows differences between the samples

The value of  $K_{270}$  extinction coefficients showed increase with addition of olive leaves in 2008 and 2009 ( $P < 0.001$ ) (Table 4, Figure 2). Results are agreed with Malheiro et al. (2011). During the storage, the oxidation increased significantly from 0.119 to 0.184 and from 0.150 to 0.184, in 2008 and 2009, respectively ( $P < 0.001$  and  $P < 0.01$ ). We determined that the  $K_{270}$  value was not affected at the storage periods (0, 6, 12 and 18 months) and leaves percentage interaction in both years.

Table 4. Changes  $K_{270}$  values of olive oils obtained with different leaf additions during 2008 and 2009 years.

Years	Storage Period (Months)				P value	LSD*
	0	6	12	18		
2008	0%	0.112±0.02 <sup>**</sup>	0.124±0.04	0.155±0.02	0.179±0.00	
	1%	0.12±0.01	0.136±0.03	0.172±0.01	0.183±0.00	n.s.
	3%	0.125±0.01	0.158±0.01	0.183±0.02	0.189±0.02	
	SP	0.119±0.01 <sup>D</sup>	0.139±0.02 <sup>C</sup>	0.170±0.01 <sup>B</sup>	0.184±0.00 <sup>A</sup>	<0.001 0.010
2009	0%	0.137±0.04	0.141±0.04	0.155±0.04	0.172±0.04	
	1%	0.14±0.04	0.151±0.04	0.157±0.04	0.184±0.01	n.s.
	3%	0.172±0.02	0.176±0.02	0.186±0.02	0.195±0.03	
	SP	0.150±0.02 <sup>C</sup>	0.156±0.02 <sup>BC</sup>	0.166±0.02 <sup>B</sup>	0.184±0.01 <sup>A</sup>	<0.01 0.014

\* Least Significant Difference ( $\alpha=0.05$ ) \*\*Standard deviation. A,B,C,D: Shows differences between the samples, n.s. not significant

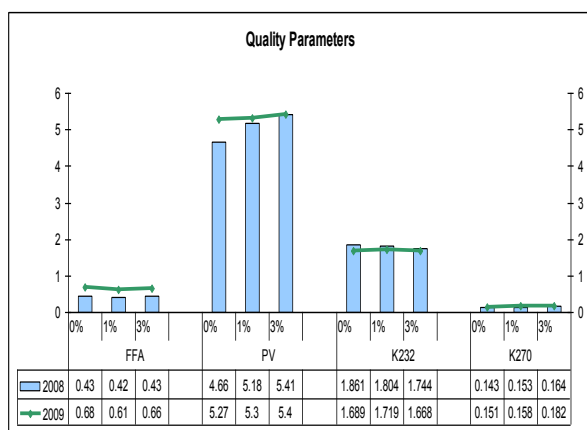


Figure 1. Changes quality parameters of olive oils obtained with different leaf additions during 2008 and 2009 years.

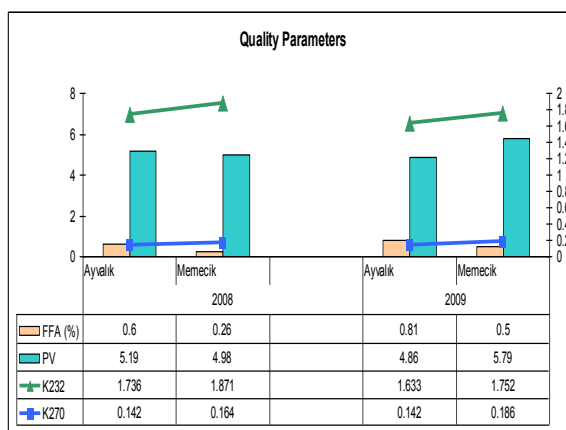


Figure 2. Changes quality parameters of olive oils obtained from cv. Ayvalik and Memecik during 2008 and 2009 years.

Oleic acid, quantitatively the most important fatty acid in olive oil (Baccouri et al., 2007), in 2008 the lowest oleic acid was detected in the olive oils with 1 % of leaves ( $P<0.001$ ) (Table 5, Figure 3). During the storage periods oleic acid content was increased in 2008, as a result of degradation of linoleic and linolenic acid (Morello et al., 2004) and decreased in 2009, as a result of oxidation ( $P<0.001$ ). In our research, we determined that, cv. Memecik olive oil oleic acid is, 74.20 % and 72.97 %, in 2008 and 2009, respectively (Figure 4) ( $P<0.001$ ).

Table 5. Changes oleic acid (%) of olive oils obtained with different leaf additions during 2008 and 2009 years.

Years	Storage Period (Months)				P value	LSD*
	0	6	12	18		
2008	0%	70.51±4.41**	72.05±3.98	73.04±3.49	71.22±4.98	n.s.
	1%	69.4±5.08	70.22±5.11	70.56±4.45	70.08±5.29	
	3%	69.53±5.08	71.31±4.91	71.81±4.45	69.84±4.55	
	SP	69.81±0.61 <sup>D</sup>	71.19±0.78 <sup>B</sup>	71.80±0.92 <sup>A</sup>	70.38±0.74 <sup>C</sup>	
2009	0%	72.13±1.59	70.93±1.98	71.33±2.35	72.06±1.47	n.s.
	1%	72.55±1.43	71.45±2.15	71.26±1.75	71.8±1.82	
	3%	72.97±0.99	71.15±1.60	71.29±2.06	71.83±1.92	
	SP	72.55±0.42 <sup>A</sup>	71.17±0.26 <sup>C</sup>	71.29±0.03 <sup>C</sup>	71.90±0.14 <sup>B</sup>	

\* Least Significant Difference ( $\alpha=0.05$ ) \*\*Standard deviation, A,B,C,D: Shows differences between the samples, n.s. not significant

Linoleic acid content was increased with addition of olive leaves in 2008 ( $P<0.001$ ) from 10.33 % to 10.93 %, respectively 0 % and 3 %. The results were agreement with Malheiro et al. (2011). However in 2009, significant difference was not determined (Table 6, Figure 3). During 18 months, linoleic acid content of oils were significantly decreased ( $P<0.001$ ) in 2008, nearly 6.31 %. The authors have reported that during the storage periods, linoleic acid content was decreased because of oxidation (Gomez-Alonso et al., 2007). We determined that, cv. Ayvalik olive oil linoleic acid content is higher than cv. Memecik olive oil, both years (Figure 4) ( $P<0.001$ ).

**Table 6. Changes linoleic acid (%) of olive oils obtained with different leaf additions during 2008 and 2009 years.**

Years		Storage Period (Months)				P value	LSD*
		0	6	12	18		
2008	0%	11.10±3.51 <sup>**b</sup>	9.98±2.96 <sup>f</sup>	10.16±2.51 <sup>f</sup>	10.08±2.75 <sup>f</sup>	<0.001	0.19
	1%	11.05±3.25 <sup>bc</sup>	10.96±3.33 <sup>cd</sup>	11.26±3.37 <sup>a</sup>	10.79±2.79 <sup>d</sup>		
	3%	11.17±3.13 <sup>ab</sup>	10.77±3.35 <sup>d</sup>	11.29±3.34 <sup>a</sup>	10.47±2.45 <sup>e</sup>		
	SP	11.11±0.06 <sup>A</sup>	10.57±0.52 <sup>B</sup>	10.90±0.65 <sup>A</sup>	10.45±0.36 <sup>B</sup>		
2009	0%	9.11±1.84	8.85±1.82	8.91±1.85	8.86±1.73	n.s.	
	1%	9.13±1.79	8.99±1.75	8.89±1.84	8.88±1.56		
	3%	8.98±1.90	8.91±1.60	8.71±1.65	8.9±1.54		
	SP	9.08±0.08	8.92±0.07	8.83±0.11	8.88±0.02		

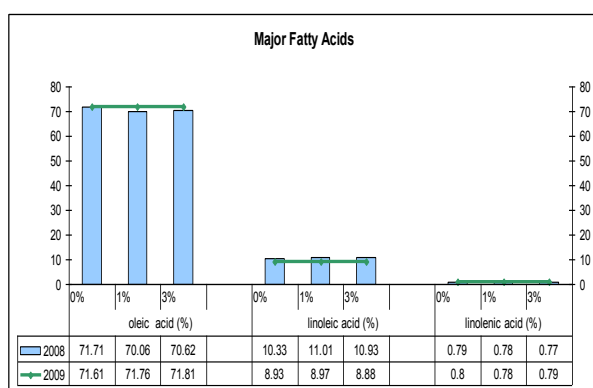
\* Least Significant Difference ( $\alpha=0.05$ ) \*\*Standard deviation, a,b,c,d; A,B,C,D: Shows differences between the samples, n.s. not significant

In 2008, a considerable decrease in the linolenic acid content observed with addition of leaves ( $P<0.05$ ) in 2008, an important decrease observed with 1 % of leaves ( $P<0.001$ ) (Table 7, Figure 4). The results were agreement with Malheiro et al. (2011). During 18 months linolenic acid content of olive oils were significantly decreased ( $P<0.001$  and  $P\leq 0.001$ ). The cv. Ayvalik olive oil presented a lower linolenic acid content than cv. Memecik olive oil, both years (Figure 4) ( $P<0.001$ ).

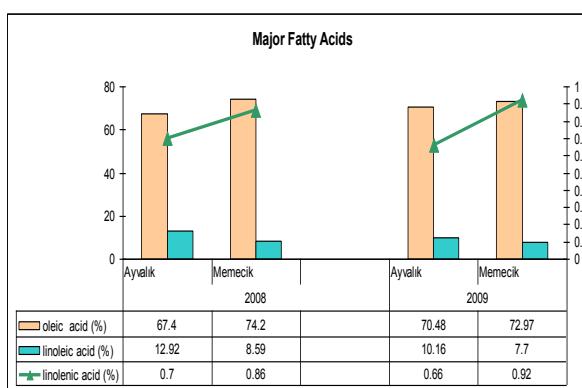
**Table 7. Changes linolenic acid (%) of olive oils obtained with different leaf additions during 2008 and 2009 years.**

Years		Storage Period (Months)				P value	LSD*
		0	6	12	18		
2008	0%	0.83±0.11 <sup>***a</sup>	0.77±0.16 <sup>d</sup>	0.81±0.18 <sup>b</sup>	0.76±0.17 <sup>d</sup>	<0.05	0.02
	1%	0.79±0.09 <sup>c</sup>	0.77±0.06 <sup>d</sup>	0.81±0.10 <sup>b</sup>	0.76±0.13 <sup>d</sup>		
	3%	0.81±0.10 <sup>b</sup>	0.73±0.06 <sup>e</sup>	0.81±0.11 <sup>b</sup>	0.75±0.13 <sup>d</sup>		
	SP	0.81±0.02 <sup>A</sup>	0.75±0.02 <sup>B</sup>	0.81±0.00 <sup>A</sup>	0.76±0.01 <sup>B</sup>		
2009	0%	0.83±0.20 <sup>a</sup>	0.80±0.19 <sup>b</sup>	0.80±0.18 <sup>b</sup>	0.78±0.21 <sup>cd</sup>	$\leq 0.001$	0.02
	1%	0.80±0.18 <sup>b</sup>	0.79±0.16 <sup>c</sup>	0.76±0.16 <sup>de</sup>	0.75±0.20 <sup>e</sup>		
	3%	0.83±0.19 <sup>a</sup>	0.79±0.20 <sup>bc</sup>	0.75±0.17 <sup>e</sup>	0.78±0.21 <sup>c</sup>		
	SP	0.82±0.02 <sup>A</sup>	0.79±0.01 <sup>B</sup>	0.77±0.02 <sup>BC</sup>	0.77±0.02 <sup>C</sup>		

\* Least Significant Difference ( $\alpha=0.05$ ) \*Standard deviation, a,b,c,d; A,B,C,D: Shows differences between the samples,



**Figure 3. Changes major fatty acids (%) of olive oils obtained with different leaf additions during 2008 and 2009 years.**



**Figure 4. Changes major fatty acids (%) of olive oils obtained from cv. Ayvalik and Memecik during 2008 and 2009 years.**

When we look at sensory profiles expressed as intensity of fruity, bitter and pungent attributes, a slight increase was observed in the positive characteristics of oils with 1 % and 3 % leaves added (Figure 5, 6 and 7). This can be related to the transmission of some effective constituents such as *trans*-2-hexanal from leaves to oils (L. Di Giovacchino et al., 1996). During storage of oil sensory profiles were decreased. The obtained data were in agreement with Gambacorta et al. (2010). At the end of 18 month, oils obtained with addition of 3 % leaves showed a more intense green olive fruity flavor and strong bitter and pungent testes than control oil. If we obtain oils classified as “extra virgin” with addition of leaves, we can improve in taste and commercial rate of olive oil. An oil rich in aroma is considered of better quality (L. Di Giovacchino et al., 1996).

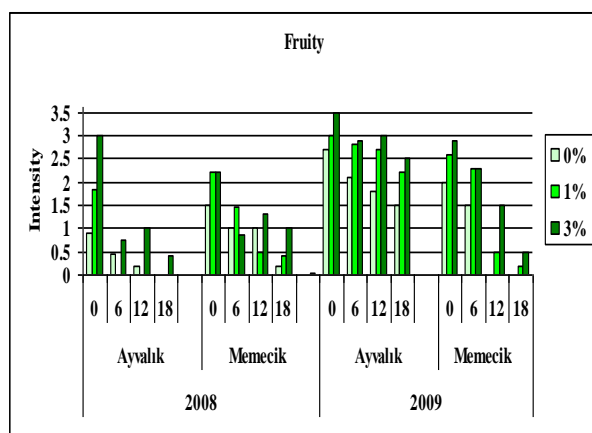


Figure 5. Effect of leaves on the fruity attributes of olive oils during 18 month.

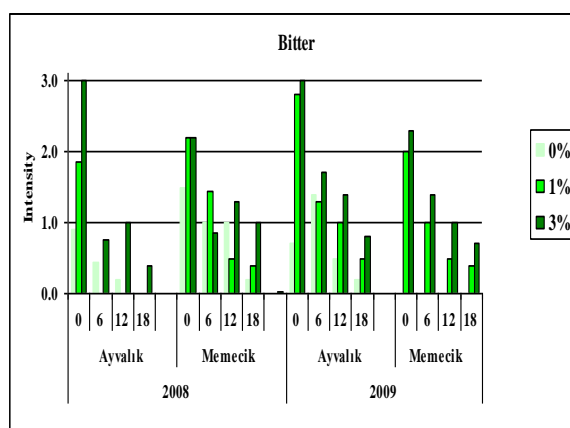


Figure 6. Effect of leaves on the bitter attributes of olive oils during 18 month.

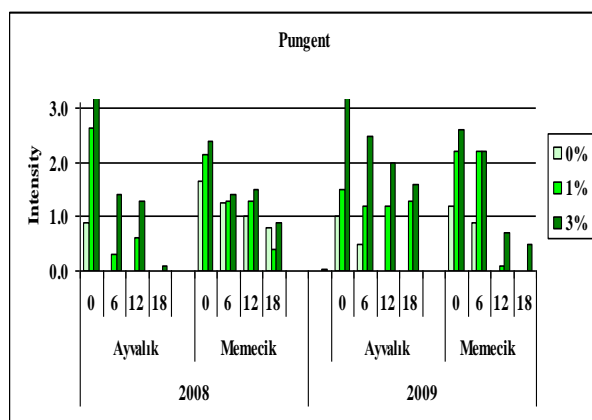


Figure 7. Effect of leaves on the pungent attributes of olive oils during 18 month.

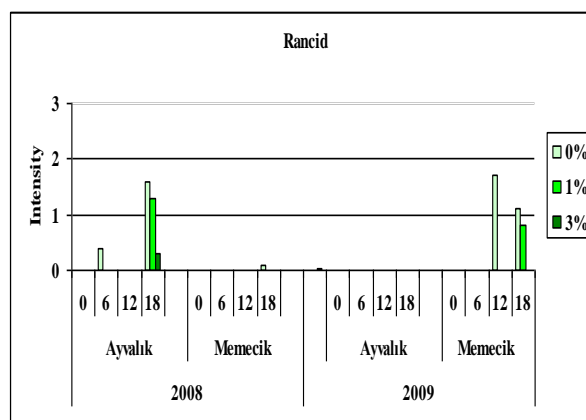


Figure 8. Effect of leaves on the rancid attributes of olive oils during 18 month.

## CONCLUSION

In our research, we determined that oils obtained with the addition of olive leaves during extraction of olive oils cv. Ayvalik and Memecik olives, free acidity not changed in 2008 but significantly changed in 2009, peroxide value was significantly increased in 2008, but not changed in 2009, K232 and K270 values significantly changed both years, oleic and linoleic acid changed significantly in 2008, but not changed in 2009, linoleic acid changed significantly in both years. The taste panel found a fruity, bitter and pungent attributes improvement in oil, when the percentage of leaves added to olives were increased. During storage periods, quality parameters changed, because of oxidation but they did not exceed the limits established by Regulation EEC/1989/2003 of the European Commission for extra virgin olive oil.

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# PHYSICAL, CHEMICAL AND MINERALOGICAL PROPERTIES OF VERTISOLS AT THE AREA OF RAHOVEC MUNICIPALITY (KOSOVO)

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## ABSTRACT

Vertisol is the most widespread soil type of agricultural land in Rahovec municipality. From a total of 27,590 ha, which is the total area of Rahovec municipality, Vertisol with its varieties comprises about 11,290 ha, which is about 40% of the total area of the municipality, or about 65% of the total arable land (13,977 ha).

In this paper the results of research of mechanical (soil texture, coefficient of extensibility, plasticity), water-physical (aggregate stability, specific density, porosity, volume of water and air), chemical (pH, humus content, CaCO<sub>3</sub> content, CEC) and mineralogical (X-ray diffraction analysis) research of soil samples from soil profiles for the five subtypes of Vertisol located in the municipality of Rahovec are presented. Research was conducted on seven soil profiles for the five different subtypes of Vertisol and a total of 20 soil samples from soil layers were analyzed.

The research results show that these soils have unfavorable water-physical properties and heavy mechanical composition, therefore these soils have limited tillage interval. The obtained results are valuable for undertaking the measures related to improving the water-physical and chemical properties of researched soil for increasing the agriculture production.

**Key Words:** Vertisols, Rahovec municipality, soil properties

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## INTRODUCTION

From 355 million hectares world-wide (FAO, 2001), Kosovo is accounted for 109 thousand ha of Vertisols (Institut za Vodoprivredu „Jaroslav Černi“, 1975). Soil map of Rahovec municipality makes a beautiful and valuable mosaic of various soil types, subtypes and variations. Total area of the municipality amounts to 27,590 ha, of which approximately 11,290 ha belongs to Vertisol and its subtypes that is 40% of the total area, i.e. 65% of the total arable land area of 13,977 ha (Hoxha, 2003).

Land resources of these mildly undulating terrains of the municipality, typically characterized by various types of Vertisol, are mainly used as vineyards (about 4,000 ha). Timely tillage of Vertisols is somewhat difficult if possible at all due to high clay content (Coulombe et al., 2000). Applications of a stable and planned agriculture production were the motive for paying a special attention to examining their physical and chemical properties and analyzing the specificities that are distinctive for various Vertisol subtypes found in Rahovec municipality, in order to obtain some new information about their characteristics (Sharku, 2012). Some of the research specificities relate to the analysis of mineral composition of the soil and clay minerals for all subtypes of Vertisol.

## MATERIALS AND METHODS

A total of 7 profiles on 5 different subtypes of Vertisol were researched. Samples were collected in disturbed state (plastic bags) in two iterations, whereas the undisturbed soil samples were taken by 100 cm<sup>3</sup> cylinders in three iterations.

- For examining mechanical and physical soil properties, the following three methods were employed: soil texture was determined using *modified pipette B method* (ISO 11277), texture class according to USDA classification, swelling index by the *Rutkovski method*, soil shrinkage by the *Filatov method*, top border of plasticity by the *Casagrande method*, down border of plasticity by the *Atterberg method*, and soil color according to the *Munsell Soil Color Chart*.

- To examine the water-physical properties of soil the following methods were used: for determining stability of macro-structural aggregates has been used the *Sekera's method* (Čustović et al.,

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2003) based on the time and intensity of the decomposition of structural aggregates in water; Air pycnometer method for true specific density; Kopecki cylinders for bulk density; total porosity was calculated based on true and bulk density; *Gračanin's* method for water retention capacity (Čustović et al., 2003) based on the difference in measurement after soil moisture in the cylinder Kopecky (capillary climbing of water through filter paper immersed in water) and drying at 105°C till constant weight; air capacity was calculated using porosity and retention capacity; maximum water capacity was determined by saturating the undisturbed soil samples up to the maximum water capacity.

- To examine the chemical properties of soil the following methods were used: *Kotzmann's* colorimetric method for determining content of humus and multiplying the level of C (%) obtained by element analyzer by the coefficient 1.73; *electrometric method* for determining pH levels of soil in H<sub>2</sub>O and 1M KCl in suspension 1:2.5 (ISO 10390); *volumetric method* by Scheibler's calcimeter to determine total CaCO<sub>3</sub> (ISO 10693); *photospectrometric* method using Calcium Acetate Lactate to determine the capacity of exchangeable cations (Na, K, Mg, Ca, Ba); *Al-method* for determining accessible P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O (ISO19730); *elemental analyzer* to determine total contents of C, N, S (Elementar "Vario EL III"); *Kappen's* method and calculations for determining adsorption complex of non-carbonate soils (ISO 14254).

- To examine mineral composition we used the methods of *X-ray diffraction analysis*, where samples were analyzed by PHILIPS PW 1009 and PW 1051 X-ray diffractometer for powder samples, using radiation from cobalt anticathode whose wave length was  $\lambda_{CoK\alpha}=1.79026\text{Å}$ , filtered with iron  $\beta$ -filter; *differential thermal analysis (DTA)* was performed by ATD 67, ADAMEL LHORMARGY apparatus with sensitivity of 0.1 mV, while temperature was measured with a Pt-PtRh thermocouple; determination of minerals was made based on endothermic and exothermic curves; *thermogravimetric analysis (TGA)*, that was carried out on a STANTON apparatus with 10°C/min heating speed and temperature range of 1,000°C.

## RESULTS

### Mechanical composition with profile description

Kosovo has not yet officially (legally) applied any international soil classification. Therefore, subtypes of Vertisols are annotated by the old classification that was used in Yugoslavia (Škorić, et al., 1985). Research was carried out on Vertisol, with A-AC-IC profile structure. Basic characteristics of specific subtypes are as follows (Table 1.):

1) *Carbonate Vertisol (vineyard)* – By its texture this profile is heavy clay. It shows a high level of swelling, shrinking and plasticity. Horizon A is 0-45 cm deep, brown color (10 YR 5/3); horizon AC is 45-100 cm deep, light brown color (10 YR 6/3); and horizon IC is 100-120 cm deep and its color is light brown (10 YR 7/3).

2) *Carbonate Vertisol (forest)* – Clay by mechanical composition, shows a high level of swelling, shrinking and plasticity (especially in the surface layer). Horizon A is 0-50 cm deep and its color is grey-brown (10 YR 5/2); horizon AC is 50-90 cm deep and the color is light grey (10 YR 7/2); and, horizon IC is 90-120 cm deep, the color is very light brown (10 YR 7/3).

c) *Loessified Vertisol (pasture)* – Clay by mechanical composition, shows a lower level of swelling and shrinking rate and plasticity in the surface horizon which significantly increases with depth. Horizon A is 0-40 cm deep, the color is light grey (10 YR 7/2); horizon Bt is 40-95 cm deep, the color is light brownish-grey (10 YR 6/2); and, horizon IC is 95-120 cm deep and the color is light brown (10 YR 6/3).

d) *Vertic Cambisol (vineyard)* – Horizon A is clay, while horizons Bv and IC are sandy clay loam by mechanical composition. It shows a lower swelling and shrinking rate and plasticity in the surface horizon which slightly increases with depth. Horizon A is 0-40 cm deep, the color is dark yellowish brown (10 YR 4/4); horizon Bv is 40-100 cm deep and its color is yellowish brown (10 YR 5/4); and, horizon IC is 100-120 cm deep, the color is uniformly brown (10 YR 6/4).

e) *Vertisol in transition to Vertic Cambisol (pasture)* – Sandy clay by mechanical composition, shows a low rate of swelling shrinking and plasticity in the upper horizon, which slightly increases with depth. Horizon A is 0-40 cm deep, the color is dark grayish brown (10 YR 4/2); and, horizon IC which is 40-80 cm deep and has dark yellowish brown color (10 YR 4/4).

f) *Eroded Vertisol (forest)* – Clay by mechanical composition, shows a lower swelling and shrinking rate and plasticity in the surface horizon which increases with depth which is in relation with clay content. Horizon A is 0-20 cm deep, the color is grey-brown (10 YR 5/2); horizon AC is 20-90 cm deep, and its color is dark grey-brown (10 YR 4/2); horizon IC is 90-120 cm deep, the color is dark brown (10 YR 4/3).

g) *Eroded Vertisol (vineyard)* – Clay by mechanical composition. Rates of swelling, shrinking and plasticity in the surface layer are lower and increase with depth. Horizon A is 0-25 cm deep, and its color is grey-brown (10 YR 5/2); horizon AC is 25-70 cm deep and the color is brown (10 YR 5/3); horizon IC is 70-120 cm deep and its color is dark brown (10 YR 4/3).

Table 1. Texture composition

Soil Profile/Subtype	Depth	Fraction of sand	Fraction of clay	Fraction of dust	Fraction of fine sand	Texture class by USDA classification
		%	%	%	%	
1. Carbonate Vertisol (vineyard)	0-45	0.51	67.7	24.6	7.19	Clay
	45-100	2.38	62.3	33.6	1.72	Clay
	100-120	0.69	62.0	34.9	2.41	Clay
2. Carbonate Vertisol (forest)	0-50	0.21	70.9	26.1	2.79	Clay
	50-90	5.51	53.4	35.7	5.39	Clay
	90-120	5.88	50.7	34.9	8.52	Clay
3. Loessified Vertisol with Pseudogley	0-40	5.96	47.0	30.4	16.64	Clay
	40-95	1.65	68.8	19.8	9.75	Clay
	95-120	1.23	68.8	19.5	10.47	Clay
4. Vertic Cambisol (vineyard)	0-40	0.94	40.7	21.1	37.26	Clay
	40-100	0.77	35.3	19.4	44.53	Sandy clay loam
	100-120	0.13	32.9	20.4	46.58	Sandy clay loam
5. Vertisol in transition to Vertic Cambisol (pasture)	0-25	24.22	35.3	18.8	21.69	Sandy Clay
	25-40	32.82	38.2	6.40	22.58	Sandy Clay
6. Eroded Vertisol (forest)	0-20	0.30	56.0	37.5	6.20	Clay
	20-90	0.06	67.8	26.9	5.24	Clay
	90-120	0.11	70.0	29.4	0.49	Clay
7. Eroded Vertisol (vineyard)	0-25	2.19	66.6	25.6	5.61	Clay
	25-70	0.86	68.2	29.9	1.04	Clay
	70-120	0.27	65.9	29.2	4.63	Clay

### Physical properties

Stability of structural aggregates is very good in Eroded Vertisol (forest), while the rate of decomposing is very pronounced in Vertic Cambisol in vineyards, Eroded Vertisol in vineyards and in Bt and IC horizons of Loessified Vertisol with Pseudogley. True density (Psg) ranges from 2.25 g/cm<sup>3</sup> in Vertic Cambisol (vineyard) to 2.68 g/cm<sup>3</sup> in Eroded Vertisol (forest). Bulk density (Vsg) ranges from 1.17 g/cm<sup>3</sup>, i.e. 1.18 g/cm<sup>3</sup> in A horizons of both profiles of Carbonate Vertisol, to 1.57 g/cm<sup>3</sup> in Vertic Cambisol (vineyard). Porosity (P) is lowest in Vertic Cambisol (vineyard), amounting to 36.7%, and highest in Eroded Vertisol (forest) reaching 54.1%. Air capacity (Kz) ranges between 2.9 in Vertic Cambisol (vineyard) to 8.6% in Vertisol in transition to Vertic Cambisol (pasture). Retention capacity (Rk) is lowest in Vertic Cambisol (vineyard), where it amounts to 31.9%, and highest in A horizon of Carbonate Vertisol (vineyard) where it reaches the level of 49.30% and in IC horizon of Eroded Vertisol of natural texture (forest) with the level of 49.35%. Maximum water-retaining capacity (MVK) ranges from 36.45% in Vertic Cambisol to 53.4% in Eroded Vertisol (forest).



Table 2. Physical properties

Soil profile/subtype	Depth (cm)	Stability of structural aggregates	P <sub>sg</sub> (g/cm <sup>3</sup> )	VSG (g/cm <sup>3</sup> )	P (%)	K <sub>z</sub> (%)	RK (%)	MVK (%)
1. Carbonate Vertisol (vineyard)	0-45	3	2.56	1.18	53.9	4.6	49.30	53.20
	45-100	3	2.53	1.32	47.8	5.2	42.60	47.50
	100-120	3	2.51	1.29	48.6	6.9	41.7	48.10
2. Carbonate Vertisol (forest)	0-50	3	2.45	1.17	52.2	4.1	48.15	51.75
	50-90	3	2.44	1.24	49.2	6.7	42.45	48.60
	90-120	3	2.42	1.26	47.9	6.2	41.75	47.30
3. Loessified Vertisol with Pseudogley	0-40	3	2.38	1.37	42.4	8.1	34.30	41.80
	40-95	4	2.42	1.23	49.2	4.4	44.8	48.70
	95-120	5	2.46	1.26	48.8	5.0	43.8	48.10
4. Vertic Cambisol (vineyard)	0-40	4	2.25	1.40	37.8	5.9	31.9	37.4
	40-100	5	2.44	1.53	37.3	2.9	34.4	36.95
	100-120	5	2.48	1.57	36.7	3.5	33.2	36.45
5. Vertisol in transition to Vertic Cambisol (pasture)	0-25	3	2.47	1.29	47.8	8.6	39.20	47.20
	25-40	3	2.39	1.22	49.0	5.8	43.20	48.30
6. Eroded Vertisol (forest)	0-20	2	2.54	1.34	47.2	6.7	40.50	46.70
	20-90	3	2.68	1.27	52.6	5.3	47.30	52.10
	90-120	4	2.66	1.22	54.1	4.8	49.35	53.40
7. Eroded Vertisol (vineyard)	0-25	4	2.55	1.28	49.8	5.5	44.30	48.80
	25-70	4	2.57	1.38	46.3	4.7	41.60	45.80
	70-120	4	2.52	1.32	47.6	6.0	41.80	46.90

### Chemical properties

Carbonate content (CaCO<sub>3</sub>) shows the lowest level in Vertic Cambisol and Vertisol in transition to Vertic Cambisol with 0.81% and the highest in AC and IC horizons of Carbonate Vertisol (forest) with 14.76% and 14.33%, respectively. Soil reaction (pH) – active acidity (pH in H<sub>2</sub>O) ranges from acidic (pH 5.08) in Loessified Vertisol with Pseudogley to alkaline (pH 8.15) in IC horizon of Carbonate Vertisol (forest). Substitution acidity (pH in M KCl) ranges from very acidic in Loessified Vertisol with Pseudogley (pH 3.65) to slightly alkaline (pH 7.33) in IC horizon of Carbonate Vertisol (forest). Phosphorus (P<sub>2</sub>O<sub>5</sub>) is in rather rich supply in A horizon of Eroded Vertisol (vineyard) where it reaches the level of 30.94 mg/100 g soil, as well as AC and IC horizons of Carbonate Vertisol (vineyard) where it amounts to 24.18 mg/100 g soil and 21.92 mg/100 g soil respectively; the poorest supply occurs in Bt horizon of Loessified Vertisol with Pseudogley with the level of 1.20 mg/100 g soil. Potassium (K<sub>2</sub>O) is in rather rich supply in all subtypes of Vertisol (particularly the A horizon of Eroded Vertisol in vineyards where it reaches the level of 72.30 mg/100 g soil) except for A horizon with 11.03 mg/100 g soil and IC horizon with 13.59 mg/100 g soil in Loessified Vertisol with Pseudogley and A horizon with 13.99 mg/100 g soil in Vertic Cambisol (vineyard). Rich in nitrogen (N) are the A horizon of Vertisol in transition to Vertic Cambisol and both profiles of Eroded Vertisol, whereas Vertic Cambisol - where nitrogen content ranges from 0.07% to 0.09%, and Loessified Vertisol with Pseudogley with 0.08% in Bt and IC horizons are particularly poorly supplied. Soil organic carbon content (C) is highest in A horizons of Vertisol in transition to Vertic Cambisol and A horizon of both profiles of Eroded Vertisol, while in other horizons of all the profiles it is considerably lower. C/N ratio is rather good in all the profiles and ranges from 3.4 to 11.2. Sulfur content (S) is low in all the subtypes (from 0.01% to 0.05%). Soil adsorption complex (AKZ) indicates that a total amount of bases capable of exchange (S) is considerably higher in A horizons of Carbonate Vertisol in

both profiles (52.8 cmol/kg and 42.8 cmol/kg soil). Unsaturation of soil adsorption complex (H) ranges from 7.8 cmol/kg soil in Loessified Vertisol with Pseudogley, to 0.8 cmol/kg soil in Carbonate Vertisol. Maximum adsorption capacity for base (T) is highest in A horizons of Carbonate Vertisol in both the profiles with a total content of 53.6 cmol/kg and 43.6 cmol/kg soil, respectively. Level of saturation of adsorption complex with bases (V) is high in all the profiles, which indicates good fertility of these soils.

Table 3. Chemical properties

Soil profile/subtype	Depth (cm)	CaCO <sub>3</sub> (%)	pH		Available		N (%)	C (%)	C/N	S (%)	Humus (%)		Soil adsorption complex			
			H <sub>2</sub> O	KCl	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O					Elem. Anal.	Color.	H	S	T	V
					mg/100 g											
1. Carbonate Vertisol (vineyard)	0-45	1.74	7.80	6.98	3.84	39.67	0.13	1.34	10.3	0.03	2.31	2.21	0.75	52.8	53.6	98.6
	45-100	5.43	7.94	7.04	24.18	39.12	0.16	1.04	6.5	0.01	1.79	0.6				
	100-120	3.08	7.94	7.09	21.92	35.13	0.16	0.64	4	0.02	1.1	0.48				
2. Carbonate Vertisol (forest)	0-50	2.11	7.51	6.70	14.27	33.98	0.12	0.92	7.7	0.02	1.59	0.98	0.8	42.8	43.6	98.2
	50-90	14.76	8.05	7.26	6.06	25.57	0.10	0.34	3.4	0.01	0.59	0.27				
	90-120	14.33	8.15	7.33	4.90	28.99	0.09	0.31	3.4	0.01	0.53	0.28				
3. Loessified Vertisol with Pseudogley	0-40	0.83	5.36	3.97	3.63	11.03	0.13	1.14	8.8	0.03	1.97	0.73	7.8	17.2	25	68.8
	40-95	0.80	5.08	3.65	1.20	21.35	0.08	0.37	4.6	0.01	0.64	0.25	7.7	25.2	32.9	76.7
	95-120	0.81	6.30	5.01	1.66	13.59	0.08	0.44	5.5	0.02	0.76	0.31	2.5	35.2	37.7	93.4
4. Vertic Cambisol (vineyard)	0-40	0.82	7.44	6.51	3.28	13.99	0.09	0.63	7	0.02	1.09	0.77	1.5	20.8	22.3	93.3
	40-100	0.9	7.32	6.43	1.78	39.16	0.08	0.32	4	0.02	0.55	0.29	1.1	18.8	19.9	94.5
	100-120	0.81	7.47	6.45	6.06	27.62	0.07	0.24	3.4	0.02	0.41	0.44	1.2	16	17.2	93
5. Vertisol in transition to Vertic Cambisol	0-25	0.83	7.01	6.33	1.89	32.10	0.24	2.29	9.5	0.05	3.95	2.15	1.2	30.4	31.6	96.2
	25-40	0.92	7.61	6.80	1.55	29.90	0.15	1.06	7.1	0.04	1.83	0.95	1.1	36	37.1	97
6. Eroded Vertisol (forest)	0-20	0.82	6.57	5.72	1.21	32.25	0.23	2.58	11.2	0.05	4.45	3.53	2.7	32	34.7	92.2
	20-90	0.84	6.87	6.10	1.95	25.88	0.13	0.92	7.1	0.03	1.59	0.77	6	30	36	83.3
	90-120	0.84	7.00	6.19	2.36	21.21	0.11	0.78	7.1	0.03	1.34	1.1	1.8	34.4	36.2	95
7. Eroded Vertisol (vineyard)	0-25	4.49	7.72	7.17	30.94	72.30	0.22	2.15	9.8	0.04	3.71	1.58				
	25-70	1.53	7.86	7.12	7.10	38.87	0.17	1.37	8.1	0.03	2.36	1.52				
	70-120	1.22	7.77	7.12	4.90	31.46	0.17	1.28	7.5	0.02	2.21	0.73				

### Mineral composition

X-ray diffraction analysis indicates that in 12 samples the most represented primary mineral is quartz, except in Vertisol in transition to Vertic Cambisol where serpentine is predominant mineral. The second most represented mineral is feldspar, except in Carbonate Vertisols, where clay minerals are predominant. Calcite was identified in five samples, while presence of aragonite was found in Vertisol in transition to Vertic Cambisol. When it comes to clay minerals, montmorillonite is predominant in all 13 samples, while illite content was medium or very low. As for other clay minerals, some insignificant amounts of kaolinite and chlorite were also identified.

Differential thermal analysis (DTA) carried out on 13 samples shows the content of the following substances: montmorillonite, organic matter, illite-sericite, quartz, calcite except in Loessified Vertisol with Pseudogley and Vertic Cambisol, whereas in Vertisol in transition to Vertic Cambisol occurred serpentine minerals – most likely antigorite, goethite-limonite. Thermogravimetric analysis (TGA) shows that humidity loss percentage was lowest at depth of 40 cm in Vertic Cambisol with a total of 6.18%, while highest – 19.58% recorded at depth of 50-90 cm in Carbonate Vertisol (forest).

## DISCUSSION AND CONCLUSION

Reduced porosity and increased bulk density in the middle horizon of Carbonate Vertisol (vineyard) can be explained by the compaction of this horizon as a consequence of the movement of mechanization during tillage, treatments with pesticides and other operations in vineyard. Potassium (K) is a major nutrient for plant growth and considered limiting in some Vertisols (Dixon, 1982), and high level of potassium in all three horizons is an effect of the application of mineral fertilizers. In terms of chemical properties, noted was a considerably higher content of carbonate ( $\text{CaCO}_3$ ) in depth in Carbonate Vertisol in natural forest texture, while in vineyard, the carbonates were apparently leached in the process of decarbonization. In Loessified Vertisol (pasture) appears the Vt horizon, which is characterized by occasional stagnation of precipitation water, due to water impermeability of deep layers where Pseudogleyification takes place leading to the formation of Eluvial-Illuvial soil, i.e. Secondary Pseudogley (Resulović *et al.*, 2002). Vertic Cambisol (vineyard) is characterized by cambic processes; process of destruction of Aluminosilicate cores of primary minerals and formation of secondary clay minerals (argilogenesis). The process of argilogenesis results in the formation of Bv horizon (Resulović *et al.*, 2008). Vertisol in transition to Vertic Cambisol is characterized by the structure of profile A-IC, which has a very small depth (only 40 cm). Also, unlike any other profiles in which predominant primary mineral is quartz, in this profile it is serpentine. Eroded Vertisols in forest are characterized by extremely shallow A horizon (only 20 cm), which is a consequence of superficial erosion, while Eroded Vertisol (vineyard) is anthropogenized and that is stated based on the content of nutrients in soil and level of soil pH reaction being the consequences of application of mineral fertilizers. In addition, A horizon is lightly deepened as a result of ploughing (Sharku, 2012).

These conclusions have aimed the improving of water-physical and chemical properties of Vertisol in order to increase volume of product per unit area and application of a stable and planned agriculture production.

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# ANALYSES OF GENETIC STRUCTURE WITHIN POPULATION OF CHESTNUT (*Castanea sativa* Mill.) IN BOSNIA AND HERZEGOVINA USING SSR MARKERS

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## ABSTRACT

Chestnut (*Castanea sativa*) is a vital fruit resource in Bosnia and Herzegovina. This country has in past been a crossroads for the spread of this fruit species from east to the west and north part of the European continent. Large chestnut populations in Bosnia and Herzegovina are located at three main regions in the country. This research aimed to conduct genetic characterization of these natural populations of chestnut. Through the genetic characterization, first data on molecular-genetic composition of Bosnia and Herzegovina chestnut population will become available. Genetic variability was examined using 13 SSR primer pairs, all of them developed on chestnut. Out of all 13 examined loci on all analyzed populations, largest number of alleles (10) was detected for loci EMCs 38, which managed to distinguish 22 genotypes. The lowest number of alleles (3) was found for loci EMCs11 and EMCs42 and they managed to distinguish four genotypes each. PIC values (*Polymorphism information content*) varied, depending on used microsatellite marker in all three examined populations of chestnut, from 0.048 for loci EMCs14 to 0.772 for loci EMCs38. 16 unique alleles were found in each of the analyzed populations, which serve as indicators of uniqueness of each chestnut population in Bosnia and Herzegovina. Fst revealed the differentiation between the analyzed three populations.

**Key Words:** European chestnut, natural populations, genetic structure, SSR markers

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## INTRODUCTION

European chestnut has for centuries had an important role in lives of people inhabiting Europe, Asia and North America. In Europe selection and grafting of chestnut with the best traits has been going on for millennia. Because of the great similarity in chemical composition between European chestnut and cereal grains, chestnut flour has in past been used for baking of bread (Rutter et al. 1991).

Until now small progress has been made in selection and breeding of European chestnut in Bosnia and Herzegovina (B&H) and the research on this species has been limited. Most studies that have been performed, have involved the characterization of morphological traits and chemical properties (Mičić et al. 1987; Skender et al. 2006; Mujić et al. 2006), especially on the natural populations. Traditional methods of studying genetic identity and variability of chestnut have been limited to examination of phenotypic attributes, but since the emerging of molecular biology, several new tools are available for this purpose. One of the best tools are genetic markers, among which microsatellite markers (SSR) have been extensively developed and used on European chestnut (Buck et al. 2003 and Marinoni et al. 2003).

The aim of this study is to analyze the genetic structure within population of chestnut (*Castanea sativa* Mill.) in Bosnia and Herzegovina using SSR markers

## MATERIAL AND METHODS

Overall 130 individual chestnut trees from three natural populations ("Konjic", "Pećigrad" and "Bratunac") were examined in this study. The extraction and isolation of genomic DNA was done from fresh leaves using cTAB protocol (*Cetyl Trimethyl Ammonium Bromide*) (Doyle and Doyle 1987).

13 primer pairs that were used to amplify alleles from the selected SSR loci have previously been published by Buck et al. (2003). Optimized multiloci PCR reactions were conducted in GeneAmp<sup>®</sup> PCR System 9700 (*Applied Biosystem*). Allele size was determined on the ABI PRISM<sup>™</sup> 310 Genetic Analyzer. The data was analyzed using software package Gene Mapper ID v3.2. Allele estimation and genotype frequency was performed using direct counting. Analysis of the SSR data was conducted according to Botstein et al. (1980) and using software POWERMARKER V. 3.32 (Liu and Muse 2004).

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**Table 1. Microsatellite (simple sequence repeats – SSR) name, code and the repeating sequence for the analyzed loci on the natural chestnut population in Bosnia and Herzegovina.**

SSR name	Loci code	Repeating sequence
EMCs2	AJ505133	[CGG] <sub>7</sub>
EMCs4	AJ505134	[GGC] <sub>7</sub>
EMCs10	AJ505135	[CA] <sub>8</sub>
EMCs11	AJ505136	[GGA] <sub>7</sub> [GGC] <sub>6</sub>
EMCs13	AJ505137	[GCA] <sub>8</sub>
EMCs14	AJ505138	[GAG] <sub>7</sub>
EMCs15	AJ505139	[CAC] <sub>9</sub>
EMCs17	AJ505140	[AGC] <sub>4</sub> [CCAA] <sub>5</sub>
EMCs22	AJ505141	[GA] <sub>19</sub>
EMCs25	AJ505142	[GA] <sub>12</sub>
EMCs32	AJ505143	[AG] <sub>18</sub>
EMCs38	AJ505144	[AG] <sub>31</sub>
EMCs42	AJ505145	[CA] <sub>11</sub>

## RESULTS

All 13 primer pairs used managed to amplify 70 clearly distinguishable alleles for all three analyzed chestnut populations.

**Table 2. Number of amplified alleles, number of different genotypes identified by each SSR loci and PIC (Polymorphism information content) for each of the primer pairs on individual populations.**

SSR name	Konjic			Pećigrad			Bratunac			All		
	No. of alleles	No. of genotypes	PIC	No. of alleles	No. of genotypes	PIC	No. of alleles	No. of genotypes	PIC	No. of alleles	No. of genotypes	PIC
EMCs2	3	3	0.207	3	6	0.534	3	5	0.428	3	6	0.44
EMCs4	3	4	0.377	4	6	0.471	4	7	0.49	4	8	0.47
EMCs10	3	5	0.461	4	6	0.385	5	7	0.518	5	10	0.48
EMCs11	2	3	0.375	2	3	0.352	3	4	0.429	3	4	0.39
EMCs13	2	2	0.043	3	5	0.483	3	4	0.385	3	6	0.38
EMCs14	3	3	0.043	1	1	0	2	2	0.093	4	4	0.05
EMCs15	3	4	0.241	3	5	0.433	4	6	0.471	5	8	0.52
EMCs17	5	8	0.588	5	10	0.693	4	9	0.606	6	12	0.66
EMCs22	6	8	0.337	6	10	0.614	3	4	0.249	9	16	0.58
EMCs25	4	7	0.601	6	6	0.585	4	5	0.513	8	12	0.73
EMCs32	4	7	0.51	3	5	0.286	4	5	0.556	6	12	0.55
EMCs38	6	7	0.312	9	17	0.757	4	7	0.562	10	22	0.77
EMCs42	3	4	0.247	2	3	0.372	2	3	0.171	3	4	0.38
Mean	3.62	5	0.334	3.92	6.38	0.459	3.46	5.23	0.421	5.31	9.54	0.49

Largest number of alleles was detected for SSR loci EMCs38 (10) (Table 2), which managed to distinguish 22 different genotypes among all the analyzed populations. The lowest number of alleles (3) was found for loci EMCs11 and EMCs42, which only managed to distinguish four genotypes each in all the chestnut populations. Loci EMCs14 was the only monomorphic one, and just for the population "Pećigrad". The largest overall number of different alleles was found in the "Pećigrad" population, while the population "Bratunac" had the lowest number. PIC value was also the highest for "Pećigrad" (0.459) and the lowest for "Konjic" (0.334).

**Table 3. Allele frequency of three analyzed chestnut populations for all 12 SSR loci**

SSR	Alleles	Konjic	Pećigrad	Bratunac	SSR	Alleles	Konjic	Pećigrad	Bratunac
EMCs2	159	0.878	0.419	0.462	EMCs22	122	0.000	0.027	0.000
	161	0.033	0.149	0.039		126	0.000	0.095	0.000
	164	0.089	0.432	0.500		130	0.023	0.095	0.000
EMCs4	165	0.011	0.054	0.141	132	0.102	0.487	0.833	
	167	0.378	0.365	0.141	134	0.034	0.000	0.000	
	170	0.611	0.554	0.654	140	0.011	0.014	0.000	
	173	0.000	0.027	0.064	142	0.796	0.284	0.000	
EMCs10	214	0.000	0.041	0.115	144	0.034	0.000	0.013	
	216	0.489	0.703	0.603	146	0.000	0.000	0.154	
	222	0.067	0.014	0.026	EMCs25	140	0.167	0.405	0.315
	226	0.444	0.243	0.231		146	0.000	0.027	0.000
	228	0.000	0.000	0.026		147	0.000	0.014	0.000
EMCs11	124	0.511	0.351	0.359	148	0.286	0.014	0.000	
	126	0.489	0.649	0.590	150	0.476	0.000	0.000	
	148	0.000	0.000	0.051	156	0.000	0.000	0.093	
EMCs13	155	0.000	0.108	0.333	158	0.071	0.405	0.556	
	158	0.978	0.568	0.641	160	0.000	0.135	0.037	
	161	0.022	0.324	0.026	EMCs32	100	0.000	0.097	0.000
EMCs14	117	0.000	0.000	0.051		102	0.000	0.081	0.385
	127	0.011	0.000	0.000		108	0.100	0.000	0.000
	129	0.011	0.000	0.000	91	0.438	0.000	0.077	
	138	0.978	1.000	0.949	96	0.450	0.823	0.462	
EMCs15	80	0.000	0.311	0.103	98	0.013	0.000	0.077	
	83	0.089	0.068	0.641	EMCs38	230	0.000	0.048	0.000
	85	0.000	0.000	0.026		232	0.093	0.387	0.000
	86	0.056	0.000	0.000		236	0.023	0.000	0.000
	89	0.856	0.622	0.231		242	0.814	0.065	0.014
EMCs17	206	0.511	0.297	0.500		248	0.012	0.048	0.371
	210	0.211	0.189	0.090	250	0.023	0.177	0.000	
	214	0.044	0.324	0.218	252	0.000	0.081	0.000	
	216	0.011	0.176	0.000	256	0.000	0.145	0.443	
	218	0.222	0.014	0.192	258	0.035	0.032	0.171	
	220	0.000	0.000	0.000	262	0.000	0.016	0.000	
					EMCs42	220	0.156	0.554	0.895
						226	0.833	0.446	0.105
						228	0.011	0.000	0.000

Analysis of allele frequency enabled the identification of unique alleles (Tab. 3). Four alleles that were only present in "Bratunac" chestnut population, were detected on the loci EMCs11 (148), EMCs14 (117), EMCs15 (85) and EMCs25 (156). The "Konjic" population held six unique alleles, detected on the loci EMCs14 (127 and 129), EMCs22 (134), EMCs32 (108), EMCs38 (236) and EMCs42 (228). Also, six unique alleles were found in population "Pećigrad", on the loci EMCs22 (122), EMCs25 (146), EMCs32 (100) and EMCs38 (230, 252 and 262). Overall 16 unique alleles were found between the analyzed populations. In order to further examine the differentiation between the three examined populations, *F<sub>st</sub>* was calculated

(Tab. 4).  $F_{st}$  value and thus the differentiation was highest between chestnut population “Konjic” and “Bratunac” (0.332) and lowest between “Bratunac” and “Pećigrad” (0.116).

Table 4.  $F_{st}$  values among all three analyzed chestnut populations.

Populations	Bratunac	Konjic	Pećigrad
Bratunac	0.000	0.332	0.116
Konjic	0.332	0.000	0.208
Pećigrad	0.116	0.208	0.000

## DISCUSSION AND CONCLUSION

Average number of alleles per locus, obtained in this study (5.31), was higher than that reported for European chestnut populations for Great Britain by Buck et al. (2003) (4.5) and lower in comparison to the study by Botta et al. (2005) on Italian chestnut germplasm (6.3) and a study on Spanish chestnut by Martin et al. (2009) (8.7).

In both the study on British and Spanish chestnut populations (Buck et al. 2003; Martin et al. 2009), as well as the study on chestnut germplasm from Spain, Italy and Greece (Aravanopoulos et al. 2005), SSR locus EMCs38 proved to be the most polymorphic one.

In comparison to the mentioned studies on European chestnut, it is evident that the B&H populations do not lack in diversity and need to be studied further in order to be utilized in future breeding programs.

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# ENVIRONMENTAL STATE ASSESSMENT OF PEATLAND ŽDRALOVAC IN LIVANJSKO POLJE

Mirza TVICA<sup>1</sup> Hamid ČUSTOVIĆ<sup>1</sup>

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## ABSTRACT

Livanjsko polje (field) is the world largest typical karstic field and a specific natural phenomenon of Bosnia and Herzegovina. The field is periodically flooded so it becomes a large seasonal peat-forming wetland (mire) and an important ecosystem for a wide range of wildlife habitats that support biological diversity. Livanjsko polje is on the list of Ramsar area and in spatial planning it is marked as Protected Landscape of V category. Peatland Zdralovac was formed in landscape depressions (fen-low mires), as a geogenous mire. People have always drained peatlands for their needs: agricultural production, peat excavation and for building hydropower systems. But, drainage (app.35 km channels) and agriculture lowered the water table level and led to subsidence, compaction and mineralization of peat, as well as to changes in vegetation cover. Also, once the peat surface has been desiccated during the summer months it becomes more prone to peat burning and erosion by wind. Furthermore, on the peatland Ždralovac there is ongoing peat excavation (app.770 ha), where the exploitation pools are subsequently filled with water, in which the process of natural revegetation by Sedges and Reeds is very slow. So these processes lead to a decrease in ecological services of peatlands. As results of this preliminary research we defined the four research areas-zones and list of the environmental indicators (using DPSIR model) that would best serve to assessing the environmental state of the peatland.

**Key Words:** Peatland, degradation, environmental indicators, assessment

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## INTRODUCTION

Livanjsko field is one of the world largest karstic fields. It covers a total area of approximately 40,000 ha (65 km x 6 km) at the average height of 700 m above sea level. It is located in the border region between the southwestern part of Bosnia and Herzegovina and Croatia. It belongs to the morphostructural unit of Outer Dinarides. This area is characterized by alternating parallel mountain ridges and beams and field basins surrounded by karst plateaus, extending in northwest-southeast direction and represent unique morphostructural units. (Zdilar, 2001) Karst fields have elongated shape where filed sides are built from karstified carbonate rocks. On the field margins, mostly at higher hypsometric levels there are water springs. At some lower levels there are swallow holes that receive surface watercourses which then flow underground toward a lower hypsographic level to the Adriatic Sea. Hydrologic communication among karst fields is mainly underground. At the time of high water level, due to complex drainage systems within the field and entire karstic massif, the lowest parts of the field, particularly those adjacent to the swallow zone, get flooded. Total area of maximum flooding in Livanjsko field is approximately 25,000 ha, which is close to 2/3 of the entire field area.

In the Livanjsko field area there are two peatlands: Ždralovac (3615 ha), located in the northwestern part, and Jagme (1500 ha), in the central part of the field. (Vlahinić, 1969). Peatlands play several very important roles in environment regulation, primarily in: carbon storage, i.e. climate regulation role in the exchange of greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O); preservation of biodiversity; water percolation; and, flood control (Polak et al. 2009). However, the survival of people living in the area of Livanjsko field is closely related to its natural resources (Čustović and Bašić, 2008). A major driver of all changes in the peatlands is water-drainage for the purpose of peat excavation, expansion of farming land and employment of hydro potential. Drainage results in lowering the water table and drying out the bedrock, which subsequently leads to a significant change of physical, chemical and biological properties of peat (Dupieux 1998). In this way the influence of mineralized underground water gets minimized, while the influence of precipitation water is maximized. In addition, extensive cultivation of peatland in agricultural production increases aeration thus inducing an increased decomposition of organic matter, as well as a change of peat's physical properties due to reduced amount of Ca<sup>2+</sup> originating from underground water (Kemmers & Jansen 1998). Inadequate application of chemicals on agricultural areas may cause water

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eutrophication (Grootjans et al. 1995). The occurrences which inevitably cause gradual or abrupt changes in ecosystem are also manifested through changes in vegetation (Dite et al. 2007).

First step in peatland rehabilitation planning, i.e. in sustainable management related decision-making, is to identify the problem. This means that we need to obtain precise information on what are the functions of peatland that have been threatened, what are the damages that have caused such a state, and what are the methods and techniques that need to be applied and implemented in order to restore lost functions. This paper actually represents the *Research notes* which address preliminary results of the ongoing research. The purpose of preliminary research presented in this paper was to screen the current status and define the environmental indicators that would best serve to assessing the environmental state of the peatland. Another objective of this phase of research was to define locations where control points for monitoring previously defined environmental indicators would be established.

## MATERIAL AND METHODS

In 2004 European Environment Agency (EEA) developed a *core set of indicators* that are organized based on a concept called „DPSIR“ (Driving Forces – causes of negative effects on environment; Pressures – pressures on environment exerted by drivers; State – state of environment; Impact – effects of pressures; and Response – measures and instruments for preservation of environment). Indicator is measurable, mainly expressed quantitatively, and is used for a simple and plastic illustration and monitoring of, as well as communication about complex environmental phenomena. Major criteria for selecting indicators include: extent of a problem in terms of negative impact on environment, possibility of collecting information, measurements and making presentations, etc. In the Federation of BiH a list of 80 environmental indicators (state of nature, water, soil, energy sector and air) is defined. A part of indicators stated in this paper is taken over from the core set of indicators, while the rest are defined in order to illustrate specific environmental parameters in BiH.

## RESULTS

### CLASSIFICATION OF PEATLAND ŽDRALOVAC

Peatland Ždralovac is divided in two parts: the northern Veliki Ždralovac and Mali Ždralovac – Table. It belongs to the low mires – fen, a topogenic formation developed in landscape depression, under the influence of marginal spring waters that spill over onto impermeable neogenic bedrock (clayey limestone), covering typical wetland vegetation and then flow into Kazanci swallow-hole. A waterlogged condition, which limits the activity of decomposer organisms, is actually a prerequisite for long-lasting accumulation of organic matter and formation of peatland. As the spring water is in contact with the surrounding carbonate rocks, this type of peatland belongs to geogenic, i.e. minerotrophic peatlands whose water is rich in  $\text{HCO}_3^-$ ,  $\text{Ca}^{++}$  and  $\text{Mg}^{++}$ . Peats are characterized by slight acid reaction in all zones and at all depths. According to water acidity, i.e. environment type affiliation, the mire belongs to the slightly acidic (sub-neutral) mires whose vegetation consists of sedge-reeds. Most represented is low peat - fen (Folic Histosols) nH-G with different depths of peat horizon, usually from 0.8 to 1.2 m, differentiated in several sub-horizons that are distinctive by the level of humification. Peat specific density ranges from 1.6 to 1.8  $\text{g cm}^{-3}$ , and bulk density in humid state amounts to 1.037-1.161  $\text{g lit}^{-1}$  of peat, and in dry state 150-200  $\text{g lit}^{-1}$  of peat; porosity ranges from 87.7 to 92.8 %. Peat is characterized by a considerably high level of decomposition, which along with a high content of organic matter (>80%) results in high content of total N (2.2%-3.2%). C/N ratio ranges between 8.5 and 17.6 : 1. These soils are also rich in total Ca (2.9-4.7%). Contents of  $\text{P}_2\text{O}_5$  and  $\text{K}_2\text{O}$  are low. (Bogdanović et al. 1967)

### DRIVING FORCES – NEGATIVE EFFECT DRIVERS – EXPLOITATION OF PEAT BY MAN

Use of water in energy production – Based on a rather rough estimate, approximately 25  $\text{m}^3 \text{ s}^{-1}$  of water is being discharged from Livanjsko field alone. Construction of a hydro-power plant in the central

part of the field has allowed for the drainage of these areas to be intensified and waters transported into accumulation lake Buško blato in the far south-east and then to the hydro-power plant Orlovac in Croatia. There is a realistic risk of accumulation and drainage of water into hydro-power plant extending onto Ždralovac cassette, which represents a separate hydrographic unit – and that has to be decisively prevented.

Drainage of peatland for peat excavation and land use changes to agriculture - Ždralovački canal, located in the central part, drains vast areas of peatland towards the swallow hole of Kazanci. North from Ždralovački canal, tranches were dug out to intensify drainage and create more favorable hydrological conditions for peat excavation (770 ha). Going south from canal, there is a reclamation area of Table (1000 ha) built in order to change the land use to agriculture. Entire system is designed based on systems of shallow and controlled drainage. In summertime, a system of canal water-gates maintains the underground water table at a level which enables capillary wetting of arable horizon and hence provision of high yields. Many scientists point out that global warming also have impact on reducing the water level on peatlands.

Excavation of peat – During the summer months, peat is excavated on the total area of 770 ha and used in processing and fabrication of plant substrates. The top layer of peat is first removed along with sedge-reeds and then outspread on the surrounding land and left for two years for additional humification. While excavating peat, the lower layer (20-40 cm) is left untouched for the purpose of natural re-vegetation of the excavation basin's floor.

Change of use of peatlands for agricultural purposes – In the reclamation area of Table which extends on approximately 1,000 ha, an extensive agricultural production existed until the past war. After the war, these areas were abandoned over the past 20 years so that the entire system of water-gates is now devastated. However, last year Table were given in concession to a large agricultural concern which this year already have started with the agricultural production.

#### **PRESSURE –PRESSURES ON ECOSYSTEM AND STATE –NEW STATE**

As a consequence of changed hydrological conditions – As a consequence of reduced water level that peat previously „floated“ on, we have subsidence of surface layers which exert pressure on lower layers of peat. In summer, the top layer loses its capillarity while increased aeration induces mineralization followed by emission of greenhouse gases and continuous deterioration of peat's quality. Peat turns harder as a result of compaction and decomposition of drained surface layer, which is reflected in increased bulk density, reduced total porosity and changed hydraulic properties. Loss of water in peat caused by drainage may be compensated with soaked up precipitation water whose chemism is different from spring water. Under the changed hydrological conditions, boundaries of terrestrial and aquatic ecosystems also change; wetland vegetation gets replaced by woody vegetation which accelerates desiccation, which also represents a conversion of this unique reservoir of natural habitats and biodiversity. Drainage of peatlands extends dry period and intensifies desiccation of peat which suits the outbreak of fire. After the fires, there occurs an abrupt change in vegetation which is primarily related to the lowering of underground water table, since woody plants can not grow in wetlands. In dry periods of the year, particularly in winter, wind erosion sweeps away the finest particles of organic matter causing an irrecoverable loss.

As a consequence of change of use of peatlands for agriculture – Mineralization of peat in agricultural soils is more pronounced due to the change of use from traditional mowing and grazing to extensive cultivation which additionally increases aeration of the surface peat layer. Previous measurements have shown increased bulk density of these peats. Application of mineral fertilizers and pesticides would likely lead to eutrophication of water and contamination of soil.

As a consequence of peat excavation – While speaking about physical loss of peat and its effect on global carbon cycle, it has to be emphasized that most of the excavated peat ends up as substrate for some other crops. In wet period, after the excavation, the exploitation fields are filled with water

averaging 0.80 m deep. These exploitation basins are of different age and show different extent of natural re-vegetation of the basin's floor. Namely, in the first years after the peat excavation, spontaneous sprouting of reed is just sporadic, and only some ten years on a major portion of the floor can be covered in reed. Slow revegetation of basin floor significantly slows down natural restoration of peatlands. Entire area surrounding the exploitation basins, along with roads and piles of excavated surface layer of peat, have lost its function as habitat to many plant and animal species, giving the impression of a visibly disrupted ecosystem. However, such changed environmental conditions are beneficial for water birds which find these basins a good substitute for continuously shrinking open water surfaces in this wetland area.

## **RESPONSES – MEASURES AND INSTRUMENTS FOR PROTECTING PEATLANDS**

It has to be pointed out that Livanjsko field is of special conservation interest being a unique wetland, mire, peatland and grassland habitat, i.e. a typical "Temperate Grassland" according to the United Nations List of Protected Areas. Because of its geomorphological, hydrological, pedological and biological specificity, the Federation of BiH projected spatial plan for 2008-2028 classifies it into the V category of protection – Protected natural landscape, in accordance with IUCN directives and FBiH legislation. Under the „Ramsar Convention“ it is protected as an important habitat for several waterbird species.

Measures for restoring hydrological regime – In reality, renewal of peatland hydrological state is not possible, therefore, the first restoration objective would be to stop any further degradations. This can be achieved by blocking the drainage canals. It requires a thorough studying of the hydrological conditions pertinent to drained area. A sequence of barriers are then placed into canals in regular intervals to block and slow down the water flow within, thus increasing the level of water in canal and surrounding area. These dumps can be made of any materials: wood, metal sheets, plastic bags filled with peat, as well as piles of dried peat.

Measure for restoring exploitation basin's floor and wildfire sites - A proactive planting of sedge-reeds on the layer of peat left on the basin floor for the purpose of having a more uniform and faster growth. Sedge-reed shoots would be replanted from the areas where their removal would not affect stability. As a measure of accelerated natural revegetation of the basin floor it is recommended to cover the normally untouched layer of peat with an additional 20 cm deep layer of the removed surface material that is abundant in rhizome and sedge-reed parts. Measure of accelerated revegetation by replanting the sedge-reeds would also be implemented on wildfire affected areas where previous removal and fragmentation of woody vegetation (that could be used for mulching the fire affected areas) would be necessary.

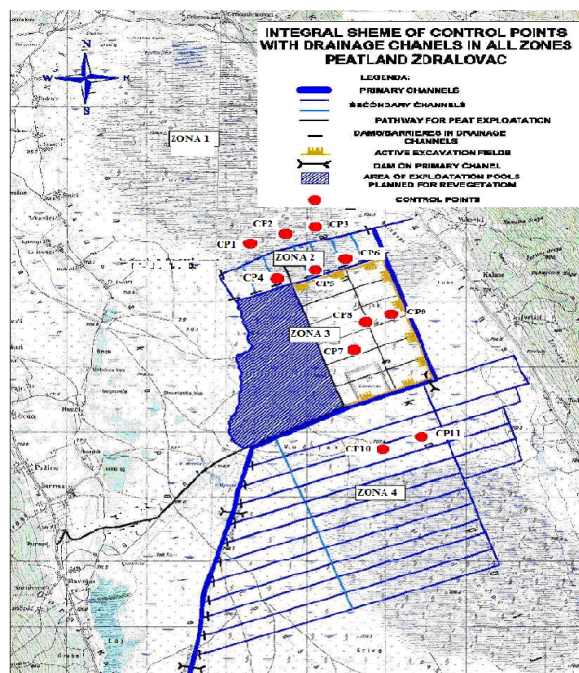
Establishment of monitoring control points – Monitoring of basic hydrological parameters is crucial part of the overall peatland monitoring. Measurement of ground water table is done in piezometers. Level of surface waters is read directly from a staff gage in the main drainage canal. Analysis of data on levels and flow helps us to precisely identify annual fluctuations of ground and surface water levels; most vulnerable and most stable areas in terms of water supply; exact flow direction of ground water; hydraulic properties of peat; and, correlation between the changes in vegetation community and changes in water regime. At the control points it is planned to take peat samples for testing its physical and chemical properties. Water chemism would be monitored seasonally, at wellspring, in the peat itself and in drainage canal. Peat layer remaining on fire affected areas would also be analyzed. A total of 11 monitoring control points would be established in selected research areas.

## **CONCLUSION**

Related to the purpose of preliminary research presented in this paper we defined four research areas – zones and list of the environmental indicators. Related to the current status in peatland we defined the environmental indicators that would best serve to assessing the environmental state of the peatland.

Table 1. Comprehensible table of indicators of environmental state of peatland by DPSIR concept

Driving forces	Pressure	State	Impact	Responses
Use of water in energy production Peat excavation Change of use of peatlands to agricultural land Natural resources exploitation methods Public awareness Climate changes	Anthropogenic and special degradation of peat	Quality of peat	Reduced or disabled environmental service of peatland: -accumulation of peat - climate regulating function -purification and retention of water  Reduced biological diversity  Cultural significance - natural heritage	Identification of ecosystems with high biodiversity value
	Emission of greenhouse gases			Monitoring of the level of ground and surface waters
	Fires and wind erosion			Monitoring of peat and water quality
	Conversion of habitats	Physical loss of peat		Monitoring of land use
	Application of mineral fertilizers	Land use ways structure		Organic farming – Certification of production
	Application of pesticides	Contaminati-on with heavy metals and pesticides		Trained people involved in process of exploitation
	Use of water for irrigation	Nutrients budget		Improved technical standards in peatland exploitation: - Building a system of mobile barriers and activation of water-gates in drainage canals - improved technical measures for sustainable peat excavation - revegetation of the floor of excavation basins and areas affected by fire
	Anthropogenic degradation of soil	Devastated/ artificial appearance of peatland		
	Conversion of primary ecosystems			



Further, we defined the following four research areas - zones:

1. zone I – in the untouched „virgin“ part of peatland Veliki Ždralovac,
2. zone II – in the part where peat used to be excavated 25 years ago,
3. zone III – in the active peat excavation sites and
4. zone IV - in the reclamation area of Table intended for agriculture.

Figure 1. Establishment of control points (CP) by selected zones (Zerem, 2012.)

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# THE STRUCTURE OF LAND COVER CHANGES IN BOSNIA AND HERZEGOVINA DURING THE PERIOD FROM 2000 TO 2006

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## ABSTRACT

The structure of land cover in Bosnia and Herzegovina (BiH) has been constantly changing due to many various factors. The war that lasted from 1992 to 1995 deeply affected life, especially the socio-economic structure which furthermore has great impact on present land cover. The analysis shows that in the period from 2000 to 2006 about 1% of the total BiH territory has changed its land cover. Agricultural areas and semi-natural areas have a trend of significant decrease, especially agricultural areas. Artificial surfaces significantly increased and that is directly linked with the process of the post-war reconstruction of the country and demographic changes. The construction of settlements is being carried out without any social or planning guidance with significant consequences on rational utilization of the land.

In this paper, land cover changes in BiH that occurred during the period 2000-2006 are analyzed and presented in graphical and alphanumerical forms. Special attention is paid on specific transition of certain land cover classes, mainly on agricultural and forest land. Land cover changes are analyzed for each environment-vegetation regions as well as different altitudes. The analysis of diversity for BiH is presented. For this research CORINE land cover databases in GIS (for 2000 and 2006) are used as a main source of the information.

**Key Words:** CORINE databases, land cover, changes, biodiversity.

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## INTRODUCTION

A permanent task of human society is to manage environment and natural heritage in a sustainable way. Having information on possible changes in various habitats, biospheres or ecosystems is essential to any decision-makers. To that effect, in 1985 the EU (that time EC) CORINE program (Coordination of Information on the Environment) was developed to collect information on the state of environment in respect of specific purposes, and coordinate collection of data and organize employment of collected information. Examples of the above stated include collection of data on: spatial distribution and state of natural area; geographic distribution and quantity of wild fauna and flora; quality and quantity of water resources; land cover structure and state of the soil, etc. Another purpose of the CORINE program is to collect all the information (at international, regional or local level) on environment, as well as to follow up the ways these changes occur. Therefore, the establishment of GIS (Geographic Information System) and preparation of databases that will provide information on the status of environment is crucial to timely decision making.

For the purpose of preserving environment and approximating to the EU standards, BiH started the CORINE program in 1998.

The second CORINE program in BiH was completed in November 2008. This paper analyzes the changes that occurred in individual classes of land cover (CLC) between the two CORINE projects, in order to try to explain causes of the incurred changes and their eventual impact on ecosystems, i.e. environment.

## MATERIALS AND METHODS

For the spatial-geographic analysis of the changes of land cover classes that took place in BiH in the period 2000 - 2006, we used data from the CORINE database (EEA, 2008) and Taletović et al. (2012). For determining classes of land cover we used the standard CORINE nomenclature consisting of five major

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categories of standard level 1 as follows: 1. artificial surfaces; 2. agricultural areas; 3. forest vegetation and other natural surfaces; 4. wetlands, and 5. water surfaces. In addition to this one, there are two more standard levels of nomenclature. This paper analyzes only the CLC changes that took place on large areas.

Accomplishment of the above stated goal requires in the first place identification of areas in which changes have occurred. For this purpose two inputs were used: „horizontal“ and „vertical“. In terms of „horizontal“ input we used the BiH environment-vegetation division (Stefanović et al. 1983), and in terms of „vertical“ input, a division based on altitude.

Based on environment-vegetation divisions, BiH comprises the following regions: Peripannonian region; transitional Illyric-Moesian region; inner Dinaric; and, Mediterranean-Dinaric region. For the purpose of analyzing the changes, a division to the following altitude ranges was used: 0-500 m, 501-800 m, 801-1,200, 1,201-1,600, 1,601-2,000 m and >2,001 m. Digital elevation model (DEM) with the resolution of 20 m was used in stated analyses. Such analyses allow us to look into terrain and identify the areas that have sustained most changes, as well as their causes.

For analyzing  $\gamma$  diversity that is commonly used in spatial analysis of diversity at national level (Kimmins, 2004), we used the Ecological Methodology software (Krebs, 1999). For the analysis we used data of standard level 1 CORINE nomenclature, categories 3, 4 and 5, for the years 2000 and 2006. Gamma diversity was expressed by Simpson and Reciprocal Simpson index and Shannon index, as well as Camargo and Evenness (Krebs, 1999). These indexes were calculated two ways: through the number of identified polygons and the area of identified polygons.

## RESULTS AND DISCUSSION

In BiH in the period of 2000-2006, changes were registered on a total of 48,226 ha, which is about 0.94% of the country's total area. Changes within the environmental-vegetation regions in BiH, which took place between the two CORINEs, are shown in Table 1.

Table 1. Major changes in the structure of land cover in specific CLC classes on the territory of BiH for the period 2000-2006, by environmental-vegetation regions in BiH

Region	Changes in CLC 2000-2006		Changed area (ha)	Changed number of polygons
	Class name (from class to class)	Class Code (from class to class)		
Mediterranean-Dinaric region	broad-leaved forest to forest vegetation successions	311 to 324	5,905.00	81
	thermophilous vegetation to burned areas	323 to 333	1,151.12	17
	complex soil cultivation system to discontinuous urban areas	242 to 112	197.38	17
	mixed forest vegetations to forest vegetation successions	312 to 324	458.32	12
Inner Dinaric region	broad-leaved forest to forest vegetation succession	311 to 324	9,595.85	220
	forest vegetation successions to broad-leaved forests	324 to 311	4,691.21	92
	forest vegetation successions to mixed forests	324 to 313	894.05	30
	coniferous forest to forest vegetation successions	312 to 324	1,227.49	31
	forest vegetation succession to coniferous forests	324 to 312	696.03	18
	complex soil cultivation system to discontinuous urban areas	242 to 112	1,713.72	68
	areas mostly used for agriculture with significant areas of	243 to 112	378.80	23
Peripannonian region	forest vegetation succession to broad-leaved forests	324 to 311	1,814.35	34
	complex soil cultivation system to discontinuous urban areas	242 to 112	1,261.48	52
	non-irrigated arable land to discontinuous urban areas	211 to 112	619.33	22
	areas mostly used for agriculture with significant areas of	243 to 112	272.97	19
Illyric-Moesian region	broad-leaved forests to forest vegetation successions	311 to 324	659.15	25
	complex soil cultivation system to discontinuous urban areas	242 to 112	486.29	19
	non-irrigated arable land to discontinuous urban areas	211 to 112	421.20	10

Changes on other classes of land cover within all the regions were rather small in scale, therefore they were not analyzed.

Biggest changes within the CLC classes occurred in the Inner Dinaric region, on a total area of 19,197.15 ha. Smallest changes occurred in the Illyric-Moesian transitional region on a total area of 1,566.64 ha, while the other two regions take intermediate position. Pronounced are degradation processes caused by anthropogenic influence in the Mediterranean-Dinaric region, in the sense of degradation of forests into lower economic forms (forest vegetation successions), with the occurrence of burned areas. A general characteristic of the Inner Dinaric region is degradation of forest vegetation into lower economic forms (forest vegetation successions) on an area larger than 10,000 ha, which, most likely, occurs within privately owned woodland abandoned by their native population due to war activities. Additionally, there is an apparent reverse trend of progressive development of forest vegetation, which transitions from the lower economic forms into the higher ones (succession to forest), on a total area of 6,281.29 ha. Inside this area, some significant changes take place in terms of devastation of agricultural land, i.e. transformation of this land into construction sites, on a total area of 2,092.52 ha.

Similar processes take place in Peripannonian region as well, on a total area exceeding 2,000.00 ha. Unexpected was the information indicating an increase of deciduous forests (1,814.35 ha) from succession vegetation in the Peripannonian region. This also indicates a trend of abandoning the agricultural land (most likely due to wartime activities) and their gradual conversion into forest vegetation. We may assume that these changes are the effects of wartime activities, as well as population migrations in the past period.

Changes within the altitude ranges in BiH, that took place in the referent period, are shown in Table 2.

Table 2. Major changes in the structure of land cover in specific CLC classes on the territory of BiH for the period 2000-2006, by altitudes in BiH

Altitude (m)	Changes in CLC 2000-2006		Changed area (ha)	Changed number of polygons
	Class name (from class to class)	Class Code (from class to class)		
0-500	forest vegetation successions to deciduous forest	324 to 311	4,875.1	86
	deciduous forests to vegetation succession	311 to 324	3,170.4	93
	complex soil cultivation system to discontinuous urban areas	242 to 112	2,817.9	109
	non-irrigated arable land to discontinuous urban areas	211 to 112	1,166.1	10
	land mostly used for agriculture with significant areas of natural vegetation to discontinuous urban areas	243 to 112	358.9	27
501-800	forest vegetation successions to deciduous forests	324 to 311	6,113.6	137
	complex soil cultivation system to discontinuous urban areas	242 to 112	1,009.0	33
	forest vegetation succession to deciduous forests	324 to 311	2,069.0	45
	forest vegetation successions to coniferous forests	324 to 312	252.9	10
	forest vegetation successions to mixed forests	324 to 313	960.2	12
801 - 1200	deciduous forests to forest vegetation successions	311 to 324	11,474.9	177
	natural meadows to complex soil cultivation system	231 to 242	1781.1	12
	forest vegetation succession to deciduous forests	324 to 311	1,181.1	24
	forest vegetation succession to coniferous forests	324 to 312	451.7	11
	forest vegetation successions to mixed forests	324 to 313	1,368	21
	mixed forests to forest vegetation successions	313 to 324	848.0	19
	coniferous forests to forest vegetation successions	312 to 324	635.9	17
1201-1600	natural meadows to forest vegetation successions	231 to 324	357.7	13
	deciduous forest to forest vegetation successions	311 to 324	3,641.8	58
	coniferous forests to forest vegetation successions	312 to 324	444.6	12
	mixed forests to forest vegetation successions	313 to 324	318.7	11



Changes that occurred within the altitude range from 1,600 to over 2,000 m are minor, as well as differences in other CLC classes, hence they were not included in this analysis.

The biggest changes in the CLC classes were identified within the altitude range from 801 to 1,200 m, on a total area of 18,098.40 ha. The smallest changes were identified in the altitude range 1,201-1,600m, on a total area of 4,405.10 ha. Significant changes in CLC classes were also identified in the altitude range from 0 to 500 m, on a total area of 12,388.40 ha. Inside this altitude zone there is an intensive process of converting agricultural into construction land (4,342.90 ha). Also present is the process of changing the forest vegetation succession into deciduous forest vegetation (4,875.1 ha), as well as the process of abandoning agricultural areas and converting them into forest vegetation. All these processes take place on an area of more than 9,000 ha, which is actually a total loss of agricultural land within this altitude zone alone. Biggest changes are related to the degradation of deciduous forests into a lower economic form, that is forest vegetation succession. Forest degradation processes most commonly occur on private holdings where, due to war activities, the population moved to some other, usually urban areas. Within this area there is a certain trend of transition from the forest vegetation succession to a higher economic form – forests, on a total area of 3,282.1 ha. All this indicates the presence of the process of abandoning agricultural areas in this altitude zone, as well as their conversion to forest vegetation. The most common and with the largest changes are degradations of forest into a lower economic form – forest vegetation succession, and they occur within the altitude range of 801- 1200 m, on a total area of nearly 13,000 ha.

Within this altitude range there is a certain trend of transition from forest vegetation into a higher economic form– forests on a total area of approximately 3,000 ha. This most commonly happen on land parcels that are no longer managed as agricultural land, that are neglected and subject to succession first and then, as it progresses, to the formation of forest vegetation. Forest degradation processes are present in the altitude range from 1,201 to 1,600 m, on a total area of about 4,500 ha. Analysis of  $\gamma$  diversity (Kimmins, 2004) shows that there are no statistically significant differences between the CLC 2000 and CLC 2006 tested data. Existence of some minor differences indicates that there are no significant changes in terms of predominance of any specific CLC classes within the analyzed categories 3, 4 and 5, standard level 1 CLC for BiH for the years 2000 and 2006, either through their numbers or areas (Table 3).



Figure 1. Ecological – vegetation regions of BiH

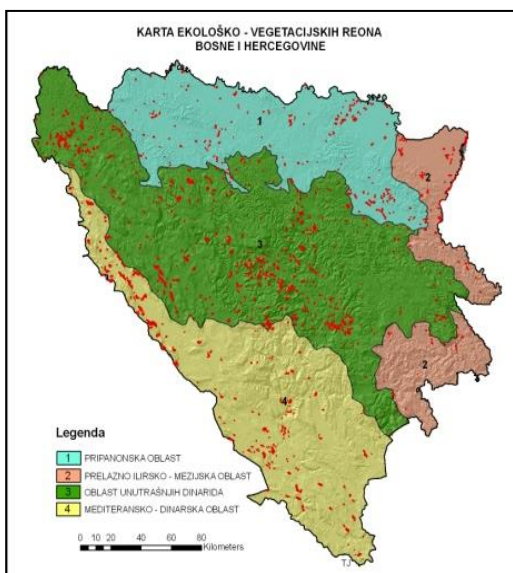


Figure 2. Map of CLC changes within environment-vegetation regions in BiH

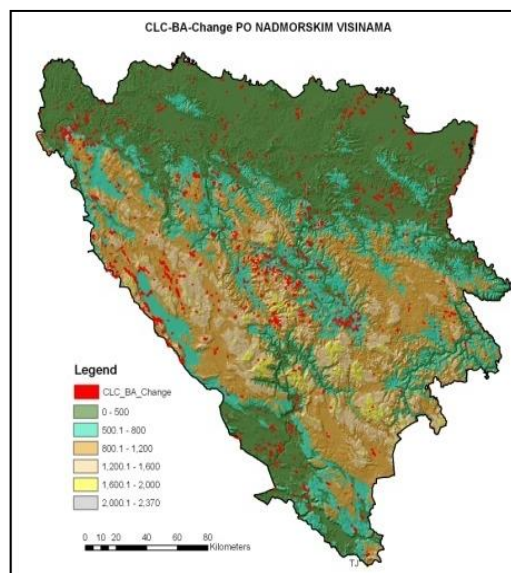


Figure 3. Map of CLC changes within defined altitude ranges in BiH

Indexes provided in Table 3. show that there are no significant changes in terms of predominance of any specific CLC classes, e.g. meadow, or any specific forms of forest vegetation, over the rest of the CLC classes from categories 3, 4 and 5 of level 1 for the subject period. This analysis also shows that, for the time being, there is no excessive disruption or change of preserved (semi)natural ecosystems into any other CLC classes at the level of BiH.

Table 3. Indexes of diversity and evenness of  $\gamma$  diversity BiH based on CLC BiH from 2000 and 2006

Indexes	Calculation using number of polygons		Calculation using area of polygons	
	CLC BiH 2000	CLC BiH 2006	CLC BiH 2000	CLC BiH 2006
Simpson	0.780	0.781	0.693	0.694
Shannon	2.523	2.527	2.276	2.281
Reciprocal Simpson	4.546	4.560	3.259	3.273
Camargo	0.289	0.289	0.251	0.252
Evenness	0.303	0.304	0.217	0.218

## CONCLUSIONS

Based on the above stated, it may be concluded that the most frequent changes occur in the Inner Dinaric region, at the height of 801 to 1,200 m above sea level. In addition, changes occurring in the Mediterranean-Dinaric region at the altitudes ranging from 0 to 500m on the entire territory of BiH are also significant. Most common changes in BiH, in respect of CLC classes include: degradation of forests from the class of deciduous forest into the class of forest vegetation successions (311 -324). Usually lost is the agricultural land of CLC class of complex cultivation system at lower altitudes (0-500 m) in the Inner

**Dinaric region. Also in the Inner Dinaric region at the height ranging from 800 to 1,200 m above sea level, there are frequent processes of progression from CLC class of forest vegetation successions to a higher economic form –forests. At lower altitudes (0-500 m) and in Peripannonian region identified are the changes related to abandonment of agricultural areas and formation of: first, the forest vegetation successions, and later on, their overrun and formation of forest vegetation. In the Mediterranean-Dinaric region there were no identified progressive changes in terms of remediation of the state of forest vegetation or any other CLC classes. Most of these changes can be attributed to the past war and its implications (changes in population, property relations, etc.), but also to the challenges of the current economic situation. Because of all this, people influence the ecosystems in many ways which is clearly reflected in Corine Land Cover. Monitoring of the state of  $\gamma$  diversity can help us to identify if any significant ecosystem changes occur at the level of. This way established CORINE database serves as a necessary framework for providing information on vulnerable ecosystems and habitats, as well as a base for sustainable management of natural resources.**

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# THE EFFECTS OF DIFFERENT LATERAL SPACING AND WETTING PERCENTAGE ON YIELD AND WATER USE FOR DRIP-IRRIGATED POTATO

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## ABSTRACT

In this study, the effects of two different lateral spacing (0.7 m and 1.4 m) and two different wetted area percentage (100% and 75%) on yield and yield components of potato were investigated in drip irrigation at Konya Plain. The study was conducted in Konya Sugar Corporation's experimental fields on Alakova-Konya during the growth season of 2008 and 2009.

Seasonal evapotranspiration (ET) were ranged between 436.63 mm and 581.54 mm in the drip irrigated plots where different lateral spacing and wetted area percentage were applied depending on the treatments. It was found that the different lateral spacing effected physical quality parameters such as tuber yield, individual tuber yield, number of tuber per plant, tuber diameter, tuber size, marketable tuber yield. Wetted area percentage effected chemical quality parameters such as tuber starch ratio and tuber protein ratio statistically. IWUE and WUE were ranged from 8.32 - 4.90 kg/m<sup>3</sup> and 7.51- 5.44 kg/m<sup>3</sup> respectively in the drip irrigated plots where different lateral spacing and wetted area percentage were applied.

**Key Words:** Drip irrigation, Konya Plain, lateral spacing, potato, wetted area percentage

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## INTRODUCTION

Production of potato (*Solanum tuberosum L.*) takes a very important place in world agriculture, with a production potential of about 324 million t harvested and 18.6 million ha planted area (FAO, 2010). Potato is one of the main crops in Turkey where the production is about 4.30 million t harvested from 0.15 million ha (FAO, 2010).

The Konya Plain where water resources are limited is consisted of 10% arable lands of Turkey and it has an arid climate. The total annual rainfall of the Konya Plain in terms of average long term records is 323 mm, and only 100-110 mm of which falls in plant growing season (Yavuz, 2011). Therefore agricultural diversity, yield and quality increase depends on irrigation in the plain. In other words, irrigation is an indispensable necessity for the vegetative production in the plain. The currently irrigated land is nearly 500 thousand ha in Konya plain (Kara et al., 2008).

Potato farming needs irrigation in Konya Plain as all over the Turkey. Potato cultivation area in Konya has been expanding each year, and the potato cultivation area in 2009 was 8747 hectares, production quantity was 315 825 tonnes and average yield was 36.11 t/ha (TUIK, 2011).

In this study; the effects of two different lateral spacing and the percentages of two wetted areas applied in drip irrigation method on yield and yield components of potato were researched.

## MATERIAL AND METHODS

The research was conducted in the trial area of Konya Sugar Inc. in Konya-Alakova between 2008 and 2009. The climatologic data of trials years (in 2008 – 2009) were recorded at the portable meteorological station installed nearby the experimental area. The climatic parameters such as average temperature, relative humidity, precipitation and average wind speed during the experimental years were given in Table1.

The physical characteristics of the soil at the experimental site was given in Table 2. The experimental site soil are silty loam at all horizons for two years. The total available soil water contents within the top 0.9 m of the soil profiles for years 2008 and 2009 are 135.6 mm and 132.3 mm respectively.

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\*This study was abstracted from PhD thesis of Duran Yavuz and supported by the Selcuk University BAP Office (Coordinating Office of Scientific Research Projects, Project No: 08101015)

**Table 1. Some climatic parameters of region for the experimental years**

Year	Month	Average temperature °C	Relative humidity %	Precipitation mm	Average wind speed m/s
2008	April	14.1	51.4	20.5	1.7
	May	15.6	51.4	28.2	1.4
	June	21.6	42.6	5.2	1.3
	July	23.3	39.1	14.8	1.2
	August	23.9	41.7	0	1.0
	September	18.8	54.1	73.4	0.7
2009	April	10.1	66.5	57.8	1.0
	May	14.6	59.5	47.2	0.9
	June	20.4	46.9	11.8	1.1
	July	22.6	49.1	17.4	1.2
	August	21.2	41.6	0	0.9
	September	16.8	55.9	25.6	0.6

**Table 2. Physical properties of the experimental site soil**

Years	Profile depth (cm)	Soil Classification	Dry Bulk density (g/cm <sup>3</sup> )	Field Capacity (FC)		Wilting Point (WP)		Available Soil Water Content		
				%	mm	%	mm	%	mm	
2008	0-30	Silty loam	1.30	22.9	89.4	12.1	47.1	10.8	42.3	
	30-60	Silty loam	1.34	26.3	105.9	15.7	63.0	10.7	42.9	
	60-90	Silty loam	1.33	27.9	111.3	15.3	60.9	12.6	50.4	
	90-120	Silty loam	1.37	30.1	123.6	18.8	77.4	11.2	46.2	
	Total (0-90 cm)				306.6		171.0		135.6	
	Total (0-120 cm)				430.2		248.4		181.8	
2009	0-30	Silty loam	1.26	24.3	91.8	12.2	46.2	12.1	45.6	
	30-60	Silty loam	1.31	26.1	102.6	15.3	60.0	10.8	42.6	
	60-90	Silty loam	1.32	27.3	108.0	16.1	63.9	11.1	44.1	
	90-120	Silty loam	1.35	29.2	118.2	18.7	75.6	10.5	42.6	
	Total (0-90 cm)				302.4		170.1		132.3	
	Total (90-120 cm)				420.6		245.7		174.9	

The Russet Burbank variety which is mostly used in industry and frozen potato was used in the research. Potato was planted at depths of 0.15 – 0.20 m by the two-row mechanical potato drill machine on 22<sup>nd</sup> April, 2008 and on 28<sup>th</sup> April, 2009. The row spacing was 70 cm and plant spacing on rows was 35 cm. Prior the experiment, to provide homogenous emergence, irrigation water applied to whole area with the amount 45 mm and 40 mm respectively in 2008 and 2009. For both years, first emergence was observed after the second half of May, but homogeneity on plant emergence was observed in the last week of May.

Drip irrigation system consisted of; the control unit and distribution lines. The control unit contained a hydrocyclone, fertilizer tank, disk filter, control valves and manometer. The distribution system consisted of PE pipes which were used as the mainline (90 mm in diameter) and manifolds (63 mm in diameters), Irrigation lateral that were 16 mm in diameter and 40 m in length had inline emitters spaced 33 cm apart with a 4.0 l/h flow rate at the pressure of 1 atm. 3/4" water flow meters were placed for each plots in order to control the amount of water.

The main plots of the research include different lateral spacing; the sub-plots, on the other hand, include percentages of different wetted areas which are going to be used in the calculation of irrigation water (Table 3). A 7-day irrigation interval was used in the study (Ünlü et al., 2006). Irrigation water, which would bring the soil moisture decreased at 90-cm root depth to field capacity, was applied for irrigation plots indicated by the symbols of DS<sub>0</sub>, DS<sub>1</sub>, DS<sub>2</sub> and DS<sub>3</sub> with 7-day irrigation intervals. Four different experimental plots were conducted in the consideration of randomized blocks experimental design with 3 replications. The irrigation was started when the 50-55% of available water content was consumed.

**Table 3. The treatments applied for the experiment**

Symbols	Main plots (Lateral spacing)	Sub-plots (Percentage of the wetted area)
DS <sub>0</sub>	Scheduling one lateral for each plant row (Lateral spacing is 0.70 m)	Applying percentage of the wetted area at the level of 100%
*DS <sub>1</sub>	Scheduling one lateral for each plant row (Lateral spacing is 0.70 m)	*Applying percentage of the wetted area at level of 75%
DS <sub>2</sub>	Scheduling one lateral between two plant rows (Lateral spacing is 1.40 m)	Applying percentage of the wetted area at the level of 100%
DS <sub>3</sub>	Scheduling one lateral between two plant rows (Lateral spacing is 1.40 m)	Applying percentage of the wetted area at level of 75%

*\* The actual percentage of the wetted-area was determined in consequence of experimental tests conducted in the field.*

Taking the features of the soil into consideration, experimental tests were carried out in the experimental field through the single lateral and 4 l/h discharge emitters at an operating pressure of 1 atm in order to determine the emitter spacing and the percentage of area that is planned to wet. The wet diameter width of soil at a depth of 30 cm from the surface was calculated as 52 cm in consequences of the conducted tests. Emitter spacing was accepted as nearly 66% (33 cm) of the measured wet diameter (Yıldırım, 2003). Percentage of the wetted-area (for DS<sub>1</sub> plot) was calculated as 75% by dividing wet diameter (52 cm) by lateral spacing (70 cm) (Keller and Bliesner, 1990; Çetin and Uygan., 2008).

In experimental plots where a lateral was scheduled for each plant row; the width and length of each plot were planned as 2.8 m and 40 m respectively, and plots had 4 plant rows. Each of the experimental plots where one lateral was scheduled for two plant rows; had 6 plant rows. That is to say that the width and length of each of these plots were designed as 4.2 m and 40 m respectively (Ünlü et al., 2006). The plants between the plots and blocks were removed by hand and then the drip irrigation system was set into the plots.

The soil water content at plant root depth was monitored with Delta-T Profile-Probe moisturemeter. Decreasing soil moisture at plant root zone depth (90 cm) during 7 day interval was calculated as depth(mm) (Equation 1).

$$d_n = \frac{(TK_v - MN_v) \times D}{10} \quad (1)$$

dn= Irrigation water as depth(mm),

TK<sub>v</sub>= Soil moisture in field capacity (cm<sup>3</sup>/cm<sup>3</sup>),

MN<sub>v</sub>=Available soil moisture in the mentioned programme (at 7 day irrigation interval) (cm<sup>3</sup>/cm<sup>3</sup>),

D= Root zone depth (90 cm)

The irrigation water amount was calculated as m<sup>3</sup> by multiplying the moisture deficiency (mm) calculated through Equation 1 by plot (m<sup>2</sup>) area and percentage of wetted area (100% and 75%).

The evapotranspiration for each treatments was calculated in accordance with water budget (James, 1988). Deep percolation losses below the root zone was determined depending on gravimetric method. Thus the 90 cm layer is considered to be the depth at which water flows into or out of the root zone. Soil samples for water content measurement were obtained at 0, 35 and 70 cm from drip emitters at depth intervals of 90-100, 100-110 and 110-120 cm. The water contents were measured by gravimetric method and converted to volumetric water content using the bulk densities and deep percolation was calculated according to Kang et al. (2004).

Just before harvest, first rows from the each side of the plots were removed and the potato plant was harvested with a single row potato harvesting machinery on 15th September and 23rd September in 2008 and 2009 respectively.

In order to determine the potato quality parameters, 10 sample plants from each plots were selected randomly. Physical and chemical quality factors were determined based on selected 10 potato plants (Önder et al., 2005). The quality factors of potato was determined according to Yılmaz (1993) and Ayas (2007).

Water use efficiency (WUE) and irrigation water use efficiency (IWUE) were calculated in accordance with Equations suggested by Tanner and Sinclair (1983).

The variance analysis was conducted on the collected data in order to determine the differences between yield and quality factors of potato statistically (Yurtsever, 1984; Düzgüneş et al., 1987). The variance analyses were conducted by using SPSS 13.0 computer programme.

## RESULTS AND DISCUSSION

The amounts of applied irrigation water are given in Table 4, the yield and quality values of potato obtained from the experimental plots are given in Table 5.

As it is seen in Table 4, the highest total irrigation water amount was found in DS<sub>2</sub> plot where the lateral spacing was 1.4 m and the percentage of wetted area was at the level of 100% in both experimental years (2008 and 2009). The total irrigation water amount applied in DS<sub>1</sub> and DS<sub>3</sub> experimental plots was low because these plots received irrigation water after multiplying the soil moisture deficit measured at 90 cm root zone by the percentage of wetted area (75%). The highest deep percolation occurred in DS<sub>2</sub> plot, where the lateral spacing was 1.4 m and the percentage of wetted area was at the level of 100%, in 2008 and 2009 as 134.28 and 137.89 mm respectively. This happens because when the irrigation water is applied through a broad lateral spacing such as 1.4 m by considering the percentage of wetted area at 100%, the moisture values of soil volume between the laterals appear lower than the moisture values of soil volume just under the lateral and they cannot receive at the field capacity. Thus, percolation loss beneath the plant root zone increases. The water application efficiency in 2008 ranged from 75.8% to 97.1%, and the water application efficiency in 2009 were between 74.3% and 96.6%.

Table 4. Net and gross water amount applied to the treatments and irrigation application efficiencies

Years	Treatments	Total Irrigation Water mm	Net Irrigation Water mm	Deep Percolation mm	Irrigation Application Efficiency %	Seasonal ET mm
2008	DS <sub>0</sub>	534.84	508.53	26.31	95.1	581.54
	DS <sub>1</sub>	412.05	400.17	11.88	97.1	490.09
	DS <sub>2</sub>	554.14	419.86	134.28	75.8	487.75
	DS <sub>3</sub>	404.49	357.60	46.89	88.4	436.63
2009	DS <sub>0</sub>	498.09	464.35	33.74	93.2	562.79
	DS <sub>1</sub>	399.46	385.88	13.58	96.6	496.44
	DS <sub>2</sub>	536.76	398.87	137.89	74.3	496.29
	DS <sub>3</sub>	419.63	369.69	49.94	88.1	472.13

The highest tuber yields in 2008 and 2009 were 50.66 and 42.29 t/ha respectively and obtained from DS<sub>0</sub> plot in which the lateral spacing was 0.7 and the percentage of wetted area was at the level of 100%. The marketable tuber yields in both experimental years were obtained from DS<sub>0</sub> plot again (Table 5).

The effect of main (lateral spacing) and sub-plots (percentage of wetted area) on yield and quality components of potato are displayed in Table 6.

Table 5. Yield and yield components

Year	Treatments	Yield t/ha	Single Tuber Yield g	Number of Tuber for Each Plant	Tuber Diameter cm	Tuber Length cm	Marketable Yield t/ha	Tuber Dry Matter %	Starch Rate %	Protein Rate %
2008	DS <sub>0</sub>	50.66	226	5.5	6.9	11.9	47.51	20.4	16.0	1.8
	DS <sub>1</sub>	40.45	158	6.3	6.2	10.6	34.96	23.0	18.4	2
	DS <sub>2</sub>	37.41	111	8.2	5.3	8.9	28.30	20.3	16.3	1.6
	DS <sub>3</sub>	35.30	104	8.1	4.8	8.3	26.00	23.5	19.0	1.8
2009	DS <sub>0</sub>	42.29	186	5.6	5.6	9.4	38.60	20.5	16.7	1.7
	DS <sub>1</sub>	37.76	147	6.2	5.2	8.9	31.73	22.4	18.5	1.9
	DS <sub>2</sub>	33.96	111	7.8	4.7	7.9	25.24	20.8	16.5	1.5
	DS <sub>3</sub>	34.80	112	7.4	4.7	7.5	24.97	22.1	19.2	1.9

Table 6. Yield and quality factors according to the main and sub-plots

Year	Treatments	Yield t/ha	Single Tuber Yield g	Number of Tuber for Each Plant	Tuber Diameter cm	Tuber Length cm	Marketable Yield t/ha	Tuber Dry Matter %	Starch Rate %	Protein Rate %	
2008	Lateral	0.70m	45.55A	192A	5.9A	6.6A	11.3A	41.23A	21.7ns	17.2ns	1.9A
		1.40m	36.35B	107B	8.2B	5.1B	8.6B	27.15B	21.9ns	17.7ns	1.7B
	Wetted area percentage	%100	44.03a	169A	6.9ns	6.1a	10.4a	37.90A	20.4ns	16.2A	1.7A
		%75	37.87b	131B	7.2ns	5.5b	9.5b	30.48B	23.3ns	18.7B	1.9B
2009	Lateral	0.70m	40.03A	167A	5.9A	5.4a	9.2A	35.16A	21.5ns	17.6ns	1.8ns
		1.40m	34.38B	112B	7.6B	4.7b	7.7B	25.10B	21.5ns	17.9ns	1.7ns
	Wetted area percentage	%100	38.13ns	148a	6.7ns	5.2ns	8.7a	31.92a	20.7ns	16.6A	1.6A
		%75	36.28ns	130b	6.8ns	5.0ns	8.2b	28.35b	22.3ns	18.9B	1.9B

A and B letters indicates significantly different according to  $p < 0.01$   
a and b letters indicates significantly different according to  $p < 0.05$   
ns letters indicates statistically insignificant according to  $p < 0.01$  and  $p < 0.05$

As it can be observed in Table 6, the lateral spacing was considered as significant at the level of 1% ( $P < 0.01$ ), and the percentage of wetted area was viewed as significant at the level of 5% ( $P < 0.05$ ) in the first year of the experiment. In 2009, which is the second year of the experiment, the percentage of wetted area was statistically insignificant and the lateral spacing was considered as significant at the level of  $p < 0.01$ . In 2008, the lateral spacing consisted of two different groups. While the plots having 0.7 m lateral spacing took place in the first group (A) with the average of 45.55 t/ha, the experimental plots having 1.4 m lateral spacing were in the second group (B) with the percentage of 36.35 t/ha. Tuber yield in plots having 1.4 m lateral spacing experienced a decrease at an average rate of 20.2% in comparison with plots having 0.7 m lateral spacing. In classification arranged by the percentages of wetted areas, while the plots having 100 percent wetted area were in the first group (a) with the average of 44.03 t/ha, the plots having 75% wetted area were selected for the second group (b) with the average of 37.87 t/ha. There was an average 14% decrease in tuber yield of plots in which the wetted area percentage was at the level of 75% in comparison with those plots having 100 percent wetted areas. In 2009, lateral spacing formed two different groups. While the plots having 0.7 m lateral spacing were in the first group (A) with



the average of 40.03 t/ha, 1.4 m lateral-spaced experimental plots were in the second group (B) with the average of 34.38 t/ha. There was a 14.1% decrease in tuber yield of plots possessing 1.4 m lateral spacing in comparison with those plots having 0.7 m lateral spacing. Similar results were also collected for the marketable yield values.

## CONCLUSIONS

In this study, one lateral design for each plant row and one lateral design for two plant rows were applied for potato irrigated through the drip irrigation method, and the effects of these applications on water use, yield and quality parameters of potato were determined. Thus, it was researched whether it is necessary to increase the number of lateral pipes for potato cultivation or not.

Total tuber yields in DS<sub>1</sub>, DS<sub>2</sub> and DS<sub>3</sub> were 15.8%, 23.2% and 24.6% less than DS<sub>0</sub> plot. Marketable tuber yields in DS<sub>1</sub>, DS<sub>2</sub> and DS<sub>3</sub> were calculated as 22.5%, 37.8% and 40.8% less respectively in comparison with DS<sub>0</sub> plot. Irrigation water use efficiency in DS<sub>1</sub>, DS<sub>2</sub> and DS<sub>3</sub> was calculated as 1.3%, 41.1% and 25.6% less than DS<sub>0</sub> plot.

It was found that the different lateral spacing effected physical quality parameters such as tuber yield, individual tuber yield, number of tuber per plant, tuber diameter, tuber size, marketable tuber yield. Wetted area percentage effected chemical quality parameters such as tuber starch ratio and tuber protein ratio statistically.

One of the most significant aspects of drip irrigation method is the high water application efficiency. When one lateral line was set for two rows, water application efficiency reduced.

It has been concluded that scheduling one lateral for each plant row for potato cultivation irrigated through the drip irrigation method would be more appropriate in terms of both water use and water application yields, and potato yield and factors of potato yield.

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# RELATIONSHIPS BETWEEN LIVE WEIGHT CHANGE AND BIRTH WEIGHT OF YEARLING GOATS FED WITH DIFFERENT FEEDING LEVELS

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## ABSTRACT

Gestation period is one of the important parts in terms of reproduction procedure. Especially in growing animals, performance of both mother and newborn is influenced by the applications during gestation. Applications, especially in growing young animals during gestation, affect the performance of mother and offspring. The aim of this study was to investigate effects of different feeding level on birth weight and live weight changes of Turkish Saanen yearling goats. The study was carried out at the research farm of Çanakkale Onsekiz Mart University. Animal material of this study was 35 Turkish Saanen yearling goats at 7-8 months age. It was divided into three groups; the first one was fed according to nutrient requirement level (Group Control G-C, n=11), the second group was fed with 80% of their requirement (G-80, n=12), and the last was fed with 20% more of their requirement (G-120, n=12). The study continued from the beginning of the pregnancy until births. Live weight during gestation in G-80 group was lower than the G-C and G-120 group (G-80: 32.90 kg, G-C: 34.87 kg and G-120: 34.64 kg,  $P<0.0001$ ). Live weight changes had significant differences among the groups of different feeding level ( $P=0.0001$ ; G-C: 4.40; G-80: 3.04; G-120: 4.54 kg). Effect of different feeding level on birth weight observed statistically significant differences ( $P=0.0039$ ; G-C: 2.63, G-80: 3.65; G-120: 2.63 kg). G-120 and G-C groups had more live weight gain and lower birth weight as compared to the G-80 group. In the G-120 and in G-C groups, stillbirth rate was higher than that of G-80 (G-C: 18.2%; G-80:8.33% and G-120: 25%).According to the results of this study, during gestation restricted group animals had lower weight gain but their kids had higher live weight, which mechanism does play a role, when occurs preterm birth and stillbirth or low birth weight, what is the breaking point in the restricted group. These topics need intensive researches, especially on goats.

**Key Words:** restricted feeding, high level feeding, birth weight, live weight changes, Turkish Saanen goat

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## INTRODUCTION

Gestation is an important period in the lives of livestock animals. A successful gestation affects lifelong production of an animal and is also an important indicator of farm efficiency. Gestation is influenced by genetic and environmental factors. An important environmental factor is the maternal nutrition during gestation. Birth success affects newborn animals health and productivity, therefore, it is very important to define well the maternal environment in which fetus are developed. Goats are seasonally polyestric animals and prolific species. The average length of gestation period is 149 d for doe. The numbers of researches on goats have been elevated in recent years but there are still needs for more attention to investigate. Gestation period could be investigated in three stages; first trimester (early gestation), second trimester, and third trimester (late gestation). Redmer et al (2004) stated that 90 % of fetal growth occurred during last trimester of gestation. Dwyer et al (2005) studied about sheep placenta and postnatal behavior and stated that placental weight achieved a maximum level in the second trimester of gestation and fetal growth accelerated in the late gestation period. Fetal nutrition is one of the important factors that influence fetal growth (Osgerby et al., 2003). Wu et al. (2004) reported that maternal undernutrition during gestation reduces placental and fetal growths of farm animals and humans. Wu et al. (2004) reported from a cited study by King (2003) that the growing animals and humans (young mothers) compete with their own fetus, because they are themselves growing. During adolescent gestation, preterm birth and/or low birth weight may be encountered.

The aim of this study was to investigate effects of different feeding level on live weight, live weight changes and birth weight of Turkish Saanen yearling goats.

## MATERIAL AND METHODS

This study was carried out at the Research Farm, Çanakkale Onsekiz Mart University during gestation period of yearling goats. Animal material of the study was 35 Turkish Saanen yearling goats. In the study live weight, live weight changes from beginning of the gestation to the giving birth of yearling goats and

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birth weight of their kids fed at different levels during gestation were observed. Yearling goats were weighed in approximately every 14 days. At the beginning of the study, yearling goats were diagnosed with single fetus pregnancy. Animals were divided into three groups; the first group was fed according to nutrient requirement level (G-C, n=11), the second group was fed 80% of the requirement (G-80, n=12) and the third group animals fed 20% of more than the requirement (G-120, n=12). Number of animal material in the feeding level groups was given in Table 1. Mean live weight and body condition scores were approximately similar in the three feeding groups.

Table 1. Distribution of animal material and sex of their kids to the research groups

	G-C	G-80	G-120
Yearling goats	11	12	12
Sex of the newborn			
Female	6	6	5
Male	5	6	7
Stillbirth rate	18.2 %	8.33 %	25 %

Information about the feeding regime of the animals during the research was given in Table 2. In the early gestation (1-8th weeks) and in late gestation periods (9-13 weeks) were presented different rations. Different feeding level was composed by the taking into account daily dry matter consumption of the groups. Yearling goats were kept in a barn during the study. Confined goats were fed with a total mixed ration (Tr). The ration forage: concentrate ratio was 85: 15 (85 % vetch hay, 15 % concentrate mixture) in the early gestational period, while it was 70:30 (30 % maize silage, 20 % vetch hay, 20 % alfalfa hay, 30 % concentrate mixture) in the late gestational period. The nutrient composition of the feed material used to prepare the total ration in the study was shown in Table 2.

The feeds were offered to the goats twice a day, one in the morning (09:00 am) and on in the afternoon (16:00 pm). The ration was calculated according to the NRC (2007)'s reports, which provide the nutritional requirements of goats in gestation. The animals were allowed a free access to water and lime block.

Table 2. The nutritional content of the feed material in the ration

Feed material	DM	CP	ME
Maize silage	28	80	2.4
Alfalfa hay	98	160	2.0
Vetch hay	89	140	2.1
Concentrate	88	200	2.9

DM: dry matter % DM; CP: crude protein g/kg DM; ME: metabolizable energy Mcal ME/ kg DM.

Goats were fed with two different rations in early gestation and late gestation period. In the early gestational period (1 to 8 weeks of gestation) and late gestation period (9 to 13 weeks of gestation), the dry matter consumption level in a day per head of the groups were 0.85-1.15 kg DM; 0.68-0.92 kg DM and 1.02 -1.38 kg DM in the G-C, G 80 and G-120 groups, respectively. The dry matter content of the ration that was offered to the yearling goats in the early gestation period was calculated as 89 % percent, crude protein content as 150 g CP/kg DM and energy content as 2.2 Mcal ME/kg DM while the dry matter content of the ration in late gestation period was calculated as 56 %, crude protein content as 144 g CP/kg DM, and energy content as 2.4 Mcal ME/ kg DM.

#### Statistical Analysis

Statistical analyses of the data were carried out using a SAS program packet (SAS, 1999). Data of the study were analyzed with Proc MIXED. Feeding level groups (G-C, G-80, G-120), live weight control periods (13 controls) and their interaction were placed in the linear model to analyze live weight and live changes. Analysis of birth weight was performed on another linear model, in which the feeding level groups and sex of kid were taken as fixed effects and live weight of mother was fixed as a covariant in the model.

Stillbirth rate was not statistically analyzed, because of the restricted number in each group. This information was given as a percentage of total number of birth kids to stillbirth kids in each group.

#### RESULTS AND DISCUSSION

Yearling goats were weighed periodically and then the differences compared to the beginning weight were calculated, and defined as live weight changes. In Table 3 information about live weight and live weight changes were given. There were statistically significant differences between the feeding level groups and weight control periods ( $P < 0.0001$ ). G-80 group animals had lower live weight (32.90 kg) during gestation than the other feeding level groups. Fasanya et al. (1992) studied with different feeding programs, in which they planned four different feeding groups, grazing+cotton seed meal+maize, grazing +maize, grazing+cotton seed cake and only grazing. Researchers stated that there were significant differences between feeding groups, and the lowest live weight was observed in the grazing group. Restricted fed animals in this study had significantly lower weight increase during the gestation (G-80, 3.04 kg) than the control (4.40 kg) or G-120 groups animals (4.54 kg) ( $P < 0.0001$ ).

Table 3. Least square means ( $\bar{X}$ ), standard error (SE) and their significance level (P) of observed effects of the groups, weight control period and their interaction on live weight and live weight changes from beginning of the study to the birth.

	Live Weight, kg		P	Live weight changes, kg		P
	$\bar{X}$	SE		$\bar{X}$	SE	
<b>Feeding Level Groups</b>			<.0001			<.0001
G-C	34.87 <sup>a</sup>	0.32		4.40 <sup>a</sup>	0.18	
G-80	32.90 <sup>b</sup>	0.30		3.04 <sup>b</sup>	0.17	
G-120	34.64 <sup>a</sup>	0.30		4.54 <sup>a</sup>	0.17	
<b>Weight control period</b>			<.0001			<.0001
2	30.69 <sup>a</sup>	0.61		0.62 <sup>a</sup>	0.34	
3	31.56 <sup>a</sup>	0.61		1.41 <sup>a</sup>	0.34	
4	31.56 <sup>a</sup>	0.61		1.48 <sup>a</sup>	0.34	
5	32.50 <sup>b</sup>	0.61		2.43 <sup>b</sup>	0.34	
6	32.52 <sup>b</sup>	0.61		2.44 <sup>b</sup>	0.34	
7	33.72 <sup>c</sup>	0.61		3.64 <sup>c</sup>	0.34	
8	34.48 <sup>cd</sup>	0.61		4.41 <sup>cd</sup>	0.34	
9	34.59 <sup>cd</sup>	0.61		4.53 <sup>cd</sup>	0.34	
10	34.96 <sup>d</sup>	0.61		4.89 <sup>d</sup>	0.34	
11	37.07 <sup>e</sup>	0.61		6.94 <sup>e</sup>	0.34	
12	40.81 <sup>f</sup>	0.71		10.46 <sup>f</sup>	0.39	
13	35.26 <sup>d</sup>	9.64		4.65 <sup>d</sup>	0.35	

\*Different letters in the same column indicate significant difference.

However interaction of feeding groups and weight control period had no significant effect on live weight ( $P = 0.4345$ ), although interaction displayed a significant effect on the live weight changes ( $P < 0.0001$ ).

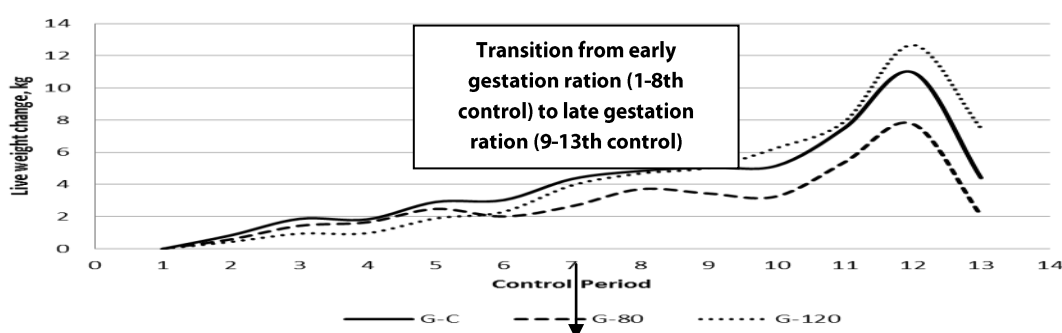


Figure 1. Live weight changes in different feeding level groups during gestation in yearling goats

In Table 3 was shown a significant effect of feeding groups on live weight changes ( $P < 0.0001$ ). Although the live weight changes from beginning the study to the giving birth indicated no significant differences in the G-C and G-120 groups. It could be seen in Fig. 1 that at the second period of gestation, especially after diet changes, there were differences between all of feeding level groups. Interaction of live weight changes from the beginning to giving birth and control period was found statistically significant ( $P < 0.0001$ ). In the early gestation period, control group animals had higher weight gain than the other groups of animal, but in the second stage after the #9 weeks of gestation the animals in the G-120 group had higher weight gain (Figure 1). G-80 group animals had the lowest weight gain. On the

other hand, the averaged live weight throughout the study was not influenced by the interaction of feeding groups and control period (P=0.4345).

**Table 4.** Least square means ( $\bar{X}$ ), standard error (SE) and their significance level (P) of feeding level groups, sex of kids and their interactions on birth weight.

Groups	Birth Weight, kg		P
	X	SE	
G-C	2.63 <sup>a</sup>	0.17	0.0039
G-80	3.65 <sup>b</sup>	0.17	
G-120	2.63 <sup>a</sup>	0.17	
Sex			0.0030
Female	2.85 <sup>a</sup>	0.13	
Male	3.47 <sup>b</sup>	0.13	
Group-Sex Interaction			0.3707
G-C x Female	3.01	0.23	
G-80 x Female	3.15	0.21	
G-120 x Female	2.40	0.25	
G-C x Male	3.43	0.25	
G-80 x Male	4.14	0.26	
G-120 x Male	2.85	0.22	

According to the birth products, G-80 groups animals gave higher birth weight than those in the G-C and G-120 (P=0.0039). Wallace et al. (2005) stated that live weight gain during 93 d gestation was 48 g/d in the maintenance fed group and 244 g/d in over nourished group (P=0.001), although the birth weight of both the groups provided similar results (maintenance 5190 g and over nourished 5420 g). Male kids had higher birth weight than the female (P=0.0030) (Table 4). The interaction between sex and feeding level groups was found not significant. The birth weight in G-80 was higher than the other groups but stillbirth rate was lowest in this group.

Environment to which the animals were exposed must be well defined and their requirements are suggested be satisfied rapidly during gestation period, which in turn affect performance and health of the offspring as well as the mother. According to the results of this study, during gestation restricted group animals had lower weight gain but their kids had higher live weight, which mechanism does play a role, when occurs preterm birth and stillbirth or low birth weight, what is the breaking point in the restricted group. These topics need intensive researches, especially on goats. It might be carefully speculated that instinct to survive and to transfer genetic material might play a role on lower weight change but higher birth products.

#### Acknowledgement

The authors are grateful to Prof.Dr. İ. Yaman Yurtman for helpful discussion and help during all stages of the study. We thank to our students for the help during research and to Assist.Prof. Dr. Zeliha Gökbayrak for the english correction.

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# A STUDY ON BEHAVIOUR OF GOATS DURING TRANSFER FROM BIRTH PLACE TO ANOTHER BARN

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## ABSTRACT

In recent years, biotechnological methods have caused an increase in the number of goat kids per litter size. However, similar increase has not been observed in motherhood ability. In this study, it was aimed to determine some motherly behaviors during the transfers of mother and the kid from the birth box in following 24 hours after the birth. Seventyone Turkish Saanen goat genotypes were used. Parity of the goats changed between 1 and 4. A total of 21 single and 50 multiple births were observed. First observations were performed on mothers after the kid was taken away. Following actions were observed on the mothers after the kid by opening the gate; whether mothers went out or not (of the birth place); whether mother came back to the birth place or not; whether they followed her kid(s) or not. High pitches bleating or low pitches bleating were recorded as frequency. Behaviors were directly observed.

According to the results of the study, getting out the birth place, birth type and parity was not statistically significant ( $P>0.001$ ). On the other hand turning back to the birth place had differences between the parities. The primiparous goats and the second parity goats had lower turning times to the birth place than the higher parity goats ( $P=0.0087$ ). Significant differences were determined between the parity groups in terms of following the kid ( $P=0.0021$ ). Primiparous goats followed their kids less than the higher parities. Multiparous goats went together with their kid(s) more together than primiparous ( $P=0.0002$ ).

Neither high nor low-pitched bleating frequency was not affected by the parity and birth type. However, their interaction was significant.

While animal behaviors are the indicators of some physiological events, a better understanding of maternal behaviors has a significant effect on increasing newborn's viability. In this regard, observing the behaviors of primiparous or second parity goats could decrease newborn losses.

Key words: Maternal behavior, low-pitched bleating, high-pitched bleating, Turkish Saanen goat

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## INTRODUCTION

A successful birth season must be completed to use maximum level of reproductive performance of livestock. Successful birth season increases reproductive productivity of livestock farming. Researches in animal reproduction have been focused mostly on the increasing offspring number, but maternal ability did not increase in parallel with it. Especially that's important for small ruminants, which gave birth in herds. This situation implies motherhood in question.

Maternal behavior can be defined as the bonding between mother and newborn that forms immediately after birth and it affects survival of the newborn and later performance (Damron, 2003). Houpt (2011) reported that the expression of maternal behavior depend on internal and external factors. Hormonal changes, experience of mother and heredity were defined as internal factors and, smell, appearance and sound were called as external factors that influenced and fortified maternal behaviors. Birth type, breed, birth period, age of dam, birth type, conditions of the farm, and nutrition play paramount role on maternal behavior and the bonding between mother and newborn. Several studies stated that poor maternal behavior or disruption of establishing a bond between mother and newborn could cause an increase in newborn mortality (Konyali et al., 2004; Lindsay, 1996; O'Connor and Lawrence, 1992; Otal et al, 2010).

Lickliter (1985) hypothesized that mother and kids began a series of vocal communication within minutes of the newborn's expulsion. Low-pitched bleating of mother to the newborn was defined by Dwyer et al. (1998) as "care giver" and high-pitched bleating as "protest", "be in pain", and "be in dangerous" or "distress bleating". Vocalization is a strengthening factor in the mother-newborn bond. Studies about vocalization after birth showed that vocalization in the first 3 hours after the birth reached its peak and in 24 hour it decreased (Jouventin 2003; Sebe et al., 2007). Vocal communications of primiparous dam are important for survival of kid and for the developing of maternal ability (Sebe et al., 2007). On the other hand vocalizations are used for identification of kid, long distance signals and

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separation distress signals (Atila, et al., 2006). Author reported that low-pitched bleating were more intrinsic and helped establish a bonding between the mother and the newborn, but high pitched bleating were accepted as more of a protest or distress indicators.

The aim of this study was to investigate maternal behaviors in Turkish Saanen goats at different parity during the transfer from birth place to another barn.

## MATERIAL AND METHODS

### *Animal Material*

Study was carried out on the Research Farm of Çanakkale Onsekiz Mart University. Seventy one Turkish Saanen goats between 1-7 years old were used. They gave birth to 21 single and 50 multiple (Table 1). The mating dates of all does were recorded, parturition dates were estimated and the does were brought to the birth places.

*Table 1. Distribution of animal material by parity of dam and birth type*

	n	%
<b>Parity</b>		
1	21	29.58
2	18	25.35
3	13	18.31
higher than 3	19	26.76
<b>Birth type</b>		
Single	21	29.58
Multiple	50	70.42

### *Behavioral Observation*

Behavioral observations on the dams were directly performed in the next 24 hours after birth. Observed behaviors were leaving birth box, turning back to the birth box, following the kids, and going together with its kid in transfer. Frequency of low- and high-pitched bleating in first five minutes was also recorded. Definitions of the observed behaviors were given in Table 2.

*Table 2. Description of observed behaviors in this study*

Behaviour	Description
Leaving birth box	When kid was taken by person from birth box and, whether dam left the box when the door was open (1: leave, 0: not leave)
Returning to the birth box	When kid transferred to another barn, dam turned back to the birth box or went together (1: turn back, 0: go together)
Following its kid(s)	While the kid were transferred, dam follows her kid(s) a little far behind
Going together with its kid	While the kid transferred, dam goes next to her kid(s).
Low- pitched bleating	During transferring, dam's bleating with a closed mouth.
High-pitched bleating	During transferring, dam's bleating with an open mouth.

### *Statistical Analyses*

Data were analyzed with the use of SAS (1999) program package. Analyzing discrete data were done with the statistical method Generalized Estimation Equation (GEE).. Continuous data were analyzed with a linear model. For each analyses, parity of dam (1, first parity, primiparaous, 2: 2<sup>nd</sup> parity, 3: 3<sup>rd</sup> parity and

4: more than 3), birth type (single-multiple), and their interactions were used. Parity of dam was grouped according to experience of mother during the analyses of the behaviors “following or going together with her kid”. In the bleating frequencies analyses, a linear model was applied using parity of dam, birth type and parity x birth type interaction as fixed effects.

However vocalization frequencies (low- and high pitched bleating) were not normally distributed, so they were subject to a square root transformation before the statistical analyzes.

## RESULTS AND DISCUSSION

Maternal behaviors of goats at different parity and different birth types were investigated and the results were given in Table 3 and Table 4. In Table 3, it was showed that parity of mother and birth type did not affect whether the dam left the birth box. “Turning back to the birth box” behavior was influenced by the parity of mother, and the difference was statistically significant (P=0.0087). Primiparous mothers, 93% and secondparous mothers, 88 % less were turned than the others (Table 3).

When the kids were taken out of the birth box, inexperienced mothers followed their kids 91% less than the experienced ones. The effect of mother experience were found statistically significant (P=0.0021). Birth type has no significant effects on following its kid(s).

Primiparous mothers went together with their kids 96% less than the experienced dams (P=0.0002).

Table 3. Regression coefficients (b), standard error (SE), Odds ratio ( $\Psi$ ) and their significance level (P) observed effects on behavior traits

Traits	Factors	b	SE	$\Psi^*$	P
Leaving birth box	Parity of dam				0.1545
	1	1.68	0.89	5.37	
	2	0.95	0.94	2.59	
	3	1.81	0.99	6.11	
	>3	0.00	0.00	1.00	
	Birth type				0.2897
	Single	0.66	0.63	1.93	
	Multiple	0.00	0.00	1.00	
Returning to the birth box	Parity of dam				0.0087
	1	-2.63	1.14	0.07 <sup>a</sup>	
	2	-2.12	1.15	0.12 <sup>ab</sup>	
	3	-0.30	1.47	0.74 <sup>bc</sup>	
	>3	0.00	0.00	1.00 <sup>c</sup>	
	Birth type				0.4572
	Single	0.47	0.63	1.60	
	Multiple	0.00	0.00	1.00	
Following its kid(s)	Parity of dam				0.0021
	Inexperienced	-2.45	0.88	0.09 <sup>a</sup>	
	Experienced	0.00	0.00	1.00 <sup>b</sup>	
	Birth type				0.8533
	Single	-0.15	0.81	0.86	
	Multiple	0.00	0.00	1.00	
Going together with its kid	Parity of dam				0.0002
	Inexperienced	-3.26	1.12	0.04 <sup>a</sup>	
	Experienced	0.00	0.00	1.00 <sup>b</sup>	
	Birth type				0.4153
	Single	-0.68	0.84	0.51	
	Multiple	0.00	0.00	1.00	

\*Different letters in the same column indicate significant differences.

Vocal communications occurred during the transferring of kid(s). Low pitched vocalizations of dam are mostly due to care given to their kid(s), but high pitched vocalizations are the results of stress, pain, anxiety or danger. In this study low pitched and high pitched vocalizations were not influenced by parity of dam or birth type. But the interaction between parity of mother and birth type for each vocalization observations were found statistically significant (low pitched vocalization, P=0.0353 and high pitched vocalization, P=0.0374; Table 4). There was no tendency towards birth type or parity in the interaction. It could be interpreted that goats established a bonding rapidly with her kid and vocal communications



were not influenced by the parity or birth type within the 24 hours after the birth. It was observed that low pitched bleating was higher in the 3<sup>rd</sup> parity & single-birth mothers and also second parity & multiple-birth mothers than the others (Table 4). However high-pitched bleating was lower in the second parity & single-birth mothers and primiparous & multiple-birth mothers than others.

Table 4. Least square means ( $\bar{X}$ ) and their standard errors (S.E.) of low pitched vocalization and high pitched vocalization according to parity of dam, birth type and their interaction.

	Low Pitched Bleating*		P	High Pitched Bleating*		P
	$\bar{X}$	S.E.		$\bar{X}$	S.E.	
<b>Parity</b>						
1	2.23	0.37	0.3559	2.76	0.51	0.5253
2	3.05	0.45		3.77	0.62	
3	3.22	0.51		2.59	0.70	
4	2.71	0.63		3.39	0.88	
<b>Birth Type</b>						
Single	2.88	0.43	0.7394	3.36	0.60	0.5017
Multiple	2.72	0.25		2.89	0.34	
<b>Parity X Birth Type</b>						
1xSingle	2.26 <sup>a</sup>	0.54	0.0353	3.66 <sup>abc</sup>	0.74	0.0374
2xSingle	2.12 <sup>a</sup>	0.76		1.86 <sup>bc</sup>	0.71	
3xSingle	4.33 <sup>c</sup>	0.85		4.55 <sup>ab</sup>	1.05	
4xSingle	2.83 <sup>a</sup>	1.20		3.00 <sup>a</sup>	0.65	
1xMultiple	2.19 <sup>a</sup>	0.51		1.06 <sup>a</sup>	1.17	
2xMultiple	3.98 <sup>bc</sup>	0.47		4.12 <sup>abc</sup>	0.78	
3xMultiple	2.11 <sup>a</sup>	0.57		4.18 <sup>c</sup>	1.66	
4xMultiple	2.59 <sup>bc</sup>	0.41		2.60 <sup>a</sup>	2.57	

\*Different letters in the same column indicate significant differences.

Dwyer et al. (1998) considered bleat rate as an expression of maternal ability and that low pitched vocalization increased during the first two hours after the birth then declined in the other stages. They reported a high pitched vocalization peaked in the next 90 minutes following birth and that primiparous ewes had higher low pitched bleat rate than multiparous ewes ( $P < 0.01$ ). In our study, parity of mother had no effect on low or high pitched bleating. This could be explained with the prolonged observation for 24 hours after birth, as low pitched bleating rate increased in first 30 min and high pitched bleating rate increased in the first 90 min. Baykal (2011) studied with seven different maternal behavior tests for determination of best maternal score in Turkish Saanen goats and reported that highest maternal score was achieved during birth and following test like in this study was positively correlated with the observed maternal score during birth ( $r = 0.39$ ,  $P = 0.0001$ ).

Expression of maternal behavior in goats is affected by environment, age or parity of dam, birth position and birth type. Since first parity goats turn back to the birth box, while their kid(s) are being transferred, they need more care after birth until their maternal ability increase. When the kids in a herd wonder or are taken away from the mothers after birth, bonding between mother and offspring can be impaired. Primiparous mothers need to show intensive interest for their kids to survive and to elevate their own productivity.

Animal behaviors are under the influence of not only physiological events but also external factors such as sound and smell of kids. Taking into account maternal behaviors in breeding strategies would include heredity of motherhood ability as an internal factor that influences animal behavior, diminishes kid mortality and increases livestock farm productivity.

## **Acknowledgement**

**The authors are grateful to Assoc. Prof. Dr. Zeliha Gökbayrak for language correction. We thank to our students to their help during collect to data.**

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# INFLUENCE OF FILTRATION ON COLOUR CHARACTERISTICS OF YOUNG HERZEGOVINIAN WHITE WINES

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## ABSTRACT

The colour characteristics of 5 non-filtered and filtered young white Herzegovinian wines (vintage 2011) of cv. Zilavka and Smederevka were studied. Wines were filtered on plate filter through the Seitz K-300 sheets (3 – 4 micron). Wine visible spectrum as well as CIE Lab variables ( $L^*$ ,  $C^*$ ,  $h^*$ ,  $a^*$  and  $b^*$ ) were measured, calculated and analysed. Measurements were done on spectrophotometer Shimadzu UV-1700 (10 mm optical path), and CIE Lab variables were calculated by MSCV<sup>®</sup> software. With some differences from wine to wine, it could be said that with filtration wines' luminosity (clarity) ( $L^*$ ) was averagely increased (96.32 → 98.18), followed by slight change of  $a^*$  value (-0.76 → -0.85), and remarkable change of  $b^*$  value (6.93 → 4.00), with consequent changes of  $C^*$  and  $h^*$  values.

**Key words:** Herzegovinian white wine, filtration, colour characteristics, CIE Lab

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## INTRODUCTION

Wine filtration is a common operation among final wine treatments before its bottling, with the aim to remove solid particles from wine. It is usually said that brilliant clearness is among the first consumer's requirements toward wine quality. Filtration of white wines before bottling is the ultimate precondition because any problem with their clarity is highly apparent (Ribéreau-Gayon et al. 2006: 364). Besides positive impacts on wine overall quality, filtration can also cause some less welcome changes of wine composition and organoleptic characteristics, but there are not so many available research results of such influences of wine filtration. Ribéreau-Gayon et al. (2006:362) cited work of Serrano and Paetzold (1994) who, as a consequence of different filtration techniques, noticed slight decrease of higher alcohols, volatile fatty acids, and ethyl esters of fatty acids in filtered white wines. They also noticed very slight decrease of OD 420 with use of sheet and membrane filters. It is, with no doubts, concluded that some filter media and its separation capacities eliminate macromolecules that contribute to wine's structure, softness and fullness (Ribéreau-Gayon et al. 2006: 362). Taking into account chemical nature of colouring matters of wines, it could be reasonably supposed that filtration affects them as well.

Well known Glories indicators (colour intensity, hue, and colour composition) based on measured absorbance on 420, 520, and 620 nm have been used for evaluation of red wine colour for a relatively long period. Partially due to difficulties with assessing the colour of white wines, during last few decades CIE Lab measurement system adopted by the CIE (The International Commission on Illumination) has been more and more used as a wine colour measurement system. The system is based on a three-dimensional colour space and it was developed to represent colour in a way which is consistent with human vision and adequate to perceived colour differences. The CIE Lab system has been promoted as the OIV standard method for wine colour determination. Regardless the fact that data obtained by CIE Lab system could be sometimes difficult for interpretation by practitioners, it was successfully used in a number of reseraches of colour of red wines (Larrauri et al. 1999; Meléndez et al. 2001; Huertas et al. 2003; Monagas et al. 2006; Crețu, Dima 2007; Han et al. 2008; Esparza et al. 2009; Dobrei et al. 2010; García-Marino et al. 2011). However, reserach interest for application of CIE Lab system in investigation of rose wines (Huertas et al. 2003; Gamasa et al. 2009; Hernández et al. 2011), white wines (Huertas et al. 2003; Gamasa et al. 2009) sherry (Serratosa et al. 2011), brandies (Canas et al. 2009), and grapes (Rolle and Guidoni 2008; Liang et al. 2011) seems to be much lower.

The research objective of this preliminary study was to check applicability of CIE Lab system in evaluation of colour of some Herzegovinian white wines, with intention to find out possible influences of

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relatively firm filtration regime on nature and direction of changes of colour characteristics of filtered wines.

## MATERIALS AND METHODS

Five white Herzegovinian wines from 2011 harvest were filtered and analyzed. For the purpose of this research wines were marked as B1... B5 with added 'NF' (not filtered) and 'F' filtered. Wines marked as B1, B2, and B5 were produced from cv. Zilavka, while wines marked as V3 and V4 were produced from cv. Smederevka grapes. The wines were collected in February 2012, i.e. they passed common seasonal treatments in wineries (racking, fining). Before the laboratory filtration only one of the wines (B2) passed a course pre-coat filtration through diatomaceous earth (1.5 Darcy) in the winery which, according to Ribéreau-Gayon et al. (2006; 363), does not affect chemical composition of wine. Experimental filtration was done on mini plate filter with Seitz K-300 (3 – 4 micron) sheets.

Prior to measurements on spectrophotometer, all wines (filtered and non-filtered) were centrifuged (5000 r.p.m/5 min.). Wine spectra between 400 and 720 nm, with 10 nm step, were recorded and absorbance measured on 450, 520, 570 and 630 nm were imported as input data for automatic calculation of X, Y, Z tristimulus values and consequently L\*, a\*, b\*, h\*, and C\* parameters on MSCV<sup>®</sup> software (Grupo de Color, Universidad de la Rioja – Universidad de Zaragoza; coordinates with illuminant D65 and 10° observer). C\* (chroma) and h\* (hue) parameters were calculated by applying functions given in the Method OIV-MA-AS2-11.

All absorbance measures were done on spectrophotometer Shimadzu UV-1700, with 10 mm optical path.

## RESULTS

The absorbance values on 420 nm, as a traditional reference absorbance values for evaluation of colour of white wines, of filtered and non-filtered wines are presented on Fig. 1.

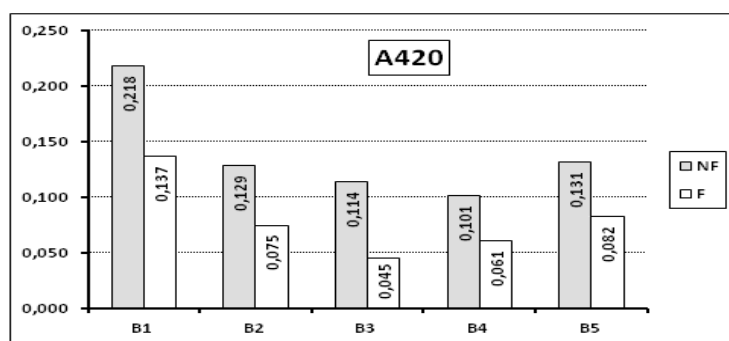


Figure 1: Absorbance values (A420) of non-filtered and filtered white wines

Data presented on Fig. 1 clearly demonstrate decreases of A420 with filtration of white wines. The decreases varied from around 60% with wine B3 to relatively stable decrease of around 40% with other four wines.

The basic CIELab chromatic parameters of non-filtered and filtered white wines are presented on Fig. 2.

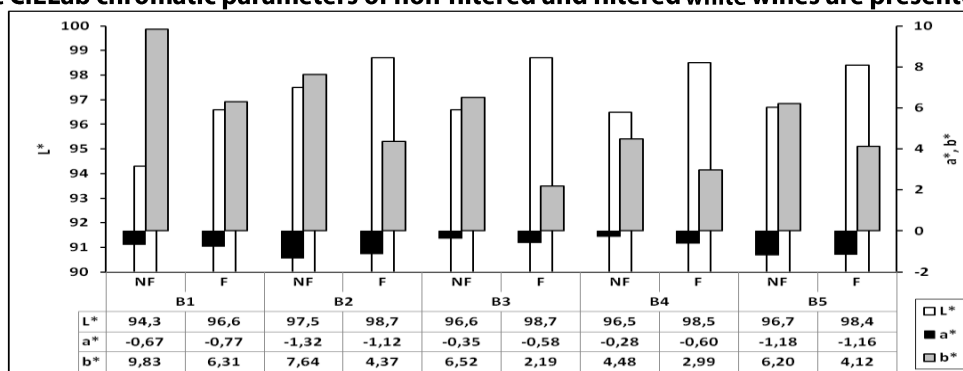


Figure 2: The basic CIELab chromatic parameters of non-filtered and filtered white wines

Data presented on Fig. 2 point out increase of  $L^*$  (luminosity, clarity) values with wine filtration. The increase of values of this parameter was around 2 CIELab units for wines B1, B3, B4, and B5 wines, and around 1 CIELab unit for wine B2. Values of  $a^*$  (red/green colour component), both in non-filtered and filtered wines, were very slightly moved toward green area, ranging from -0.28 (B4-NF) to -1.32 (B2-NF). However, there was not the same direction of changes of values of  $a^*$  parameter. Filtration of the wines B1, B3, and B4 led to decrease of  $a^*$  values (i.e. moving toward green area), filtration of the B2 wine caused increase of  $a^*$  value (i.e. moving toward red area), while filtration of the B5 wine did not cause remarkable changes of this chromatic parameter. Unlike to changes of  $a^*$ , filtration of white wines led to uniform changes – decrease – of  $b^*$  (yellow/blue colour component) values. Decrease of  $b^*$  values, ranging from 1.49 (B4) to 4.33 CIELab units (B3), was noticed with all filtered wine. After filtration, colour of the white wines still was in yellow area, but with obvious lower intensity.

It was interesting to have a short insight to two derived wine colour parameters –  $C^*$  (chroma) and  $h^*$  (hue) calculated from  $a^*$  and  $b^*$  values. Their values for non-filtered and filtered white wines are presented on Fig. 3.

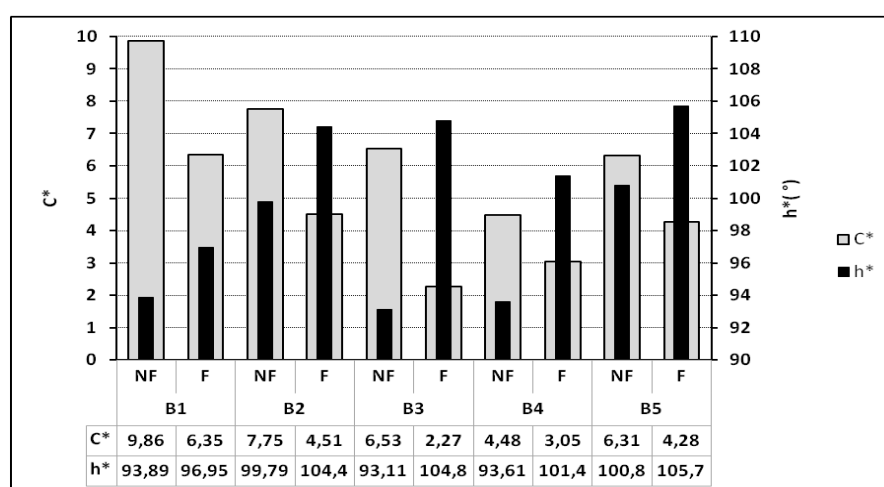


Figure 3:  $C^*$  (chroma) and  $h^*$  (hue) values of non-filtered and filtered white wines

How it is visible from data presented on Fig. 3, filtration of all analyzed white wines at the same time caused decrease of chroma ( $C^*$ ) and increase of hue ( $h^*$ ) values, with moderate negative correlation coefficient (-0,61) between these two parameters. The changes of  $h^*$  values are also in accordance with changes of  $b^*$  values, confirming move from more to less intensive yellow zone with filtration of wines. From the point of view of  $C^*$  and  $h^*$  values, filtration caused more intensive changes in chromatic characteristics of wines B1, B2, and especially B3, than those of wines B4 and B5.

CIELab system was promoted as instrumental and therefore objective method for evaluation of wine colour characteristics. A number of researches on red wines confirmed its compliance with earlier used indicators (Glories, etc.). With rare exceptions (Gamasa et al. 2009), there are not so many published researches about application of the CIELab system in evaluation of colour of white wines. The results of this short inside could point out some reasons for such shortage. Namely, calculated values of  $a^*$  CIELab indicator for different filtered and non-filtered wines are close to each other, with no clear deflection with the applied experimental treatment (filtration). Besides, white wine colour itself is probably characterised by nature of spectral zones around 400 nm. CIELab parameters are calculated with four absorbance values (450, 520, 570, and 630 nm) where three of them are far from the mentioned spectral zone.

## CONCLUSION

Understanding this research as a preliminary insight of possibilities to use CIELab system in evaluation of white wines' colour, from one side, and collecting the first information about influences of

**filtration on colour characteristics of some Herzegovinian white wines, from other side, the following conclusions could be listed:**

- **With filtration of the observed white young wines absorbance values at 420 nm were decreased between 40 and 60%;**
- **According to measured and calculated  $b^*$  values, filtration of the observed white wines caused meaningful move of their colour on yellow-blue axis toward less intensive yellow nuances;**
- **Filtration of the observed white wines did not cause significant and clearly directed changes of  $a^*$  values, i.e. they, both for filtered and non-filtered wines, stayed at the very beginning of the green zone on red-green axis;**
- **As it was expected, values of  $L^*$  (clarity, luminosity) were increased with filtration of the observed white wines;**
- **Filtration caused increase of  $h^*$  (hue) and decrease of  $C^*$  (chroma) values of the observed white wines, with moderate negative correlation coefficient between them.**

**It makes sense to spread the further researches on bigger number of white wines, with different filtration regimes and with deeper insight on possible correlations among CIELab parameters of non-filtered and filtered wines.**

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# STUDENTS ACQUIRED HABITS REGARDING SCHOOL SNACK AND ITS' CONTENT

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## ABSTRACT

School snack is the only meal that students of Public Primary schools in Bosnia and Herzegovina consume during their stay in school. As one of recommended five meals it should represent an adequate share of the daily intake of nutrients.

The aim of this research was to identify acquired habits that dominate in choosing type of snack, to determine supply of school snacks, which are available in the schools in Canton Sarajevo and to conduct microbiological analysis of the same.

Results indicate that school snack consists mainly of puff pastry, contains no fruit, little bit of vegetables, dairy products are present in small quantities and do not include any beverage. Results of microbiological analysis of samples of snacks indicate that there is no danger of primary contamination.

Based on the foregoing, it can be concluded that the school snack as the only school meal does not meet the principles of proper nutrition, is not attractive to students and therefore older ones, prefer to buy snacks by their choice at the bakery, fast food, grocery shop on the way to school which are also nutritionally inappropriate.

**Key words:** School snack, daily intake, microbiological and nutritional analysis, primary school.

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## INTRODUCTION

Children aged 6-14 years in Bosnia and Herzegovina attend mostly Public Primary schools, which is held in two shifts. Only meal which school children consume during their stay in school is school snack. It is organized by school management and it differs from school to school. For the students attending first shift it mostly presents the breakfast. Students can choose between snack provided by school or to bring/buy snack on their own choice. There are, in some schools, shops where children can buy all kinds of nibbles, sweets and soda drinks.

The recommended calorie intake for girls 9 to 13 is 1.600 calories per day and boys 8 to 13 need 1.800 calories per day. The CNPP (Center for Nutrition Policy and Promotion) recommends that both groups receive 10 to 30 percent of their calories from protein, 45 to 65 percent from carbohydrates, and 25 to 35 percent from fat (IOM, 2002). USDA's Project School Meals mandated that school meals provide on average, over a 5-day week, at least (school lunch) one-third of the RDA (Recommended Dietary Allowances) of the Food and Nutrition Board, and (school breakfast) one-fourth of the RDA. The decisions about what specific food to serve and how they are prepared are made by local school food authorities (USDA/FNS, 2012).

Organizations worldwide prepare and conduct standards regarding school children's nutrition and meals because it is known that proper food habits which lead to optimum health are adopted by adolescence and that schools are the most favorable environment for such actions.

Missing literature about school snacks and no available Standards regarding school children's nutrition or school snacks in Bosnia and Herzegovina made this issue a subject of interest.

## MATERIAL AND METHODS

This research included nutritional and microbiological analysis of schools snacks and primary school students opinions and habits regarding it, expressed by means of Questionnaire.

10 samples of school snacks were taken from 4 Primary schools in Canton Sarajevo from which 237 students (96 females and 141 males) aged 12-14, participated in the survey.

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Nutritional analysis present school snacks as energy values (kcal), total fat (g), proteins (g) and carbohydrates (g).

In laboratory analysis standard methods were used:

- Total proteins- Kjeldahl,
- Total fat- Soxlet,
- Total carbohydrates- Luff-Schoorl.

For the calculation of energy values (kcal) of the samples of school snacks, NutriSurvey program was used ([nutrisurvey2007.exe](#)).

Microbiological analysis included tests regarding *Salmonella*, *Coagul. Pos. Staphylococcus*,

*Sulph. Red. Clostridium*, *Proteus species*, *Escherichia coli* and total number of bacteria in 1 g, according to Standards for microbiological safety by Regulations on microbiological safety for real foodstuffs (Službeni list R BH 2/92)<sup>1</sup>.

Questionnaire contained 5 questions specifically designed for this survey, it was filled in anonymously in the classroom, in the presence of the first author and the teacher. Statistical analysis were performed using SPSS 13.0. Pearson Chi-Square test was used to describe statistical significance.

Research has been approved by Ministry of Education and Sciences of Canton Sarajevo.

## RESULTS

Research suggests that school snacks, which are paid monthly (free for socially disadvantaged children) are consumed mostly by children aged under 10 years (up to 5th grade) and that older students prefer to receive the money from parents and buy snacks at the bakery, fast food, grocery shop on the way to school. The most important to parents is that children are not hungry and that the food they eat is safe.

Table 1. Nutritional analysis of school snacks

No	Sample	Quantity (g)	Energy value (kcal)	Fat (g)	Proteins (g)	Carbo hydrates
1	Puff pastry with hot dog	80	261.8	7.32	8.87	17.5
2	Donut with choco cream	80	274.6	4.83	7.27	29.4
3	Roll with paté	90	228.4	12.87	7.90	40.6
4	Croissant with choco cream (bakery)	70	355.7	9.38	3.23	31.4
5	Choux pastry with choco cream	90	283.7	20.50	6.39	24.0
6	Potato pie (2 sticks)	80	159.9	5.00	7.75	24.7
7	Puff pastry with cottage cheese	85	292.1	29.46	5.48	18.9
8	Pizza slice (capricciosa)	90	262.4	25.86	4.92	30.9
9	Croissant with choco cream (industrial)	60	156.0	12.18	3.9	7.68
10	Potato pie	96	194.3	19.80	6.72	29.9

Nutritional analysis (Table 1) show that school snack provided by schools are in the range 156.0-355.7 kcal which is not satisfactorily according to USDA's recommendations. Also, it is consisted mainly of puff pastry, rolls and dough with chocolate. There is no fruits at all, vegetables are represented by potato in the pie and dairy products as a cottage cheese in the puff pastry. Beverages are not included in the school snack.

<sup>1</sup> Official Gazzete of Republic of Bosnia and Herzegovina 2/92

USDA's Standards state that breakfast (can be compared with a snack) over 5- day week should include fruits (5 cups, vegetables can be offered instead), grains (8-10 oz eq)<sup>2</sup> and milk (5 cups, fat-free or low-fat). Min-max. calories should be:

- 350-500 kcal (Kindergarten till 5 grade, 5-10 years)
- 400-500 kcal (6-8 grade, 11-13 years) and
- 450-600 kcal (9-12 grade, 14-18 years) (USDA/FNS, 2012).

Regarding microbiological analysis of school snacks, tested samples meet requirements set as standards for microbiological safety by Regulations on microbiological safety for real foodstuffs (Službeni list R BH 2/92). According to this, it may be concluded that school management takes into account the microbiological safety of food when selecting suppliers.

Table 2. Students habits regarding consumption of school snacks

School		Yes	No	Total
"Grbavica 1"	Count	37	18	55
	% within school	67.3%	32.7%	100.0%
"Sokolje"	Count	33	34	67
	% within school	49.3%	50.7%	100.0%
"9.maj"	Count	8	53	61
	% within school	13.1%	86.9%	100.0%
"Edhem Mulabdic"	Count	25	29	54
	% within school	46.3%	53.7%	100.0%
Total	Count	103	134	237
	% within school	43.5%	56.5%	100.0%

Pearson Chi-Square test shows that consumption of school snacks depends on the school,  $\chi^2=36,64$   $p<0,0005$ .

Table 2 shows that 53.5% of students in all four schools do not consume snack provided by the school.

Table 3. If you consume the school snack, do you like it?

School		Yes	No	Total
"Grbavica 1"	% within school	56.8%	43.2%	100.0%
"Sokolje"	% within school	100.0%	0%	100.0%
"9.maj"	% within school	87.5%	12.5%	100.0%
"Edhem Mulabdic"	% within school	44.0%	56.0%	100.0%
Total	% within school	69.9%	30.1%	100.0%

Answer to this question is not correlated with the school,  $\rho=0,30$   $p=0,761$ .

Table 3 shows that most of the students (69.9%) who consume school snack like it and 30.1% of students don't like it.

<sup>2</sup> 8-10 oz eq is cca 290 g (226.79-283,49 g), oz=ounce=28.35 g, <http://www.unitconversion.org/weight/ounces-to-grams-conversion.html>

**Table 4. If you don't consume school snack provided by the school, do you bring snack from home?**

School		Yes	No	Total
"Grbavica 1"	% within school	61.1%	38.9%	100.0%
"Sokolje"	% within school	20.6%	79.4%	100.0%
"9.maj"	% within school	17.0%	83.0%	100.0%
"Edhem Mulabdic"	% within school	27.6%	72.4%	100.0%
<b>Total</b>	<b>% within school</b>	<b>26.1%</b>	<b>73.9%</b>	<b>100.0%</b>

**Pearson Chi-Square test shows that bringing snack from home depends on the school,  $\chi^2=14,286$   $p=0,003$ .**

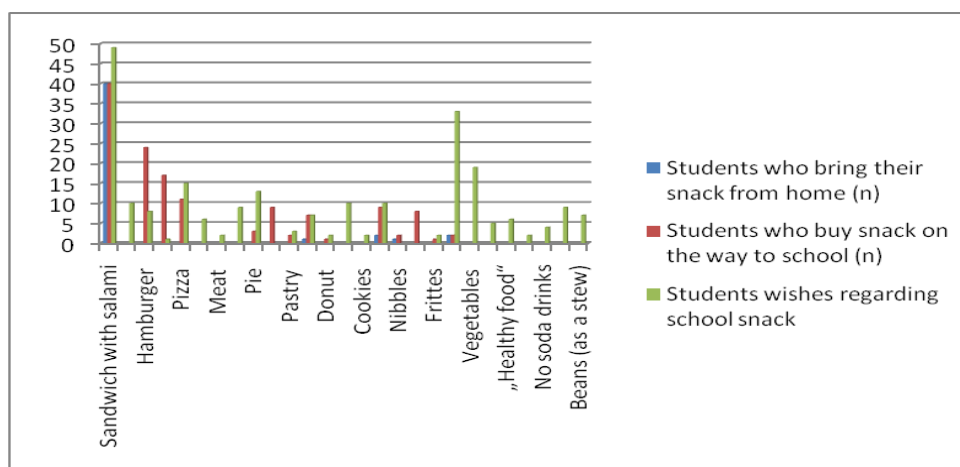
**Table 4 shows that very small percentage of students bring their snack from home (26.1%), which might be pointed to the parents, their habit about not making snack for the school.**

**Table 5. If you don't consume school snack provided by the school, do you buy snack at the bakery, grocery shop, fast food?**

School		Yes	No	Total
"Grbavica 1"	% within school	33.3%	66.7%	100.0%
"Sokolje"	% within school	73.5%	26.5%	100.0%
"9.maj"	% within school	76.5%	23.5%	100.0%
"Edhem Mulabdic"	% within school	77.8%	22.2%	100.0%
<b>Total</b>	<b>% within school</b>	<b>70.0%</b>	<b>30.0%</b>	<b>100.0%</b>

**Pearson Chi-Square test shows that buying snack at the bakery, grocery shop or fast food depends of the school which students attend,  $\chi^2=13,520$   $p=0,004$ .**

**It is shown that most of the students (70.0%) regardless of having snack provided by the school, buy snack by their own choice on the way to school (Table 5).**



**Figure 1. List of food students use and prefer as a school snack**

Figure 1 shows specific food brought from home or bought in the bakery, etc as well as food students prefer to have as a school snack.

23.21% of students who bring their own snack from home mainly consists of sandwich with salami.

Those 70.0% of students who buy their snack on the way to school buy mostly sandwich (40), hamburger (24), hotdog (17), pizza (10).

Regarding students' wishes, they would like to have as a school snack: sandwich with salami (49), fruits (33), vegetables (19), pizza (15), pie (13), sandwich with chicken breasts, pancakes and chocolate (10).

Snacks which students bring from home or buy on the way to school are also nutritionally inappropriate and their wishes regarding school snacks are mostly consisted of fast food with some exceptions (fruits, vegetables, chicken breasts).

## DISCUSSION

Literature regarding school snack is missing because schools worldwide usually have canteens and students have lunch during their stay in school and there are no papers regarding this issue in the Region.

There is paper from neighboring country Croatia, presenting snack as one of recommended five meals a day (independently of school snacks), which states that 4.3% of students in Zapsesic, Croatia consume „fast food“ as everyday snack and 16.9% consume „unhealthy snacks“ as are nibbles and sweets (Koprivnjak, 2008). They mostly consume breakfast at home (81.6%) or in organized collective meals (where breakfast presents school snack). Students mainly have fruits (45.3%), sandwich (30.3%), sweets (16.9%) and 7.3% do not have any snack during the day.

Snacks can be associated with breakfast, not lunch and there is „School meals: Building blocks for healthy children“ where IOM (2010) introduces school breakfast and lunch according to the students needs with reduced sodium, limited saturated fat and zero trans fat. According to that, fruits, grains and milk should be included in the breakfast with different energy requirements for different age groups (5-10, 11-13, 14-18 years).

School snack in Primary schools in Canton Sarajevo are the same for every child, no matter the age and are nutritionally and energetically inadequate.

Sikirica et al (2012) state that there are less and less children feeding in school canteens in Croatia and that automats in the hallways are equipped with choco bars, nibbles and soda drinks instead of fruits, cheese, energy bars, yoghurts, nuts etc.

This survey shows that students' preferences do not differ a lot from what they already have as a snack and Neumark-Sztainer et al (1999) found that the most influential factors in the adolescent's food selection included hunger or cravings, taste of food, time available and convenience of food. In addition to this, findings of Hodžić, I. and Smajić, A. (2012) that adolescents in Sarajevo did not adopt form of proper nutrition, that they usually consume three meals a day and that breakfast is the mostly skipped meal, states that not only Standards but Nutrition programmes are needed in the Primary schools in Bosnia and Herzegovina.

## CONCLUSION

School snack as the only meal that students consume during their stay in the school does not meet principles of proper nutrition, is not suitable for the students category and is not attractive to the students. This makes students prefer to buy snacks by their choice at the bakery, fast food, grocery shop on the way to school which are also nutritionally inappropriate.

**Students' preferences regarding school snacks suggest that Nutrition programmes are seriously needed and should refer to the students, parents, teachers and school management.**

**Further actions should be directed to the Ministry of Education and Sciences and to the Ministry of Health in order to introduce Nutrition programmes into Primary schools, write Standards and organize proper school snacks which would contribute to students health, physiological needs, concentration and efficacy.**

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# NUTRITIONAL FACTORS EFFECTING FERTILITY IN DAIRY CATTLE

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## ABSTRACT

Lower reproductive performance of dairy cattle has become an important issue for the producers through increased medical expenses, fewer offspring, and consequently, reduced milk/meat yield, difficulty in herd management and therefore ultimately reduced profit is inevitable. Nutritional factors are important among the other factors affecting estrous cycle, fertilization, initiation and maintenance of pregnancy, parturition and post-partum health of cow and calf. In high yielding dairy cows, inadequate nutrition during pregnancy and lactation may lead to negative nutrient balance or excessive body condition and can affect reproductive and metabolic hormone production and secretion. Energy sources from carbohydrates during early lactation affects reproductive and metabolic hormone levels having positive impact on follicular development and pregnancy rates. Dietary long-chain unsaturated fatty acids, precursors of certain reproductive hormones, may affect hormone production. Phytoestrogens having molecular structures similar with estrogen can be consumed by animals and have estrogenic or anti-estrogenic effects depending on their variety and concentration. Compounds produced by fungi may have estrogen-like features or toxic effects and cause miscarriage. In this study, effects of nutritional methods and dietary factors on puberty, implantation, maintenance of pregnancy and producing healthy offspring are discussed and feeding strategies are emphasized for improved fertility.

Key Words: Dairy cow, fertility, nutritional factors, hormones.

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## INTRODUCTION

Reproductive potential of modern high-yielding dairy cattle is affected by many factors. Nutrition influences virtually all aspects of reproduction and is one of the important factors (i.e. genetics, health, management, environmental factors and milk yield) affecting reproduction. A close relationship between nutritional factors and reproduction has long been recognized and studied in many aspects. Knowledge of regulatory processes between nutrition and reproduction has led to development of nutritional strategies to improve fertility such as sequential feeding of glucogenic-lipogenic diets and supplementation of organic Se in the transition period (Thatcher et al, 2011). Limited feed resources can reduce reproductive efficiency to an extent dependent upon the degree of feed restriction (Mackey et al., 2000) and reproductive status at the time of feed restriction (Smith, 1988). Despite high number of studies on relations between nutrition and reproduction, substantial information is still coming out of the studies in this area. Developments in feed industry have increased number of nutritional factors (e.g. new products) that could be predictive in reproduction. At the same time knowledge on reproductive traits has been increasing. Some of the factors affecting reproductive traits in different studies are nutritional levels, phyto-active factors, dietary oil supplements, sequential feeding, minerals and vitamins etc. Cow reproductive traits affected by nutrition in different studies are; age at first heat and calving, gestation length (GL), calving interval (CI), post parturition heat (PPH), birth weight (BW), dry period (DP), services per conception, service period, embryonic survival, calving ease, twinning, live offspring per parturition, weaning age, reproductive hormones, metabolic hormones, ovulation rate, sperm quality and quantity, This review focuses on relations between potential nutritional factors and their effects on reproductive traits and strategies to overcome reduced reproductive performance by nutritional manipulations.

## NUTRITIONAL LEVEL AND REPRODUCTION

It has been known for long time that under nutrition due to inadequate quantity or poor quality of feed is a main factor negatively influencing reproduction. When the nutritional state of animals is altered, changing concentrations of metabolic compounds may influence functions of the hypothalamic-pituitary-ovarian axis that regulate production of reproductive hormones. Effects of under nutrition on reproduction were exerted at the level of hypothalamus (Randel, 1990), anterior pituitary gland (Prunier and Quesnel, 2000), and ovary (Gong, 2002). Feedback mechanisms at each level of the hypothalamic-

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pituitary-ovarian axis also increase the complexity of understanding the interacting mechanisms. Chronic undernourishment perturbs metabolic processes and can ultimately result in decreased fertility and nutritionally-induced anestrus, characterized by a deficient secretion of LH from the anterior pituitary gland (Dunn and Moss, 1992). Decreased concentrations of serum glucose and increased concentrations of non-esterified fatty acids (NEFA) and urea nitrogen during feed restriction altered the secretion of metabolic hormones (increased GH, decreased IGF-I and thyroid hormones) necessary to maintain homeostasis (Christensen et al., 1997). Administration of the metabolic inhibitor, 2-deoxy-D-glucose just before and during the time of expected estrus prevented occurrence of estrus and formation of corpora lutea (CL) in well-fed heifers, supporting the hypothesis that hypoglycemia is a main reason responsible for infertility induced by acute energy deficiency in lactating cattle (McClure et al., 1978). Reproduction is a very energy demanding process that the demand increases due to fast growing fetus, developing mammary gland and milk secretion around parturition. During food deprivation or at the time of high energy demand but low energy intake (i.e. early parts of postpartum) the hypothalamic-pituitary-gonadal axis is down-regulated in order to conserve energy that could compromise fertility. Diskin et al. (2003) reported a gradual reduction in dominant follicle growth rate, maximum diameter and persistence in chronic dietary restricted cows that became anestrus when they lost an average 23% of their initial body weight. In addition to effects on the secretion of LH and GH at the level of the pituitary gland, nutritional signals can also act on the central nervous system detects the metabolic status of the animal and alters signals (GnRH and GHRH) regulating secretion of LH and GH (Barb et al., 2001). Endogenous opioid peptides (OEPs), neuropeptide Y (NPY), glucose (Diskin et al., 2003) and leptin (Barb et al., 2001) appeared to play key roles in the nutritional regulation of GnRH release and in turn pulsatile secretion of LH.

Sequential feeding of glucogenic-lipogenic diets is strategy suggested to improve fertility. Feeding glucogenic diet postpartum increases blood glucose and insulin, promotes follicle development and restore postpartum ovulation. Following glucogenic diet, during breeding season, lipogenic diet reduced insulin concentrations which had negative effect on blastocyst development and improve oocyte competence and embryo quality. Targeting certain lipids (i.e. rich in omega 3 fatty acids) in lipogenic diet may increase beneficial effect on fertility. During transition period (i.e. from pregnancy to lactation) nutrient intake is not sufficient for milk production and primarily adipose tissue is mobilized to support lactation (Thatcher et al., 2011). Mobilization of body reserves results in animals to enter negative energy balance (NEB) that begins few weeks prior to calving primarily and remain for five to seven weeks postpartum (Grummer, 2007). Body condition score (BCS) is used to monitor nutritional and health status of cows. Cows, with low BCS (1.5–2.5; over 5-point scale) at calving or losing excess BCS early postpartum may have impaired oocyte competence and are likely to have lower ovulation rate and exhibit estrus, reduced conception rate to first service, increased likelihood for pregnancy loss and increased calving to conception interval (Roche et al., 2009). Minimizing BCS loss in the first few weeks post partum is very important. Crowe (2008) recommended that cows should have a BCS of 2.75–3.0 (scale 0–5) at calving and they should be managed to stand for a BCS loss not more than 0.5 between calving and first service. On the other hand, fertility is compromised in cows that have a BCS  $\geq$  3.5 (over 5-point scale) at calving. These cows have reduced dry matter intake (DMI) just prior to calving, take longer to increase DMI postpartum, tend to have greater fat mobilization and more severe NEB early postpartum than cows with an optimum BCS at calving (Roche et al., 2009). Severe NEB increases risk of metabolic diseases generally within the first month of lactation, causing reduced immune function and subsequently reduced fertility and anestrus (Diskin et al., 2003). Level of nutrition also affects timing of the onset of puberty and pregnancy rates. Schoppee et al. (1996) demonstrated that 0% of heifers reached puberty and had lower concentrations of serum IGF-I, estradiol-17 $\beta$ , and follicular IGF-I when animals were chronically feed restricted (fed to gain 0.5 kg/d) between 104 and 393 d of age compared to 71% of control (fed to gain 0.9 kg/d) heifers. Excess protein intake causing urea and ammonia in body fluids may alter uterine pH and granulosa cell functions and be toxic to embryos (Santos et al., 2008). Overfeeding degradable protein with inadequate fermentable carbohydrates negatively affects fertility that was shown by a inverse relationship of high serum or milk urea N concentrations and pregnancy per AI (Butler, 1998). These diets cause inefficient protein utilization because excessive ammonia is absorbed by rumen and detoxified into urea by liver with a further energy cost (Thatcher et al., 2011). Therefore, it is crucial to keep nutritional status of dairy cow at moderate level and to follow certain feeding strategies for a better reproductive performance.

## DIETARY OIL SUPPLEMENTS AND REPRODUCTION

Use of dietary oil supplements in ruminant diets has been historically suggested to increase energy density of the diet (Coppock and Wilks, 1991). Since energy is quantitatively major nutrient of the diet, meeting high yielding animals' energy requirements is challenging. Consumption of excessive amounts of readily fermented carbohydrates causes an increased supply of total acids that can result in reduced pH in the rumen, intestines and blood resulting in digestive disturbances. Therefore, use of a limited amount of oil supplements was suggested because excessive dietary oils can reduce ruminal fermentation, intestinal absorption (Palmquist, 1994) and elevate NEFA concentrations that might antagonize fertility (Thatcher et al., 2011). Maybe more important than providing energy, beneficial effects of dietary oil supplements on fertility were shown by *in vitro* and *in vivo* studies. These beneficial effects could be due to fatty acid profile (i.e. essential long chain polyunsaturated fatty acids like linoleic and  $\alpha$ -linolenic acids) of supplemented fat and their availability to the tissues. For example, oil supplementation enhanced ovarian follicular growth and function (Hightshoe et al., 1991) and the life span of induced corpora lutea (Espinoza et al., 1995). Exact mechanisms through which such effects were exerted are not clearly established. However, responses were often associated with factors important to ovarian follicular and corpus luteal (CL) physiology (Thomas et al., 1997). Dietary lipids from plant oils increased serum concentrations of lipoprotein-cholesterol, growth hormone (GH) and insulin, elevated intrafollicular concentrations of high-density lipoprotein cholesterol, and enhanced CL production of insulin-like growth factor-1 *in vitro* (Ryan et al., 1995). Beneficial effects of dietary fats on reproduction may be due to improved energy status, increased availability of precursors for the synthesis of hormones and eicosanoids (i.e. linoleic acid for synthesis of arachidonic acid and eicosanoids and cholesterol for synthesis of steroids (Mattos et al., 2000). Fatty acids may directly influence transcription of proteins related to reproduction (Mattos et al., 2000). Type of polyunsaturated fat content of the diet is important to influence both ovarian and uterine functions. Among isoenergetic, isonitrogenous, and isofibrous diets, saturated (animal tallow), unsaturated (soybean oil) or polyunsaturated (fish oil) fat-supplemented diets increased serum concentrations of total cholesterol, GH and concentrations of IGF-I in follicular fluid of large follicles during estrus in cows. Polyunsaturated fat supplementation stimulated ovarian follicular growth to a greater extent than saturated and highly polyunsaturated fat supplements and control diets in cows (Thomas et al., 1997). Precursors of prostaglandins are arachidonic acid which is derived from dietary linoleic acid. Ovarian and endometrial synthesis of prostaglandin  $F_2\alpha$  can be inhibited by linoleic, linolenic, eicosapentaenoic and docosahexaenoic acids by decreasing the availability of arachidonic acid. Competition by these fatty acids with arachidonic acid for binding to prostaglandin H synthase and inhibition of prostaglandin H synthase synthesis and activity may reduce prostaglandin synthesis (Mattos et al., 2000). Staples et al. (1998) suggested that alterations in metabolic hormones and hormonal clearance may target reproductive tissues to improve reproductive functions in fat-supplemented animals. Improved fertility could be explained by beneficial effects of strategically supplemented fatty acids on immune function early postpartum and their immunosuppressive effects during the breeding period (Silvester et al. 2011). Beneficial reproductive effects of polyunsaturated fatty acids have been shown by several studies, but more studies are needed to determine the concentrations of specific fatty acids in the diet.

## PHYTOACTIVE FACTORS AND REPRODUCTION

Phytoestrogens from plants (most abundant in legumes) represent one of three groups of naturally occurring estrogens beside ovarian steroids and mycoestrogens from fungi. Phytoestrogens are stereochemically similar to estradiol- $17\beta$  and act as weak estrogens or anti-estrogens in animals and function primarily as antioxidants and phytoalexins (compounds that are able to inhibit the growth of microorganisms) in plants (Anderson and Garner, 1998). Phytoestrogens, classified into 4 main groups as isoflavonoids, flavonoids, stilbenes and lignans (Cos et al., 2003), are diverse and have diverse mechanisms of action, as antioxidants, endocrine disruptors, or protein tyrosine kinase inhibitors (Liggins et al., 2000). More than 300 plants have been reported to cause estrogenic effects in animals (Mazur et al., 1998). Detrimental effects of dietary phytoestrogens on reproductive traits of ewes and cows fed estrogenic forage have been known for a long time. Phytoestrogens may directly influence pituitary, ovarian and uterine characteristics, induce estrus in immature animals, interfere with normal reproductive processes (Thomson, 1975), influence estrogen feedback mechanisms between the



hypophysis and the ovary impair ovarian function, reduce conception rates, increase embryonic loss and temporary or permanent infertility (Adams, 1995). Phytoestrogens are glycosidically linked to carbohydrates and are deconjugated from the carbohydrate portion by bacteria in the large intestine (Liggins et al., 2000). In ruminants, microbial metabolism of phytoestrogens may change estrogenic or anti-estrogenic properties of feed ingredients. For example, demethylation of 4'-methoxy-coumestrol enhanced estrogenicity because demethylation allows the hydroxyl groups to bind to the estrogen receptor. Alternatively, genistein and biochanin A may be degraded to non-estrogenic p-ethyl phenol and organic acids (Cox and Braden., 1974). Welshons et al. (1990) found detectable estrogenic-activity in 88 of 166 feed samples analyzed by using a sensitive bioassay for detection of dietary estrogens in animal feeds. For this assay, estrogen dependent growth rates of human breast cancer-derived MCF-7 cells were measured in response to phytoestrogens in methanol extracts of feeds. Kiyama (2005) studied to detect and compare estrogenic activities of feed and duodenal samples using an MCF-7 cell proliferation bioassay. Response of the cells to estrogens was greatest for estradiol-17 $\beta$  followed in order by  $\alpha$ -zearalanol, zearalenone, coumestrol and genistein. Estrogenic activity among the extracts of feedstuffs was the highest for soybeans followed in order by corn, high-linoleate safflower seeds, high-oleate safflower seeds, corn oil, and soybean oil. Although high levels of phytoestrogens can result in infertility problems, possible beneficial effects (i.e. decreased pubertal age) and concentrations of individual dietary phytoestrogens needs to be determined in future studies controlling all components of specific diets (i.e. fatty acid composition, content, etc).

#### OTHER DIETARY FACTORS AFFECTING REPRODUCTION

Vitamins, macro-minerals, trace elements and antioxidants have important roles in reproduction directly or through health status of animal despite their low quantity in diets. Supplementation of vitamin E, beta-carotene, chromium and Se reduced the incidence of mastitis and retained placenta (Spears and Weiss, 2008). Trace minerals are important in reproductive processes and they appeared to be more available to tissues when bound to organic molecules like amino acids. Replacement of inorganic Cu, Zn, Mn and Se with organic forms postpartum improved in conception rates and days to first service (Ballantine et al., 2002). An acute decline in blood Ca is observed with the beginning of lactation when the rate of calcium uptake into the mammary gland for milk production is greater than that of dietary intake or reabsorbed from bone. This rapid decline is minimized by a reduction in dietary cation anion difference (DCAD; Calculation of the DCAD is based on levels of cations (K<sup>+</sup> and Na<sup>+</sup>) and anions (Cl<sup>-</sup> and S<sup>2-</sup>) to negative values during 3 weeks before parturition. Cows on a negative DCAD diet pre-calving tended to have improved conception rate to first service and dry matter intake and reduced number of days to first service (Wilde, 2006). Correct supplementation of macro and micro minerals, and vitamins should be a strategy to improve fertility, considering variation in forage levels and changing demand of cows by production periods.

#### CONCLUSION

Nutritional factors related to reduced fertility which is a complex and multi factorial problem in dairy cattle. The relation between nutrition and reproduction could be direct or through immune function or health status and it becomes more important pre- and postpartum periods. Nutrient demand of dairy cattle is critical during transition period and certain strategies have to be followed to meet the demand to protect the cow from the state of negative nutrient balance. Type (glycogenic and lipogenic) and time (first postpartum ovulation and breeding season, respectively) of dietary supplements, essential long chain polyunsaturated dietary fatty acids, vitamins and minerals are strategic dietary factors to improve fertility. Although dietary phytoactive factors should be considered as endocrine disruptors at certain region, to benefit from these compounds more studies are needed to determine right doses at right times. Due to ruminal digestion, quantitative determination of the some nutritional factors (e.g. vitamin, phytoestrogen) is difficult. Number of studies evaluating relations between nutrition and reproduction is high that is promising new strategies to improve fertility in dairy cattle.

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# AN EVALUATION ON BREEDING KID SELECTION AS A PART OF “HAIR GOAT BREEDING UNDER FIELD CONDITIONS” PROJECT\*

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## ABSTRACT

Breeding animal selection is usually performed based on morphological traits. Pedigree records can also be used in this regards, given they have been kept. In this study, the aim was to evaluate selection criteria for breeding kids according to corrected daily weight gain as well as their morphological traits. A total of 3412 data from 20 hair goat herds in Çanakkale were evaluated. Within the project, approximately 25 % of herd population should be selected from the kids, as a rule. If the number of the kids is not enough, then yearling does could be used. In the investigated herds, average 20.40 % (6.08 %-34.04 %) were selected from goat kids. Litter size, sex and age were used to correct the average daily weight gain. An evaluation was performed according to corrected phenotypical daily weight gain. During the evaluation, average daily weight gains were ranked from maximum to minimum. As many as the number of selected kids for breeding the kids in each of the herds were listed from high to low according to the uncorrected average daily weight gain values. Later, corresponding rate of the kids placed in the both lists was calculated. Average corresponding rate was 23 % (8-46 %). The correlation between selected and ranked animals for birth weights, weaning weight and average daily weight gain were statistically significant and a strong positive correlation was detected. The relationship between difference and corresponding rate for weaning weight was significant. An increasing in the difference caused a decrease in corresponding rate ( $r = -0.49$ ,  $P = 0.0264$ ). Kids that described as “good” by their average daily weight gain were not selected as breeding stock because of their morphological traits such as not having breed characteristics, or having undesired mammary traits like supernumerary teats, short ears, separate testicles, white hair color, hornlessness.

For a more efficient breed selection, it could be recommended that the records should be kept regularly, morphological traits should be evaluated in more detail, and the selection should be based both records and the morphological traits.

**Key Words:** Hair goat kids, selection for morphological traits, daily weight gain, animal production in field conditions

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## INTRODUCTION

Indigenous genetic resources which are under the risk of being lost have led to the launch of several studies on conservation of these resources. Studies in animal production about protection of indigenous genetic resources in the world since 1959 began to be expressed? (Ertuğrul et al., 2005). There are several protection methods for indigenous genetic resources, and one of them is protection in a breeding environment in the hands of breeder. In Turkey the studies have been started about the protection of valuable indigenous genetic resources under controlled conditions. General Directorate of Agricultural Research and Policy (TAGEM) planned a project between 2005-2010 years, which was called “Territorial Animal Breeding under Field Conditions”. Objectives of this project were to increase the yields of pure breeding and selection of indigenous breeds, to establish nucleus breeding farms, to reveal of genetic potential of indigenous breeds and to teach Sheep and Goat Breeders Association and goat breeders animal breeding organization as well as animal protection. This project has been extended for another five years, between 2011 and 2015.

In order to improve herd yield, genetic capacity improvement or improvement of environment for requested traits was suggested in animal breeding studies (Gökdağ ve ark., 2011 and 2012). Barillet (2007) reported that current breeding programs have been focused on pure bred animals. However, it was stated by the author that indigenous breeds were crossed with foreign breeds and as a result, pure bred animal population was decreased. Indigenous breeds are used in the cross breeding with the foreign breeds because indigenous breeds have better adaptation to environment. In addition to testing breed’s own, yield information of its family or relatives are beneficial in breeding studies.

Data like birth weight and weaning weight also give information on meat quality in animal breeding studies (King, 2009). Ismail et al. (2005) reported that morphological characteristics can be used as a tool to monitor an individual's genetic potential. Bahreini Behzadi et al. (2007) stated that live weights in

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\*This study is a part of the project, which was supported by TAGEM, called “Territorial Animal Breeding under Field Conditions”.

different ages should be recorded and genetic relationship information between the traits should be gathered for genetic parameter estimation in deciding the most suitable breeding strategy.

One of Turkey's indigenous breeds, Hair goat is also named Black Goat or Anatolian Black goat. Breeding purposes of hair goat are meat, milk and hair production (Anonym, 2012). Hair goat has low production level. Atay et al. (2011) stated that 97% of goat population of Turkey was hair goat and 3 % of red meat production comes from hair goat. Researches about hair goat were in limited number, and the existing studies were focused on crossbreeding. Although hair goat is our indigenous breed, there are variations in the breed as a result of uncontrolled crossbreeding.

Aim of this study was to evaluate selection criteria for breeding hair goat kids according to corrected daily weight gain as well as their morphological traits.

## MATERIAL AND METHODS

This study was planned as a subproject "Hair Goat Breeding under field conditions in Çanakkale" that was carried out within the context of "Territorial Animal Breeding under Field Conditions". The data from the subproject were analyzed for this study. In this respect, six villages in Çanakkale were visited in which 20 goat herds and 3412 goat kids from the herds were evaluated. The project "Territorial Animal Breeding under Field Conditions" with the special aim of protection and improvement of indigenous breeds under their own environment was commenced in 2005. After the completion of the first five-year stage of the project the second five-year stage was carried out. This project has encouraged the goat breeders to keep records. By the participating herd owners, birth records during birth season and weaning weight records in the approximately three months ages were routinely collected along with the information like weaning age and average daily weight gain (ADWG).

### Statistical Analyses

Data of the study were analyzed with SAS-Program package (SAS, 2000). Birth weight (BW), birth type (single, twin, triplet), sex and weaning weight (WW) (three months age) of the kids were recorded. The differences between weaning weight and birth weight gave the "weight gain" in this period and division of weight gain to weaning age was calculated as "average daily weight gain (ADWG)". A linear model was used to correct daily weight gain. In the model weaning age, sex, birth type and their interactions were used as fixed effects. Eventually, corrected phenotypic daily weight gain value was calculated.

As many as the number of selected kids for breeding in each of the herds were sorted out in a descending order, which will be denoted as the raw list thereafter, from high to low according to the uncorrected average daily weight gain values. Later, corresponding rate of the kids placed in the both lists was calculated. Correlation between ADWG values of selected and the kids in the raw list were determined. Ratio (%) of the kids selected to the ones in the raw list ones was also determined. Differences between ADWG means of the selected kids and raw list kids and their corresponding rates were correlated. Means of yields (BW1, WW1 and ADWG1) of the listed kids and selected ones (BW2, WW2 and ADWG2) were analyzed using t-test.

## RESULTS AND DISCUSSION

In this study, the changes in the corresponding rates were investigated on the selection of hair goat kid according to the phenotypic and the morphological traits. The results of this study were given as following.

Hair goat kids had 3.32 kg average birth weight, 90 days (98 day $\pm$ 11.69 days) average weaning age and 15.35 kg weaning weight.

The corresponding rates of the raw listed and the selected for breeding for each herd were given in Table 1. The corresponding rate was highest in the goat herd (#10) as 46%, and the lowest in the herd #8 as 8%. In this Table the main effect was not given. All main effects have statistically significant ( $P<0.0001$ ). In this study was investigated not the effects of birth type, sex and weaning ages on daily weight gain, but the corresponding rate of selected as breeding and unselected kids.

Birth weight and weaning weight in the 20 goat herds were not significantly different between the kids selected for breeding and raw listed (Table 2). Selected breeding kids had quantitatively higher weaning weights than the raw listed ones. On the other hand, raw listed kids had higher averaged daily weight gain.

The traits investigated in the animals selected for breeding or raw listed were analyzed with t-test and their significance level was given in Table 3. Birth weights of the two groups were not significant but weaning weight and average daily weight gain were statistically significant both in the kids selected for breeding and raw listed.

**Table 1.** Corrected phenotypic daily weight gain (kg, ADWG1, ADWG2), birth weight (kg, BW1, BW2) and weaning weight (kg, WW1, WW2) values in the raw listed (1) and selected (2) goat kids and their corresponding rates.

Herd	ADWG1	ADWG2	BW1	BW2	WW1	WW2	Corresponding rate, %
1	0.108	0.107	2.882	2.902	12.378	13.983	41
2	0.116	0.107	2.717	2.676	11.919	13.578	18
3	0.111	0.113	2.794	3.079	12.436	14.610	30
4	0.109	0.110	2.779	3.056	10.978	14.469	12
5	0.127	0.110	2.737	2.486	17.033	16.404	13
6	0.122	0.106	3.191	3.090	16.521	15.984	19
7	0.122	0.117	3.131	3.116	13.112	15.014	17
8	0.117	0.110	3.275	3.326	13.628	16.056	8
9	0.128	0.110	3.628	3.340	18.028	16.009	21
10	0.120	0.110	3.224	3.298	15.908	16.272	46
11	0.102	0.103	3.073	2.990	12.790	15.127	11
13	0.124	0.127	3.892	3.223	13.950	13.007	30
14	0.130	0.119	2.941	3.234	19.239	18.156	29
18	0.130	0.120	4.340	3.889	17.341	18.860	18
19	0.105	0.100	2.941	3.053	14.232	14.940	33
20	0.123	0.121	3.690	3.831	14.285	15.265	34
21	0.129	0.126	3.466	3.742	15.064	17.997	17
22	0.126	0.119	4.111	3.998	18.991	19.254	34
23	0.131	0.114	3.596	3.601	13.880	14.446	11
24	0.118	0.120	3.186	3.204	14.781	14.800	34

As explained before, data were ranged from highest to lowest ADWG and also according to from highest to lowest corrected ADWG. In order to find correlations, 10% of both of ranges were selected in each of the goat herds, and the relationship between corrected and raw listed BW, WW and ADWG were correlated. The correlation coefficients and their significance level were given in Table 4. In addition, the corresponding rate value and the differences between corrected and uncorrected BW, WW and ADWG values were also correlated and shown in Table 4.

**Table 2:** Means and standard deviations of the birth weight (BW), weaning weight (WW) and average daily weight gain (ADWG) of the selected for breeding and raw listed animals in the investigated farms

	Selected for Breeding		Raw Listed	
	Mean	SD	Mean	SD
BW, kg	3.2	0.39	3.2	0.46
WW, kg	15.7	1.72	14.8	2.38
ADWG, g	113.4	7.42	119.9	8.90

There was a strong correlation of birth weight between selected and listed groups ( $r=0.84$ ) and this relationship was statistically significant ( $P<0.0001$ ). A similar situation also applied for the WW and ADWG values. There was a significantly negative correlation between the corresponding rate and the difference of both weaning weight means ( $r= -0.49$ ,  $P=0.0264$ ). Increased difference between weaning weights of selected and raw list animals caused a decrease in the correspondence rate. Decrease in the differences between WW1 and WW2 increased the importance of morphological characteristics in selection. In this study, there were kids not selected for breeding purposes because of their unsuitable morphological features even though they listed in the top of the raw list. The reasons for exclusion of female goat kids were that they did not have breed characteristics, or they have undesired mammary traits like supernumerary teats and short ears. Male goat kids were not selected for breeding due to separate testicles, white hair colour, short ears, hornlessness, and lack of breed characteristics. In a similar fashion, the decreased differences in ADWG resulted in an increase in the corresponding rate, but this relationship was not found significant ( $r= -0.31$ ;  $P=0.1788$ ).

**Table 3. Significance level for birth weight, weaning weight and average daily weight gain traits of animals selected for breeding and raw listed.**

Traits	P-Value
Birth weight	0.3423
Weaning weight	0.0072
Average daily weight gain	0.0003

In Turkey selection of breeding animal has been usually made based upon morphological characteristics only. Although there are no pedigree records, herd owners sometimes perform selection according to unrecorded information on parents. The results of this study showed that by the selection of breeding animals from corrected and uncorrected data, average corresponding rate was 23% (8-46% from the 20 herds). Selection based on morphological traits or phenotypic values solely does not provide sufficient information. Knowledge on the animals of early selection for breeding gives information for the future yields. Portolano et al (2002) reported that there was a genetic correlation between birth weight and live weight at 60th day ( $r_G$ : 0.86), which enables us to make an indirect selection. Researchers stated that phenotypical correlation was lower than genetic correlation, but they were analogs with each other.

**Table 4. Correlation coefficients (r) and significance level (P-Value) for birth weights (BW), weaning weight (WW), average daily weight gain between the corrected and raw listed values and the correlation of their corresponding rates and the differences.**

Trait	r	P
Birth weight, BW	0.84	<0.0001
Weaning weight, WW	0.78	<0.0001
Average Daily weight gain, ADWG	0.65	0.0017
BW (corr. rate-difference)	0.02	0.9090
WW (Corresponding-Difference)	-0.49	0.0264
ADWG (Corresponding-Difference)	-0.31	0.1788

In conclusion, early breeding selection solely based on morphology is not sufficient. Selection using only corrected phenotypical value is also not helpful. Due to the selection by the morphological features, recorded yields and also analyzed data, the quality of selected individuals as "breeders" could be increased.

#### Acknowledgement

This study is a part of the project supported by Ministry of Food, Agriculture & Livestock, called "Territorial Animal Breeding under Field Conditions". The authors were grateful to the herd owners, General Directorate of Agricultural Research and Policy (TAGEM), Çanakkale Sheep and Goat Breeders Association and Çanakkale Office of Ministry of Food, Agriculture & Livestock, Dr. İrfan Daşkiran and for the english correction Dr. Zeliha Gökbayrak.

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# THE IMPORTANCE MAIZE AND MAIZE PRODUCTS

Gül Ebru ORHUN<sup>1</sup>

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## ABSTRACT

Maize is one of the most popular cereals in the world and forms the staple food in many countries including USA, Africa etc. Health benefits of maize are offered by presence of quality nutrients in it. It not only provides the necessary calories for daily metabolism, but also is a rich source of vitamins A, B, E and many minerals. Also maize oil is useful. Maize oil is the most widely consumed in the world. Because this oil is generally less expensive than most other types of vegetable oils. Recently, many researches have discovered the strong antioxidant potential mostly in maize oil. Health benefits of maize oil include controlling diabetes prevention of heart ailments, It has reduced hypertension and prevented neural-tube defects at birth. The aim of this article is to revise maize and maize products, its importance for life.

Key Words: Maize, maize products, food, feed

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## INTRODUCTION

The plant (*Zea mays L.*) is a monoic annual plant which belongs to *maideas* tribe and the grass family of *gramineae*, and their cells have 2n chromosomes. Maize is the third most important crop after wheat and rice and is grown in more countries than any other crop in the world. It is cultivated virtually in all parts of the world except Antarctica. It has very specific water and climatic requirements in order to thrive. Most importantly, for the plant to germinate it needs a temperature ranging from 15 to 20°C (Meija 2003). This plant is the largest grown (785 million tons) cereal in the world with doubled grain yield per unit area compared to wheat and barley. In Turkey, corn is produced on approximately 550 thousand hectares with annual production of 3.5 million tons, of which nearly half is produced in the Mediterranean region. The share of corn production as second crop in the Mediterranean region is very high (Özcan, 2009). Today, in Turkish agriculture maize is one of the most important cereals after wheat and barley. According to the Statistical database of Food and Agricultural organization of the world (FAOSTAT, 2009), 592,000 ha of land (about 35% of areas under cultivation in Turkey) produce 4.25 million tons of maize grains per year (Cömertpay et al., 2011) 64% of maize production in Turkey is used for forage purposes and 36% for food and industrial products (Ege and Karahocağil, 2001). Maize is also used as food and raw material for industrial use. In industrialized countries, a larger proportion of the grain is used as livestock feed and as industrial raw material for food and nonfood uses. On the other hand, the bulk of maize produced in developing countries is used as human food, although its use as animal feed is increasing. Maize is the largest food crop of the United States, which is responsible for 40 percent of the world's production. The major chemical component of the maize kernel is starch, which provides up to 72 to 73 percent of the kernel weight. After starch, the next largest chemical component of the kernel is protein. Protein content varies in common varieties from about 8 to 11 percent of the kernel weight. Most of it is found in the endosperm (Landry and Moureaux, 1970). The oil content of the maize kernel comes mainly from the germ. Oil content is genetically controlled, with values ranging from 3 to 18 percent. After carbohydrates, proteins and fats, dietary fibre is the chemical component and vitamins (provitamin A (carotenoids), niacin, vitamin E and vitamin C found in the greatest amounts. Meal is a primary product obtained from maize. The meal from maize can be obtained by manual or mechanically milling. The other products include: tortillas, maize flours (masa), chips and several types of snack, breakfast cereal, thickness, pastes, syrups, sweeteners, grits, maize oil, soft drinks, beer, whisky, etc.

Maize is the most important raw material for industrial starch. Maize starch is a maize product and it is employed in the manufacture, ceramics, dyes, plastics, oil cloth, paper and paper boards and in textiles, cosmetics, pharmaceutical industries. The derivatives of maize starch include glucose or corn syrup, corn sugar, dextrans and industrial alcohol, which are employed in different industries.

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## **MATERIALS AND METHODS**

In this study, results of some researches regarding maize and maize products were revised. Particularly, utilize of maize and maize products were emphasized for industry and the other areas. Importance of maize and maize products were discussed for human and animal health. Because maize is very significant for life human and animal.

## **RESULTS**

### **Maize Products and Utilize**

Maize starch plays a leading role in determining the texture of many foods, which is vital to both the consumer and the food manufacturer, as a major factor that governs the acceptability and palatability of most food products (Anoumyous, 2012) Include paper manufacture, textile, adhesives and packed foods, and as the starting material for the manufacture of syrups and dextrose sugar by hydrolysis. The starch obtained from the wet milling of waxy maize, also called "amioca", which consist mainly of amyl pectin, is non-jelly and has clear, fluid, adhesive properties. Heated and dried maize starch/water slurries yield pre-gelatinized starch, known as "instant starch" as it thickness upon addition of cold water. Glucose and dextrose are used in beer, cider, soft drinks, pharmaceuticals, confectionary, baking and jams. The dextrins are products obtained by the breakdown of the solid dry starch, which is heated with chemical products like mineral acid almost always hydrochloric acid (Mejia, 2003). Maize starch is used as an adhesive in pigment coating for paper and paperboard. The most commonly used pigments are clay, calcium, carbonate and titanium dioxide. The primary purpose of coating is to enhance the printability and appearance of the paper. High-fructose maize syrup is produced by milling maize to produce maize starch. Maize syrup, which is almost entirely glucose, and then adding enzymes that change some of the glucose into fructose.

Maize flour can be used exactly as wheat flour in making bread, breakfast meals and more. Maize flour, also called corn flour is highly rich in protein, dietary fibre and very low in fat. Maize flour is by far the most widely eaten flour after wheat and rice flour. It is uniquely rich in dietary fibre, protein, vitamin B6, magnesium and omega 6 acids, vital for good heart and fight against infections. Fortified maize flour has been used in the eradication of malnutrition in some parts of the world. The maize grain gives the highest conversion ratio to meat, milk and eggs when is compared with others grains used as livestock feed, this is due its high starch and low fibre content which make it a very concentrated source of energy for livestock production. Although there is not available statistic for maize and livestock use, it is believed that greater portion is used as poultry feed in tropical countries. Yellow maize is preferred for livestock feed and it is used as whole grains, cracked or coarse ground, dry or wet or steamed and generally supplemented with vitamins and others proteins. Is expected that use of maize in formulated feed will increase in the future.

Maize use for maize silage that it is also known as corn silage. Silage has been valuable source of feed for cattle. The nutrients in a ton of corn silage are related to the percent dry matter in the silage. Corn silages within the same year on a farm may commonly range from 30 to 45 percent in dry matter. The use of QPM (Quality Protein Maize) as animal feed promise good potential and it still remains to be exploited particularly for swine production. So far, there is some use of QPM for pig feed and it has been reported that the use of QPM as an ingredient in pig feed could help to reduce costs. However, it is possibly that the unavailability of sizeable quantities of QPM grains in the market, and the fact that cultivation of QPM has not been taken up on a commercial scale.

### **Maize Products and Industry**

Basically, there are two milling process used for the maize industry for making various food, feed or industrial products. They are:

1. The wet milling process normally produce pure starch, sweeteners (dextrose, fructose, glucose and syrups including high fructose syrups), proteins, industrial starch, fibres, ethanol and maize oil from the germ. The most important by-products are animal feed and this industry usually uses the flint and dent maize types.

2. The dry milling process is also used to produce a wide variety of food and non food products. In general, the process of maize starts with milling, even the maize which is used at household level. Except the maize eaten as kernel on the cob and popcorn all other products from maize are based on milled maize.

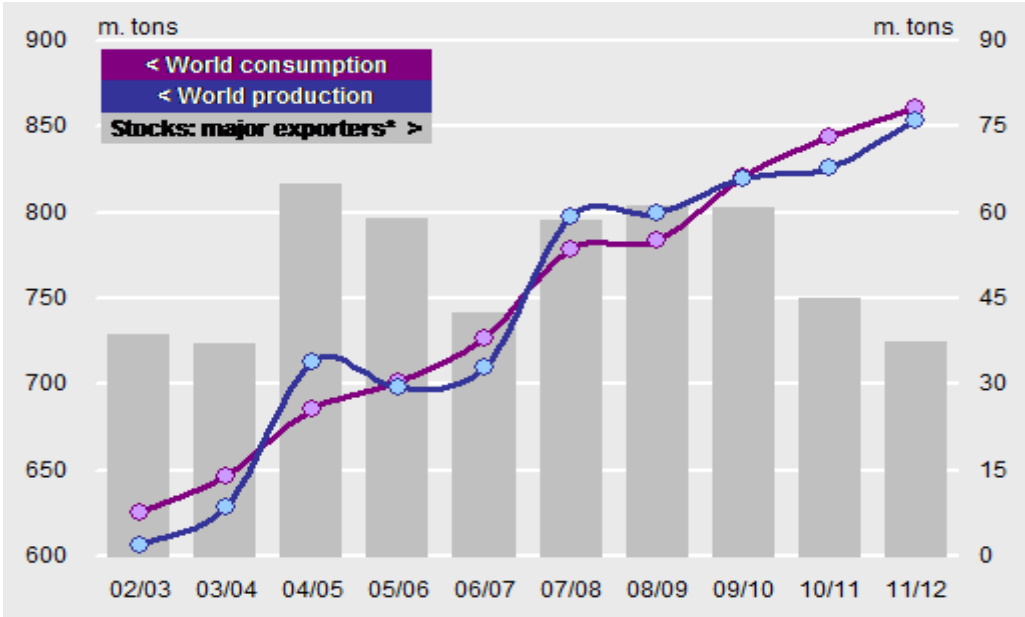


Figure 1: Maize production and consumption in the world. Resource: International Grains Council.

As seen in the figure graphic(1), maize production and consumption have been increasing worldwide. According to IGC (International Grains Council) the world’s corn production was 811 million tons in 2010. The corn production will not be sufficient to cover the increasing consumption needs that is expected to be 845 million ton.

Maize oil is very important product of the maize milling industry. USA is the largest maize oil production country all over the world with its maize oil production taking up over 50% of the world total production. Industrial uses for corn oil include soap, salve, paint, rustproofing for metal surfaces, inks, textiles, and insecticides. Corn oil and free fatty-acids - industrial uses; chemicals and insecticides, lecithin (for pharmaceuticals, cosmetics, linoleum, printing inks, etc.), paint and varnish, printing ink, rubber substitutes, rust preventative (surface coatings), soluble oil (leather and tanning use), textiles (Orhun, 2012). Corn oil is also one source of biodiesel and used biofuel. Corn oil biodiesel is suitable for use in diesel engines.

There are many products from maize that have been taken over by industry and manufactured and marketed at commercial scale. Several of these products already mentioned are now industrialised on a small or large scale. In the USA over 1 000 different items can be found on the shelves of a typical supermarket and they are derived wholly or partially from maize. These products include: tortillas, maize flours (masa), chips and several types of snack, breakfast cereal, thickness, pastes, syrups, sweeteners, grits, maize oil, soft drinks, beer, whisky, etc.

Table 1. Mineral Elements Content in Maize Grain

Elements	TR 1	TR 2	TR 3	TR 4	Unit
Se	32.58a	30.78a	26.21b	24.04b	ng g <sup>-1</sup>
Mo	701.32c	850.32a	792.83a	778.80b	ng g <sup>-1</sup>
I	26.50a	13.06b	9.86c	8.54c	ng g <sup>-1</sup>
Mn	6.44a	3.07b	4.17b	2.20c	μg g <sup>-1</sup>
Fe	38.11a	21.93c	28.50b	15.11d	μg g <sup>-1</sup>
Cu	2.87a	3.00a	2.80a	2.80a	μg g <sup>-1</sup>
Zn	18.33a	13.60b	14.33b	13.27b	μg g <sup>-1</sup>
Ca	18.19a	16.56b	13.30c	16.01b	μg g <sup>-1</sup>
Cr	384.48a	299.42b	348.93ab	288.96b	ng g <sup>-1</sup>
K	3673.16a	3520.60a	3367.10a	3554.23a	μg g <sup>-1</sup>
Na	5.99b	5.92b	6.56 b	13.38	μg g <sup>-1</sup>
Mg	1027.40a	945.79ab	1007.68a	938.94ab	μg g <sup>-1</sup>

Different letters after numerical values indicate significant differences (LSD,  $p \leq 0.05$ ).

Resource: (Yu-Kui et. al., 2009)

Maize oil is very useful for health. Because it is rich in linoleic acid and oleic acid, these of the three essential fatty acids. Linoleic acid is unsaturated fatty acid that humans and other animals must ingest for good health (Adom and Liu, 2002; Dupont, 1990).

Some researcher from University of Illinois at Urbana-Champaign have pointed out that corn contains important chemicals called lectins. This unique group of proteins and glycoproteins attribute various health benefits of corns. Several lectins have been found to possess anticancer properties in vitro, in vivo and in human case studies; they are used as therapeutic agents, preferentially binding to cancer cell membranes or their receptors, causing cytotoxicity, apoptosis, and inhibition of tumor growth (EG De M. and Prisecaru VI, 2005). Because the body requires them for various biological processes but it cannot synthesize them from other food components. Oleic acid is the major dietary monoenoic acid. It might have a slight and controversial positive effect on LDL-cholesterol (Hunter et. al., 2000; Dubois et. Al., 2007). HealthSome researchers found that the cholesterol absorption was 38% higher after consumption of the sterol-free corn oil than after consumption of commercial corn oil with identical fatty acid content in a study of 10 healthy subjects. And when corn oil phytosterols were added back to sterol-free corn oil at a concentration of 150 mg/test meal, cholesterol absorption was reduced by 12% after inclusion of 300 mg phytosterols (Ostlund, 2002).

## CONCLUSION

Maize is an important cereal crops in the world. It provides staple food to many populations. In developing countries maize is a major source of income to farmers among whom many are resource-poor. All studies have demonstrated maize and maize products are needed for life.

In addition, maize and maize oil have used any area (agricultural, industrial, medicinal etc. But corn oil may have a mildly anticoagulant effect, the potential benefit of which is discussed the combination of corn oil and diet with a particular constitution may cause adverse effects on the renal tubules in pregnant and/or lactating rats, suggesting that corn oil gavage as a vehicle can be a confounding factor in the reproductive toxicity studies, depending on the diet (Sato et. al., 2000).

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# TECHNOLOGY AND QUALITY CHARACTERISTICS OF TRADITIONAL LIVNO CHEESE

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## ABSTRACT

Livno cheese is traditional Bosnian raw milk hard-type cheese. Ripening period for this cheese is at least two months. Basically, it is made of mixture of ewe and cow milk in ratio of 70:30. However, this ratio often varies and technology is somewhat unstandardized. As a result, cheese has variable physical, chemical and microbiological characteristics. The aim of work was to investigate current producers practice and to test quality characteristics of Livno cheese in order to set standard parameters.

One family cheesemaking was chosen to follow manufacturing procedure. Physical characteristics of mixed milk were investigated while pH and temperatures during production and manufacture conditions were noted. All investigations were done in three consecutive days. To obtain characteristics of mature cheese, 12 samples of two months old cheese were taken from four producers including former one. Chemical and microbiological analyses were done and measuring of physical properties was made.

The acidity of bulk mixture of ewe and cow milk was 8.8-9.0°SH while pH ranged from 6.46 to 6.64. pH of cheese after pressing varied from 5.00 to 5.10. Ripened cheese samples in average contained 62.57% of dry matter and 34.08% of fat. Mean percentage of fat in dry matter was 54.36% and moisture on fat-free basis 55.63%. pH value of cheese samples was in average 5.38. It can be concluded that quality characteristics of mature Livno cheese rather vary depending on producer but also within the same manufacture.

Key Words: Cheese, quality, ripening, pH

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## INTRODUCTION

*Livno cheese* is produced in the Livno area in the south-western Bosnia and its production is spread to areas of Glamoč and Duvno (Kirin et al., 2003; Bijeljac and Sarić, 2005). It can be truly regarded as a traditional cheese of Bosnia and Herzegovina, because it has been producing for 125 years in this area. The beginnings of its production goes far into the 1886th (Franjić, 1983; Mandžeralo, 1999; Kirin et al., 2003; Marijan, 2005) i.e. 1888th year (Filjak and Baković, 1974; Kutle, 1996; Sarić, 2002; Bijeljac and Sarić, 2005; Sarić et al., 2008). It belongs to a group of hard cheeses. Initially, it had been produced from ewe milk, and later from a mixture of ewe and cow milk in different proportions, which was stabilized. So, it is still traditionally produced by this way (Zdanovski, 1947; Filjak and Baković, 1974). Nowadays, *Livno cheese* is also manufactured in industry, from pasteurized cow milk, with the addition of lactic acid bacteria but there is still a traditional production on small farms, from raw, unpasteurized mixed ewe and cow milk, without addition of starter cultures. During the period when there is no ewe milk (September-April) cheese is produced from cow milk. In the period when the milk mixture is applied for cheese production the ratio is different and depends on the period and the available amount of ewe milk (Sarić et al., 2010).

Technology of *Livno cheese* was studied by many authors (Zdanovski, 1947, 1956, 1967; Filjak and Dozet, 1953; Filjak and Baković, 1974; Dozet et al., 1974a, 1974b, 1975, 1976, 1981, 1996; Franjić, 1983; Kutle, 1996; Kirin et al., 2003; Sarić, 2002; Bijeljac and Sarić, 2005). The milk from the morning and evening milking is usually coagulated in the morning, and only sporadically cheese is produced both in the morning and evening. Renneting time varies and it takes from 25 to 75 minutes to coagulate milk while the renneting temperature is 32-33°C. The curd is cut into the size of corn or wheat grains. Then, scalding and drying of grains takes place. The temperature is slowly raised to 46-48°C during 30 to 40 minutes with constant stirring. Pressing takes about 24 hours, and salting is carried out in brine salt concentration 25% within 2-3 days. Ripening lasts for 60 days at temperature 12-15°C with relative

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humidity 80-90%. *Livno cheese* of good quality "should have on a cut surface evenly distributed holes, medium sized, yellowish or yellow body, smoothy, healthy and yellowish crust with a pleasant odour and full, or fuller, well-pronounced taste both of them characteristic and specific for sheep cheeses" (Dozet et al., 1974a; Dozet et al., 1996; Kirin et al., 2003; Bijeljac and Sarić, 2005). Filjak and Baković (1974) stated that the *Livno cheese* is of cylindrical shape, with height slightly less than the diameter of a roll, which is about 10.0 cm. The weight of cheese is between 2.0 and 2.5 kg. According to literature (Filjak and Dozet, 1953; Maldburg-Mair, 1974; Dozet et al., 1996; Kutle, 1996) these figures vary considerably. The yield varies within wide limits, from 10.00 to 28.00 kg of cheese form 100 liters of milk (Balić, 1933; Filipović, 1938; Filjak and Dozet, 1953; Zdanovski, 1956; Dozet et al., 1974a; Franjić, 1983). Chemical composition of ripened *Livno cheese* is as follows (in%): dry matter content 60.67-68.53, fat content 27.30-34.88, fat on dry basis, 44.90-52.35; moisture on fat.free basis, 48.04-56.44, protein content 25.80-27.49 and salt content 1.72-2.40 (Baković, 1963; Dozet et al., 1996; Kutle, 1996; Kirin et al., 2003). pH of mature *Livno cheese* varies from 4.91 to 5.43 (Kutle, 1996; Kirin et al., 2003). Sensory score of *Livno cheese* by layers evaluation and expert panel showed highly variable characteristics of traditional cheese Livno (Sarić et al., 2010).

Based on the above, it can be seen that, despite numerous investigations, data on production and characteristics of traditional *Livno cheese* are quite old and variable. The aim of this study was to investigate the technology, as well as physical and chemical characteristics of mature traditional *Livno cheese* and to determine the discrepancies between different cheese manufacturers.

## MATERIAL AND METHODS

Examination of the traditional *Livno cheese* technology was done in a small family dairy in the area of Livno. Three consecutive days during the season of cheese production from mixed cow and ewe milk were monitored. These comprised the following: identification of raw material i.e. type and quantity of milk; measurement of cheese milk density (lactodensimeter); measuring of cheese milk titrable acidity (°SH); measurement of pH and temperature of cheese milk (°C); measurement of pH and temperature of the curd after cutting; measurement of pH and temperature of the curd after pouring into molds; determination of acidity, pH and temperature of whey; measurement of pH and temperature of the cheese before pressing and after pressing. The pH-meter Mettler Toledo - FiveGo™ is used for measuring the pH value and temperature measurement is performed by cheese thermometer.

In order to study the characteristics of ripen *Livno cheese* three samples aged 60 days of 4 manufacturers (including previous) were taken, in total 12 samples of cheese. Dimensions of cheese were measured - height, circumference and diameter of the cheese and expressed in cm. The cheeses were tested for: dry matter content by drying at  $105 \pm 2$  °C (Heraeus, IDF Standard 1982), the fat content by Van Gulik-Gerber method (IDF Standard, 1997). Fat on dry basis (FDB) and moisture on fat-free basis (MFFB) were obtained by calculation (Bylund, 1995; Spreer, 1995). Measurement of pH was done using a Metrohm 632 pH meter and electrode Sentix stitch sp (A044010037). As a final pH value was taken mean of three measurements in a wheel of cheese. Statistical analysis included calculation of mean values and standard deviation. Differences between manufacturers were tested by ANOVA, Tukey test and Principal component analysis (SAS system). All producers were coded with letters from A to D.

## RESULTS AND DISCUSSION

From Table 1 is evident that in this family cheesemaking cheese is made of mixed evening and morning cow and ewe milk. Acidity of bulk milk was fairly uniform (8.8 and 9.0 °SH), and evening milk temperature was above 10°C due to a rather poor cooling conditions during the night. As it was a month of June, the share of ewe milk was quite high, almost 2/3 of the total quantity of milk for cheese production (from 62.58 to 63.72%). Having in the mind that the three consecutive days were observed, the low variation was quite expected. It can be seen in Table 2 that the pH value of cheese falls during pressing (about 24 hours) from the values 6.17-6.32 to values 5.00-5.10 caused by activity of lactic acid bacteria.

**Table 1. Physical and chemical analyses of milk for Livno cheese production**

<i>Evening milk</i>	<i>Ewe milk</i>			<i>Cow milk</i>		
<i>Day</i>	1.	2.	3.	1.	2.	3.
Density (kg/cm <sup>3</sup> )	1.035	1.032	1.031	1.026	1.022	1.027
Temperature (°C)	15.3	14.9	17.5	12.9	9.3	15.3
Acidity (°SH)	9.0	9.0	9.0	8.2	8.2	8.2
pH value	6.75	6.76	6.45	6.72	6.71	6.41
Milk quantity (L)	26.80	29.00	27.50	16.00	16.00	16.00
<i>Morning milk</i>	<i>Ewe milk</i>			<i>Cow milk</i>		
Density (kg/cm <sup>3</sup> )	1.034	1.036	1.033	1.026	1.026	1.029
Temperature (°C)	19.8	22.7	21.0	22.7	23.1	21.4
Acidity (°SH)	9.6	9.0	9.2	8.0	8.0	8.0
pH value	6.70	6.65	6.44	6.62	6.60	6.40
Milk quantity (L)	21.80	20.00	21.00	12.00	11.90	13.00
<i>Cheese milk</i>						
<i>Day</i>	1.		2.		3.	
Density (kg/cm <sup>3</sup> )	1.033		1.031		1.027	
Temperature (°C)	17.0		22.7		18.9	
Acidity (°SH)	8.8		8.8		9.0	
pH value	6.64		6.64		6.46	
Milk quantity (L)	76.60		76.90		77.50	

As shown in Table 3 different manufacturers have an impact on the diameter of the cheese and the manufacturer C differs significantly from manufacturers A and B. This is probably caused by the use of somewhat different dimensions of the mold. On the other hand, there is no statistically significant difference in height of cheese among manufacturers, which indicates that they fill molds with curd to about the same height.

**Table 2. Parameters of traditional technology Livno cheese**

<i>Curd</i>	<i>After cutting</i>			<i>After scalding</i>		
<i>Day</i>	1.	2.	3.	1.	2.	3.
pH value	6.56	6.30	6.33	6.52	6.25	6.19
Temperature (°C)	27.9	30.4	29.2	30.2	36.0	39.5
<i>Whey</i>						
Density (kg/cm <sup>3</sup> )	-	1.023	1.029	-		
Temperature (°C)	30.8	35.0	33.5			
Acidity (°SH)	5.6	5.6	6.4			
pH value	6.51	6.20	6.24			
<i>Cheese</i>	<i>After draining</i>			<i>After pressing</i>		
pH value	6.32	6.21	6.17	5.00	5.10	5.07
Temperature (°C)	33.3	35.1	35.9	20.2	21.0	18.6



**Table 3. Influence of different producers on circumference, height and diameter of *Livno* cheese**

Producer	Circumference (cm)	Height (cm)	Diameter (cm)
A	64.47 <sup>a</sup> ± 0.32	8.27 <sup>a</sup> ± 0.32	19.17 <sup>a</sup> ± 0.03
B	63.43 <sup>a</sup> ± 0.97	7.43 <sup>a</sup> ± 0.52	19.53 <sup>a</sup> ± 0.03
C	59.73 <sup>a</sup> ± 2.18	8.50 <sup>a</sup> ± 0.66	17.93 <sup>b</sup> ± 0.34
D	60.83 <sup>a</sup> ± 0.17	8.00 <sup>a</sup> ± 0.27	18.60 <sup>ab</sup> ± 0.21
Mean	62.12	8.05	18.81

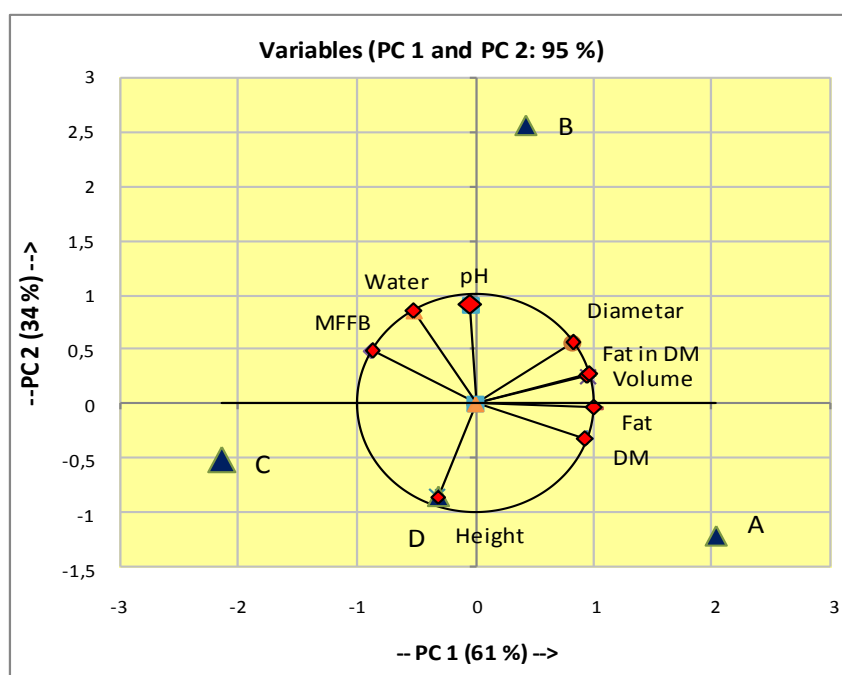
<sup>a,b</sup>Means within the same column and not sharing the same superscript letter are significantly different (\*P<0.05)

**Table 4. Influence of different producers on chemical composition and physical properties of *Livno* cheese**

Producer	Dry matter (g/100g)	Fat (g/100g)	FDM (%)	pH	MFFB (%)
A	65.80 <sup>a</sup> ± 0.80	37.50 <sup>a</sup> ± 0.50	57.00 <sup>a</sup> ± 1.09	5.35 <sup>a</sup> ± 0.05	52.60 <sup>a</sup> ± 2.11
B	61.90 <sup>ab</sup> ± 0.42	34.67 <sup>a</sup> ± 1.30	56.00 <sup>a</sup> ± 1.86	5.49 <sup>b</sup> ± 0.05	58.34 <sup>a</sup> ± 0.84
C	59.30 <sup>b</sup> ± 0.68	30.50 <sup>a</sup> ± 2.47	51.36 <sup>a</sup> ± 3.58	5.40 <sup>ab</sup> ± 0.005	56.35 <sup>a</sup> ± 0.005
D	63.29 <sup>ab</sup> ± 2.24	33.67 <sup>a</sup> ± 2.13	53.11 <sup>a</sup> ± 1.91	5.31 <sup>a</sup> ± 0.01	55.25 <sup>a</sup> ± 1.97
Mean	62.67	34.09	54.37	5.38	55.64

<sup>a,b</sup>Means within the same column and not sharing the same superscript letter are significantly different (\*P<0.05)

It was found that different manufacturers had an impact on the dry matter content and pH of cheese (Table 4). According to the content of dry matter cheese of manufacturer C is different from a cheese of manufacturer A while the pH of cheese manufacturers B differs from the pH of cheese producers A and D.



**Figure 1. Principal component plot (PC1 versus PC2) of four group cheese samples (A,B,C and D), showing correlations with physical and chemical properties of cheese samples**

**Principal component analysis (PCA-Fig. 1) was applied to the data to identify the most important factors of variability and also to describe the relationship between variables (physical and chemical properties of cheese) and observations (cheese producers). The first two principal components (PC1 and PC2) accounted for 95 % of the variation in the data. PC1 and PC2 displayed 61% and 34% variance, respectively. The distance between the locations of any cheese samples on the plot is directly proportional to the degree of differences or similarity between them. Cheese samples A and C located on the opposite side of PC1, and moisture and MFFB were to be the major responsible for the difference of this two cheese samples. Samples A was characterized by the highest value of dry matter (DM) fat, volume, diameter and fat in dry matter. Opposite of A samples C showed higher value of MFFB and water. The pH value is located on the positive and height of cheese on negative side of PC2. Those two variables were the main factor of distinguishing cheese B and D. Cheese from producer D was dominantly determinate by height and exhibited the lowest pH value, while cheese from producer B, showed the highest pH value and lowest height.**

## CONCLUSIONS

**Technology, physical characteristics and chemical composition of traditional *Livno* cheeses were examined. It was established that quality characteristics of cheese varied depending on producer. Significant influence of different cheese producers on diameter, pH and dry matter content of *Livno* cheese was established. The results obtained in this study point to the need for improving the conditions for milk processing by the traditional manufacturers. It is also necessary to standardize the technology in order to obtain *Livno* cheese with uniform quality.**

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# EWES' FEEDING, DIET STRUCTURE AND METABOLIC BLOOD PROFILE

## AN INVESTIGATION ON THE METABOLIC BLOOD PROFILE OF EWES

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### ABSTRACT

Indicators of blood homeostatic data were carried out study in the Animal Husbandry Department of Agriculture Technology Transfer Centre, Korça, (former Small Ruminant Station of Korça). The ewes were divided into four groups that were approximately balanced for live weight, physiological status and year of lactation.

The analysis of blood indicators showed that proteins and glucose were in the normal values and were not verified changes ( $P > 0.05$ ) compare with normal ones, but urea and mineral indicators showed statistically proven changes ( $P < 0.05$ ).

The indicators' comparison between groups was pointed out to a rough picture. Glycaemia, total proteins, protein fractions were verified no statistically changes ( $P > 0.05$ ) and urea, total calcium and magnesium were statistically verified changes ( $P < 0.05$ ). This was as the result and reflected the effect of the structures of feedstuff used in their nutrition and physiological state of the ewes. Finally, we conclude that metabolic indicators reflect the level of providing raw feed rations used.

**Key words:** Ewe, diet, blood, profile, metabolism.

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### INTRODUCTION

Metabolic blood indicators reflect the intensity of metabolic pathways (Aliko, 1978; Khaeld, 1999). They depend on the structure of the food portion through a combination of metabolic pathways provides storage of homodynamic of blood and tissues (Mane, 2005). Important role play on rumen activity the micro flora, which significantly affects all metabolic levels (Gelee, 1995). This phenomenon is apparent in the transformation of the carbohydrates' resources to volatile fatty acids, improving the balance between essential amino acids and absorbed in the intestine (P McDonald, 1995; Beyer, 1987).

Metabolic indicators reflect the interaction of dietary structures, activity of rumen micro flora and metabolic processes that occur in body cells (Aliko H., 1978). The organism of animals which owns the hormonal mechanisms in the context of metabolic interrelationships preserve the dynamic concentration of various metabolites in the blood, (Mane, 2005). This is closely related to the level of the ingredients taken through food in quantity and the relations between the constituent components (Harmeyer, 1995, Gelee, 1995). At the rumen' animals it is important how this composition of foods ensures the normal activity of rumen micro flora (Oskov, 1987). Due to the internal mechanisms of regulation is internal mobilization of body reserves. However changes in the level of indicators observed (Beyer, 1987).

Thus, serum increased level of the urea occurs for two basic reasons: taking food through a large quantity of proteins and the introduction of protein catabolic ways of the body because of the energy deficiency (Opsomer, 1995). The introduction in the diet of the urea is a growth factor of the blood urea because of its transformation from rumen micro flora, (Khaled, 1990).

Our study aims to verify when the different used dietary structures provided by food rations preserve the homeostatic data as a condition of optimal production and economic reproduction.

### MATERIALS AND METHOD

This study was carried out at the Department of Livestock of ATTC Korça, Albania (Former Small Ruminants Station of Korça, Albania) with merinos sheep breed. The study was performed in 4 groups

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with 17 head of ewes each one. Groups were analogue of live weight and condition during lactation and physiological status. Besides rations of first, third and fourth groups urea was used as a supplementary non protein nitrogen (NPN). In the first period of lactation it was used at 20 g per head per day, in the second period until the end of the regime, 16 g per head per day. Chemical compositions of the feeds used in this study are given below (Table 1).

**Table 1 Chemical Composition of the Ration**

Groups	Feeding Level (U.F.)& gr/head/day							
	First Phase of Lactation				Second Phase of Lactation			
	U.F	DigestiblePro teins (g)	Ca g	P g	U.F	Digestible Proteins (g)	Ca g	P g
1	1.801	194	17.32	4.42	1.456	156	13.93	3.56
2	1.780	194	31.90	6.44	1.421	158	26.0	5.24
3	1.840	187	12.39	2.74	1.50	149	13.9	3.50
4	1.820	188	23.66	4.51	1.456	150	19.5	3.71

Selected metabolic indicators were intended to determine the state of energy metabolism (glycaemia), the state of protein metabolism (total proteins and their fractions in blood serum, serum urea), the state of mineral metabolism (total calcium, inorganic phosphorus and magnesium in serum). Analytical determination was carried out in laboratory indicators of Physiology, Faculty of Veterinary Medicine of Tirana Agriculture University. The data were processed statistically by determining the average, standard deviation, the average error and the authenticity of change between groups, Student's t-distribution (KUME, 2007).

## RESULTS AND DISCUSSION

Details of blood indicators are presented in the following tables.

**Table 2 The Blood Indicators of the Study Compare with Normal Average Values (First Phase of Lactation)**

Indicators	Norma	Gorup I	Group II	Group III	Group IV	1:2	1:3	1:4	1:5
Glucose (mg%)	68.4±4.6	71.8±14	75.4±6.5	66.2±7.4	74.2±9	0.6	0.9	0.7	0.8
Total Proteins(g%)	7.2±0.52	6.3±0.2	6,3±0.19	6.12±0.16	6.22±0.12	1.7	1.7	1.6	1.6
Albumins (g%)	2.7±0.2	2,3±0.18	2.3±0.18	2.22±0.1	2.4±0.18	1.5	1.3	1.3	1.6
Globulins (g%)	4.4±1.7	3.8±0.17	4±0.27	3.9±0.2	3.8±0.14	0.35	0.4	0.33	0.34
Urea (mg%)	15±2.0	22.6±1.7	19.4±1.1	28.7±2.3	25.6±1.6	2.89a	2.91a	4.5c	4.14c
Phosf.in(mg%)	6.4±0.2	4.96±0.6	4.62±0.14	4.6±0.54	4.06±0.4	2.29	7.4c	5.4c	5.32c
Total Ca(mg%)	12.6±0.3	6.4±0.45	10.7±0.7	7.84±0.57	7.45±0.7	2.5a	2.2a	11.5c	10.7c
Magnesium(mg%)	2.5±0.3	5.23±0.2	3.18±0.25	4.36±0.26	4.47±0.4	7.58c	0.86	2.3a	3.94a
A/G ratio	0.59	0.6	0.58	0.57	0.63				

There is no statistically determined average changes between normal and those measured in the study groups, such as level of blood serum glucose, total serum proteins, but serum level of the urea has statistically significant differences ( $P < 0.05$ ). Mineral indicators are variations between the average normal values and values derived from our study. The level of inorganic phosphorus and total calcium have lower average values in the experiment groups compare with average of normal values. These changes are statistically significant ( $P < 0.05$  and  $P < 0.01$ ). Compared with average values of blood indicators drawn from studying limits fluctuation (Kaneko, 1997) showed the concentration of glucose in

the blood in our survey data tends towards maximum values. Ours vary from 58 mg% and maximum limits to 84 mg%. Total proteins in normal values vary from 6-7.9 g% (Kaneko, 1997) and our study data are 6.22-6, 54 g% limits. Blood serum albumin by Kaneko (1997), vary from 2.4 to 3 g%. Our data also vary within these parameters. Assessment is the same as for the level of globulins in blood serum (Tables 2 and 3). Synthetic data for the report Albumin / Globulin in all groups of the experiment is within the normal average values. These data reinforce the view expressed above that protein ratios have not significant statistically changes with normal values.

*Table 3 The Metabolic Indicators between Groups (the First Period of Lactation)*

Indicators	Group I	Group II	Group III	Group IV	tD 1:2	tD 1:3	tD 1:4	tD 2:3	tD 2:4	tD 3:4
Glucose (mg%)	71.8±14	75.4±6.5	66.2±7.4	74.2±9	0.23	0.35	0.19	0.93	0.11	0.87
Total Prot.(g%)	6.38±0.16	6.3±0.19	6.12±0.16	6.2±0.12	0.32	1.1	0.68	0.7	0.31	0.23
Albumins (g%)	2,3±0.18	2.3±0.18	2.22±0.1	2.4±0.18	0.0	0.1	0.15	0.1	0.15	0.2
Globulins (g%)	3.8±0.17	4±0.27	3.9±0.2	3.8±0.14	0.7	0.05	0.04	0.2	0.25	0.1
Urea (mg%)	22.6±1.7	19.4±1.1	28.7±2.3	25.6±1.6	5.49c	2.69a	1.1	3.67b	3.12b	1.1
P.in. (mg%)	4.96±0.6	4.62±0.14	4.6±0.54	4.06±0.4	0.48	9.21c	0.22	0.3	1.4	1.1
TotalCa (mg%)	6.4±0.45	10.7±0.7	7.84±0.57	7.45±0.7	5.15	1.93	1.21	3.47b	3.13b	0.43
Mg (mg%)	5.23±0.2	3.18±0.25	4.36±0.26	4.47±0.4	5.8b	2.41a	1.73	3.27b	2.94b	0.25

Analysis of metabolic indicators of all the groups fed with different food rations showed that glucose level, total protein content and their fractions have no statistically significant differences ( $P>0.05$ ). It means that the needs are met by food energy and protein. There are differences between groups in our research concerned the level of the urea in the blood serum. The first group urea level is higher than the second and lower than the third and fourth. There are statistically significant differences ( $P<0.05$ ). The differences between the first and fourth and third and fourth groups are not statistically significant ( $P>0.05$ ). While the difference between the second groups with third and fourth have statistically significant changes ( $P<0.01$ ). These data showed that blood ratios generally reflect the level of indicators in the diet.

*Table 4: Performance of Blood Indicators (the Second Period of the Lactation)*

Indicators	Group I	Group II	Group III	Group IV	tD 1:2	tD 1:3	tD 1:4	tD 2:3	tD 2:4	tD 3:4
Glukose (mg%)	60.8±6.4	62.6±3.1	58.6±2.8	72.6±4.2	0.2	0.31	1.54	1.7	0.7	2.77
Total P (g%)	5.92±0.2	6.12±0.2	5.5±0.15	5.6±0.3	0.8	1.88	1.03	2.6	2.6	0.24
Albumins (g%)	2.35±0.5	2.33±0.5	2.25±0.9	2.5±0.3	0.3	0.1	0.29	0.08	0.08	0.29
Globulins (g%)	3.57±0.5	3.79±0.3	3.23±0.3	3.1±0.4	0.4	0.51	0.79	1.0	1.0	0.28
Urea (mg%)	32.5±1.7	40.8±0.7	32.9±2.6	32.3±1.3	4.5	0.15	0.09	2.9	2.9	0.2
P.in. (mg%)	5.07±0.7	4.87±0.5	4.66±0.2	4.72±0.3	0.2	0.58	0.46	0.43	0.43	0.16
Total Ca (mg%)	9.02±0.6	9.64±0.6	8.19±1.1	9.4±0.6	0.8	0.68	0.47	1.19	1.19	0.98
Magnesium (mg%)	3.53±0.1	3.18±0.2	3.7±0.19	3.5±0.1	1.6	0.74	0.4	1.88	1.88	1.05

Blood serum indicators in the second phase reflected changes in the relation to the first phase but they remain within normal values (Table 4). This rule represents the level of the urea in the blood serum. In the normal value, it is within the limits of 8-20 mg% and in the survey data, they move from 32.5-40.8 mg%. Because the glucose level is within the limits of normal values, there is no reason to testify metabolic energy weaknesses in the body. In mineral metabolism is observed a moderate reduction in the level of total serum calcium. It is fluctuated within the limits 8.19-9.64 mg% in the experiment groups compare with the lowest level of 11.5 mg% in the normal case. This overall decrease of calcium has led to the birth moment as a result of easy phosphorous serum level. Dietary used structure does not justify the decrease of the total level of calcium in serum. May be it is because of the antagonism between calcium and inorganic phosphorus. This condition is demonstrated in the four groups of our study. This is evidenced by the fact that the levels of the metabolic indicators in our research have not showed significant statistically differences ( $P>0.05$ ).

**Table 5 Performance of blood indicators (the third period of the experiment)**

Indicators	Group I	Group II	Group III	Group IV	tD 1:2	tD 1:3	tD 1:4	tD 2:3	tD 2:4	tD 3:4
Glukose (mg%)	66.6±3.2	69.8±2.4	74.4±2.7	67.2±1.8	0.8	1.9	0.2	1.3	0.9	2.2
Total P (g%)	6.16±0.2	6.2± 0.14	5.32±0.2	5.64±0.2	0	2.8a	1.8	3.1b	2	1
Albumins (g%)	2.56±0.2	2.82±0.2	2.59±0.2	2.55±0.1	0.49	0.06	0.04	0.43	0.41	0.18
Globulins(g%)	3.16±0.2	3.34±0.2	2.73±0.2	3.09±0.2	0.34	0.7	0.13	1.1	0.47	0.68
Urea (mg%)	34.7±1.6	28.2±2.2	30.1±1.3	33.4±2.1	2.4a	2.2a	0.5	0.7	1.7	1.3
P.in.(mg%)	3±0.14	3.34±0.4	3.13±0.2	3.15±0.3	0.3	0.4	0.4	0.2	0.2	0.1
Total Ca(mg%)	8.98±0.3	10.2±0.5	8.89±0.2	9.68±0.5	2.3a	0.3	1.3	2.7a	0.8	1.5
Magnesium (mg%)	3.18±0.1	2.79±0.2	3.29±0.1	2.71±0.1	1.6	0.2	3.6b	2.2a	0.4	4.7
A/G Ratio	0.81	0.84	0.97	0.82						

Data of the Tables 4 and 5 showed that limits fluctuations are normal in terms of glucose, proteins and albumins blood serum levels and other indicators are below the limits of normal values. Thus, 2.55 to 3.34 g% are limits of globulins reach in the experiment groups when normal average level is 3.5 g%. Serum level of the urea is higher. It varies in 28.2-34.7 mg% and normal values ranging from 8-20 mg%. Albumins: Globulins ratio undergoing significant increase, but is within the limits of normal values. Deviations represent the minimum values of the three main mineral indicators included in the study. These data indicate that the dietary feeding structure of 4 groups have mineral deficiencies and have impact in protein metabolism, which appears with an increased dissimilation of amino acids and a moderate serum globulins. Comparative evaluation of indicators from within the groups is clear that protein ratios with glucose express no statistically significant changes. Urea in the serum level has been increased in all groups and this has led that differences between them are less significant.

## CONCLUSION

1. Metabolic indicators included in the study clearly show the effects of food ration structures used.
2. Total proteins, albumins, globulins and albumin ratio/Globulin are more stable and show a normal protein metabolism.
3. Urea is the variable indicator. Its level cannot clearly present the effect of ration structures.
4. Dynamic of glucose serum level represents a normal energy metabolism in the body.
5. Fluctuation of calcium and phosphorus serum level is result of the influence of many factors.

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# A RESEARCH ON STRUCTURAL CHARACTERISTICS OF DAIRY FARMS IN ÖDEMiŞ DISTRICT OF IZMIR PROVINCE

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## ABSTRACT

The objective of this study was to determine the structural characteristics of dairy farms in the Ödemiş district of İzmir. The dairy farmers are members of İzmir Cattle Breeders' Association. A total of 92 farms were selected by proportional sampling. Farms were divided initially into three groups (5 to 20, 21 to 40 and over 41 heads) based on the number of cows they own. The average age of farmers was 46.4 years, their average education level was 6.5 years, and their average dairy experience was 17 years. The mean number of animals was 29.7, 68.0 and 123.6 heads for group 1, 2 and 3, respectively. The mean land asset value of farm groups was 4.64, 7.97 and 10.91 hectares, respectively. Almost all of the farms (97.8%) provided their subsistence with agricultural activities. About 23.9% of the farms had a cooling tank for milk. The mean milk sale price was 0.501, 0.541 and 0.568 TL/kg for group 1, 2 and 3, respectively. Consequently, as farms get larger, the level of consciousness of farmers and the profitability of farms increases.

**Key Words:** Dairy farms, structural characteristics, Ödemiş, Turkey

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## INTRODUCTION

In Turkey, cattle products have a big share in the animal food production of the country (Akman et al., 2010). Not only the genetic capacity of animals, but also environmental conditions, play a significant role in increasing the quantity and quality of livestock products. In order to improve environmental conditions, it is necessary to investigate the current environmental conditions, farm and herd management techniques and solutions for potential problems. Therefore, initially the structural characteristics of dairy farms should be investigated. There are some local studies carried out in Turkey to determine such characteristics (Tapkı, 1996; Tugay and Bakır 2009).

This study was conducted to determine the structural characteristics of dairy farms in the Ödemiş district of İzmir. The province of İzmir and in particular the Ödemiş district is an important centre for dairy cattle breeding and dairy cattle production.

## MATERIAL AND METHODS

The data were obtained through surveys completed by 92 Holstein cattle farmers selected through the proportional sampling method (Newbold, 1995) among 2778 dairy farmers in Ödemiş. The dairy farmers are members of the İzmir Cattle Breeders' Association. The study was carried out between July and October 2008. Farms were divided into three groups based on the number cows of each farm. The farms were classified as; 1st group: 5 to 20 cows (55 producers), 2nd group: 21 to 40 cows (29 producers) and 3rd group: 41 and more cows (8 producers). The presence of cattle owned by farmers converted large animal unit (LAU) with the help of a coefficient used by Erkuş et al., 1995. The data were analyzed by chi-square test and continuous variables through variance analysis. To analyze data such as amount of land, milk yield, feed consumption and reproductive characteristics, the following linear model was used:  $Y_{ij} = \mu + a_i + e_{ij}$  Where;  $Y_{ij}$  = traits (milk yield, feed consumption, etc.),  $a_i$  = farm groups ( $i = 1, 2, 3$ ),  $e_{ij}$  = random error. SPSS (1999) statistical software was used for statistical analysis and the Duncan test was used to compare the means.

## RESULTS AND DISCUSSION

The farmers' personal characteristics are given in Table 1. In group 3 (farmers who owned more than 40 cows), age and experience of farmers are lower but number of family members are higher than groups

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1 and 2. Interestingly, the education level of farmers in 3rd group was lower than that of group 2. In a study conducted in Izmir, Saner (1993) observed younger ages but lower experience and education levels for large dairy facilities. On the other hand, Koyubenbe (2005) reported similar ages for Ödemiş farmers but lower education levels (5.4 years) than in current study.

Table 1. Dairy farmers personal characteristics

Traits	Farm groups			
	Group 1	Group 2	Group 3	Average
	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$
Age of farmers (year)	47.0 ± 1.57	47.1 ± 2.03	40.0 ± 3.92	46.4 ± 1.19
Level of education (year)	6.07 ± 0.32	7.7 ± 0.50	6.88 ± 0.79	6.46 ± 0.26
Dairy experience (year)	16.51 ± 1.33	19.31 ± 2.15	12.00 ± 2.95	17.00 ± 1.09
Number of family member	4.07 ± 0.18	4.14 ± 0.16	4.63 ± 0.46	4.14 ± 0.13

The farms, housing and herd management characteristics are given in Table 2. In group 2, specialization of dairy farming, keeping milk yield records and feed crop production planning were at a higher rate than the group 1 and 3. In group 3, satisfaction from dairy farming, health and fertility and input-output record keeping, milking system and milk cooling tanks were at a higher rate than the others. In addition, the presence of ideal barn system and maternity pens in group 3 were at a higher rate than the others. All these characteristics were at a low rate in group 1. Contrary to expectations, feed crop production planning and milk yield record keeping in group 3 were at a low rate; however, in group 2, feeding and artificial insemination practices were at a higher rate than the other groups. Record keeping and feed production planning are critical issues for a profitable livestock production.

The degree of specialization of farms with regard to animal and plant production may be influenced by factors such as regional differences, climate, land size, and profitability, etc. On the other hand, in dairy cattle farms, producing one's own forage are a significant factor for economic production. Tapkı (1996) reported that plant and animal production constituted almost 90 % of the total production of the Hatay province. Previous research has indicated high satisfaction levels for cattle breeders (Tugay and Bakır, 2009). The high satisfaction levels of Tekirdağ and Uşak farmers and their desires to increase their number of cattle has also been mentioned by Köse (2006) and Soyak et al. (2007).

In the farms investigated, record keeping was a significant problem. The members of the Turkish Dairy Cattle Breeders' Association are required to keep such records. High record keeping rates (92.1%) was reported (Kaygısız and Tümer, 2007) but overall rates are still low. Quality of milking and cooling equipments was seen to increase the larger the herd size. Every single farmer in group 3 was reported to own a cooling tank.

Barn style is also a significant factor for the dairy facilities of the region due to climate conditions. Particularly in the western provinces, weather is hot in summer and moderate in autumn and winter, therefore, partially close and three- or four-sided open barns are more common (Bardakçioğlu et al., 2004). Fully closed barns are especially preferred in Central Anatolia because of severe winter conditions (Oluğ, 1996; Köse, 2006; Tatar, 2007).

In this study, 93.5% of farmers used intermittent milking for the transition to the dry period (Table 2), although abrupt transitions are an easier method for farmers (Akman, 2003). Intermittent milking may extend the transition period and may cause stress (Oğan et al., 2011).

In modern farms, artificial insemination is usually recommended. In this study, over 75% of all groups used artificial insemination. However, the rate of use for this method is still low for large dairy farms (group 3). Koyubenbe (2005) reported decreasing insemination rates with increasing of herd sizes. However, the fact that artificial insemination support exists in Turkey lead us to expect that such high rates would exist. In this study, an increasing rate of maternity pens was observed with larger herd sizes. Bardakçioğlu et al. (2004) reported the rate of presence for maternity pen for dairy facilities of Aydın as being 45.5%.

Table 2. Farms, barns and herd management traits

Traits	Farm groups								
	Group 1		Group 2		Group 3		Total		
	n	%	n	%	n	%	n	%	
Specialization of farms*	Dairy farming	27	49.1	25	86.2	6	75.0	58	63.0
	Dairy farming and plant production	26	47.3	4	13.8	2	25.0	32	34.8
	Dairy farming and other	2	3.6	0	0.0	0	0.0	2	2.2
Satisfaction <sup>NS</sup>	Pleasure	20	36.4	12	44.1	6	75.0	38	41.3
	Not pleasure	35	63.6	17	58.6	2	25.0	54	58.7
Desire of herd enlargement <sup>NS</sup>	Yes	40	72.7	22	75.9	6	75.0	68	73.9
	No	15	27.3	7	24.1	2	25.0	24	26.1
Health records keeping <sup>NS</sup>	Yes	28	50.9	19	65.5	7	87.5	54	58.7
	No	27	49.1	10	34.5	1	12.5	38	41.3
Fertility records keeping <sup>NS</sup>	Yes	47	85.5	29	100	8	100	84	91.3
	No	8	14.5	0	0.0	0	0.0	8	8.7
Milk yield records keeping*	Yes	39	70.9	23	79.3	5	62.5	67	72.8
	No	16	29.1	6	20.7	3	37.5	25	27.2
Input and output records*	Yes	11	20.0	15	51.7	5	62.5	31	33.7
	No	44	80.0	14	48.3	3	37.5	61	66.3
Feed crop production planning <sup>NS</sup>	Yes	25	45.5	20	69.0	5	62.5	50	54.3
	No	30	54.5	9	31.0	3	37.5	42	45.7
Milk cooling tank*	Yes	3	5.5	11	37.9	8	100	22	23.9
	No	52	94.5	18	62.1	0	0.0	70	76.1
Milking system*	Portable milking machine	39	70.9	5	17.2	0	0.0	44	47.8
	Milking parlor	1	1.8	10	34.5	3	37.5	14	15.2
	Pipe line	15	27.3	14	48.3	5	62.5	34	37.0
Barn style <sup>NS</sup>	Fully closed	6	10.9	2	6.9	0	0.0	8	8.7
	Semi-closed	9	16.4	5	17.2	0	0.0	14	15.2
	Three or four sides open	40	72.7	22	75.9	8	100	70	76.1
Transition to dry period <sup>NS</sup>	Abruptly	5	9.1	0	0.0	1	12.5	6	6.5
	Intermittent	50	90.9	29	100	7	87.5	86	93.5
Forming feeding groups for milk yield <sup>NS</sup>	No	16	29.1	2	6.9	2	25.0	20	21.7
	Yes	39	70.9	27	93.1	6	75.0	72	78.3
Breeding <sup>NS</sup>	Natural service	1	1.8	0	0.0	0	0.0	1	1.1
	Artificial insemination	46	83.6	25	86.2	6	75.0	77	83.7
	Both	8	14.5	4	13.8	2	25.0	14	15.2
Maternity pen*	Available	14	25.5	16	55.2	5	62.5	35	38.0
	Not available	41	74.5	13	44.8	3	37.5	57	62.0

<sup>NS</sup> Non significant. \*  $P < 0.05$ .

The land assets of farmers are given in Table 3. The total land assets of group 1, 2, and 3 were determined to be 4.64, 7.97 and 10.91 hectares, respectively. The land assets of dairy farmers were reported as being between 6.3-16.97 hectares/farm (Saner, 1993; Fidan, 1996). Land per cow was calculated as being 0.41, 0.28 and 0.23 hectares/cow for group 1, 2 and 3, respectively. For an economic dairy farming, producing its own forage and possessing an irrigable land size of 0.3-0.4 hectares/cow are strictly recommended (Akman, 2003).

Table 3. Land asset of dairy farmers

Land size	Farm groups			
	Group 1	Group 2	Group 3	Average
	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$
Total, ha	4.64±0.425 <sup>a</sup>	7.97±1.022 <sup>b</sup>	10.91±1.988	6.23±0.490
Land/cow, ha	0.41±0.034	0.28±0.037	0.23±0.046	0.35±0.025

<sup>a, b, c</sup> Values with different letters in the same row are significantly different ( $P < 0.05$ ).

The animal numbers and proportional distributions are shown categorized according to the different groups in Table 4. Cows account for 43.3% of livestock, while calves (0 to 6 months of age) account for 24.3%. The lowest share belongs to bullocks (young bulls) (2.8%). In a dairy farm, depending on the

breeding strategy, the proportion of cows should be around 42% (Akman, 2003). In this study, although the mean proportion of cows in the herds is 43.3%, Düzgüneş and Eliçin (1987) reported that cow share in a dairy herd should be 50%.

Table 4. Number of animal groups according to age, sex and physiological condition

Cattle group	Farm groups							
	Group 1		Group 2		Group 3		Average	
	$\bar{X} \pm S_{\bar{x}}$	%	$\bar{X} \pm S_{\bar{x}}$	%	$\bar{X} \pm S_{\bar{x}}$	%	$\bar{X} \pm S_{\bar{x}}$	%
Calves, 0 to 6 months age, head	7.8±0.64	26.1	14.2±1.08	21.5	28.1±4.09	22.3	11.6±0.87	24.3
Female calf, 7 to 12 months, head	2.9±0.42	9.2	6.5±0.76	9.2	10.5±2.69	8.9	4.7±0.48	9.2
Male calf, 7 to 12 months, head	1.7±0.29	4.5	3.5±0.70	4.7	6.8±1.68	5.6	2.7±0.35	4.7
Non-pregnant heifer, head	2.9±0.42	8.5	6.6±0.9	9.6	12.0±3.83	9.2	4.9±0.58	8.9
Pregnant heifer, head	2.0±0.26	6.2	5.4±0.9	7.3	11.1±2.32	9.2	3.9±0.47	6.8
Cow, head	11.7±0.63	43.0	29.2±1.03	44.1	51.3±3.61	42.3	20.7±1.42	43.3
Bullock, head	0.7±0.17	2.4	2.7±1.08	3.6	3.9±2.46	2.6	1.6±0.42	2.8
Herd size, head	29.7±1.93	100.0	68.0±3.08	100.0	123.6±11.12	100.0	49.9±3.47	100.0
Herd size, LAU	19.2±1.17		46.7±2.10		83.3±7.02		33.4±2.36	

The average daily milk yield per cow were 19.6, 20.7 and 22.3 kg ( $P < 0.05$ ) for group 1, 2 and 3, respectively (Table 5). Total milk yield for an average 305-day milking period was calculated to be 5978, 6314 and 6801 kg for group 1, 2 and 3, respectively (not shown in tables). In Ankara and Aksaray, milk yields of 305-day periods for dairy herds were found to be 4937 and 5094 kg, respectively, (Tatar, 2007) and in Aydın, the average daily milk yield was determined to be 25.8 kg (Nizam, 2006).

Average calving interval was found to be 13.1, 13.3 and 13.4 months for groups 1, 2, and 3, respectively. The ideal calving interval should be 12 to 13 months. Prolonged calving intervals are one of the measurements of fertility. Prolonged calving interval reflects fertility problems. In the USA, the average calving interval is 13.2 months (USDA, 2008). This value is very similar to value in the present study but average milk yield (8700 kg/year) in the USA is much higher than that in the present herds.

Table 5. Some technical traits of farms

Traits	Farm groups			
	Group 1	Group 2	Group 3	Average
	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$	$\bar{X} \pm S_{\bar{x}}$
Milk yield per cow (kg/day) <sup>1</sup>	19.6±0.48 <sup>a</sup>	20.7±0.56 <sup>ab</sup>	22.3±1.11 <sup>b</sup>	20.2±.36
Calving interval (month)	13.1±0.08	13.3±0.13	13.4±0.22	13.2±0.07
Milk feeding period, calf, day	77.5±2.1 <sup>a</sup>	63.8±2.75 <sup>b</sup>	66.3±3.9 <sup>b</sup>	72.2±1.68
Milk intake, calf, kg/day	5.3±0.12	5.2±0.15	4.6±0.26	5.2±0.09
Feed consumption of milking cows, kg DM/day	17.7±0.27 <sup>a</sup>	18.2±0.35 <sup>a</sup>	19.9±0.64 <sup>b</sup>	18.1±0.21
Concentrated feed consumption of milking cows, kg DM/day	5.8±1.86 <sup>a</sup>	6.2±2.03 <sup>a</sup>	7.6±1.06 <sup>b</sup>	6.1±1.92
Milk price, TL/kg	0.501±0.004 <sup>a</sup>	0.541±0.006 <sup>b</sup>	0.568±0.005 <sup>c</sup>	0.519±0.004

<sup>a, b, c</sup> Values with different letters in the same row are significantly different ( $P < 0.05$ ).

<sup>1</sup>Milk yield per cow: Declared by farmer for daily average milk yield per cow, kg

The mean milk feeding period of calves were determined to be 77.5, 63.8 and 66.3 days for group 1, 2 and 3, respectively ( $P < 0.05$ ). Daily milk intake per calf was 5.3, 5.2 and 4.6 kg for group 1, 2 and 3, respectively. Nizam (2006) reported that 5.0 kg milk should be given to calves per day during the milk feeding period (71.2 days).

The dry matter intake of dairy cows per day were 17.7, 18.2 and 19.9 kg for group 1, 2 and 3, respectively ( $P < 0.05$ ). The concentrated feed intake of dairy cows on DM basis were 5.8, 6.2 and 7.6 kg for group 1, 2 and 3, respectively ( $P < 0.05$ ). Milk yields and concentrated feed consumption per animal increased the larger the herd size. However, the quality of forage may influence the amount of concentrated feed, and poor quality hay may increase the need for concentrated feed quality and quantity. Akkan (2010) reported that ratio of concentrates to total feed intake could change according to milk yield per day and this ratio for 15-20 kg and 20-25 kg milk yield should be 30 to 40 % and 40 to 50%, respectively. In the present study, this ratio was found to be 32.2, 33.9 and 38.7 % for group 1, 2 and 3, respectively (not shown in tables). The ratio of concentrated feed to total feed intake (on DM basis) was found to be acceptable. The mean milk sale price was 0.501, 0.541 and 0.568 TL/kg for group 1, 2 and 3, respectively. It was seen that as farms get larger, both the level of consciousness among farmers and the individual farm's profitability increase.

Milk prices and feed costs are among the most important problems that dairy farmers in Ödemiş encounter as is the case all around the country. Reproductive and disease problems account for 6.5 and 3.3%, respectively. These problems can lead to dissatisfaction. Reducing problems associated with cow farming in Turkey may increase the satisfaction levels of farmers and such satisfaction can lead to specialization and sustainability.

Table 6. Problems of dairy farmers

Problems	Farm groups							
	Group 1		Group 2		Group 3		Total	
	N	%	n	%	n	%	n	%
Milk price <sup>NS</sup>	28	50.9	17	58.6	5	62.5	50	54.3
Feed cost <sup>NS</sup>	17	30.9	11	37.9	0	0.0	28	30.4
Reproductive problems <sup>NS</sup>	4	7.3	1	3.4	1	12.5	6	6.5
Diseases <sup>NS</sup>	2	3.6	0	0.0	1	12.5	3	3.3
Others <sup>#NS</sup>	4	7.3	0	0.0	1	12.5	5	5.4

<sup>NS</sup> Non significant. <sup>#</sup> Other: High health costs, technical knowledge, milk-feed price ratio.

## CONCLUSION

The satisfaction level of farmers, land asset and milk prices increased with increasing herd sizes. Records keeping in areas such as health and fertility, artificial insemination using, feed production planning rates in large farms were at a higher rate than in small ones. Also, there were some improvements in the large dairy herds (group 3), in areas such as presence of a maternity pen, open barns, milk yield, milk cooling storage tank. Therefore, increasing herd size may also increase the performance of farms. However, increasing of herd sizes is not an easy task. However, small farms with limited economic opportunities may cope with some problems through being a member of some organizations. Such organizations (i.e. Cattle Breeders' Associations) may encourage farmers to keep regular records of their production activities and provide educational activities to improve their performance and sustainability.

## ACKNOWLEDGEMENTS

Authors thank for support to Ege University Scientific Research Projects Unit, EBİLTEM, Izmir Cattle Breeders' Association, and the surveyed dairy cattle breeders.

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# ECONOMIC ANALYSIS OF MANUAL FELLING WITH A CHAIN-SAW IN CASPIAN FORESTS

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## ABSTRACT

Information on the productivity, cost and application of harvesting machines is a key component in the evaluation of forest management plans. This study carried out with the aim of determining the production rates and costs of chainsaw felling in Caspian forest sites. Time and motion studies were conducted to evaluate the impact of terrain characteristics and work methods on Chain-saw productivity. The gross and net production rate was 20.6 m<sup>3</sup> and 26.1 m<sup>3</sup> per hour, respectively. The unit cost considering the gross and net production rate was US\$1.05 and 0.81 per cubic meter, respectively.

**Key Words:** Chain-saw, working efficiency, unit cost, felling, Iran

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## INTRODUCTION

Approximately 1.9 million hectares of forests in Iran are commercial forests called Caspian forests, Hyrcanian or Northern forests (Limaei & Lohmander 2007). The commercial forests have located in the northern part of Iran, between north of the Alborz Mountain and south of Caspian Sea. These forests are uneven-aged structures of varying species such as: beech (*Fagus orientalis*), hornbeam (*Carpinus sp.*), maple (*Acer sp.*), oak (*Quercus sp.*) (Limaei & Lohmander 2007). Information on the productivity, cost and application of harvesting machines is a key component in the evaluation of management plans for the rehabilitation and utilization of Caspian forests (Behjou et al. 2008).

Generally, many factors can affect the productivity of chain-saws. Jones (1983) conducted a time study on a 60-acre tract with three thinning treatments in northern West Virginia. The three treatments were defined as 45%, 60% and 75% of the residual stocking. The harvest comprised of manual felling with a chainsaw. Time studies showed that hourly felling production increased while skidding productivity decreased from the treatments 45%, to 60% and to 75% of residual stocking. Regression equations were later developed based on the above time-study data (Brock et al. 1986), which can be used for estimating production rates and costs for similar thinning operations. Some production/cost studies using manual harvesting systems have been conducted in harvesting planted pine stands in the south. Kluender & Stokes (1994) conducted a time study on a southern pine harvest consisting of manual felling, grapple skidding, and cable skidding. Lortz et al. (1997) conducted further analysis of southern pine felling with chainsaws and produced several equations for estimating felling times and productivity. Wang et al. (2004) developed a productivity model for chain-saw felling, which included variables such as diameter at breast height and the distance among harvested trees. Holmes et al. (2002) conducted a time study on the forests of eastern Amazon, they found that the productivity and cost of manual felling were 20.46 m<sup>3</sup>/h and 0.46 USD, respectively. Nikoie (2007) and Behjou et al. (2009) developed a productivity model for chain-saw felling in Caspian hardwood forests, which included variables such as diameter at breast height and the distance among harvested trees. The objectives of this study were to:

1. Conduct a continuous time study on manual harvesting systems with a chainsaw model Stihl in a Caspian hardwood forest.
2. Estimate the production rates and costs of chainsaw felling.

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## MATERIALS AND METHODS

This study was carried out in compartment 231 in Chafroud forests in the north of Iran. The altitude ranged from 1350 to 1550 m above sea level and the average annual precipitation was 1450 mm. The forest was uneven-aged beech (*Fagus orientalis* Lipsky) with the average growing stock 320 m<sup>3</sup>/ha. The slope of the compartment was 20 to 60% and the aspects of the slopes were northern. The total volume of production was 1900 m<sup>3</sup> and the skidding of production was done from the stump area to the roadside landing by ground-base skidding system. The skidder type used in this study was wheeled skidder Timberjack 450C, with the power of 177 HP and the weight was 10,257 kg (Behjou et al. 2008). Table 1 shows the characteristics of the study area.

Table 1. The characteristics of the study area

Characteristics	Study aspect	Characteristics	Study aspect
Forest district	Chafroud	Number of workers	3
Compartment number	231	Average field slope (%)	30
Altitude (m.a.s.l.)	1412	Silviculture system	Selection cutting
aspect	Northern	Kind of timber	Beech, Alder

Dominant canopy species include *Fagus orientalis*; *Carpinus betulus*; *Acer velutinum*, *Alnus subcordata* and *Ulmus glabra*. Canopy height averages approximately to 26 m. The manual harvesting system examined consisted of felling with a chainsaw. Felling was performed using a Stihl chainsaw with 2.2kW engine and bar length of 80 centimeter. The field study was conducted in March of 2006 on Chafroud forests, north of Iran.

Times and operational variables were measured using a stopwatch and recorded on paper (Ledoux & Huyler 1997, Behjou et al.2008). The work cycle for each operation consisted certain elemental functions and factors. The times for each function and the value of each factor were recorded in the field. Elemental time functions for chainsaw felling were defined as: Walk to tree, Acquire, Undercut, Back cut. Harvesting factors or operational variables for chainsaw felling measured in the field include distance to tree, tree species, diameter at breast height (DBH) and ground slope in felling area and ground slope between two trees. A total of 129 cycles for chainsaw felling was observed in the field. The number of observations varied depending on the amount of time required collecting time study data. Each felled tree was measured for DBH/butt diameter to the nearest centimeter. Local volume equations were used to compute the volume of felled trees (Zobeiri 1994). SPSS 14 was used to analyze the data. The response variables were tested with Duncan Multiple Range Test at 0.05 levels. Regression techniques were also employed to develop models for elemental times, cycle time, and productivity of chainsaw felling. DBH of felled trees ranged from 40 to 273 cm and averaged 87.62 cm. Among harvested trees varied from 0 to 385 m with an average of 35.63 m. In addition to the total felling cycle we must considered delay time. The delay times and the reasons for the delays were also recorded. Three categories of delays were used in the delay analysis as the personal delay, mechanical delay and operational delay, which represent delays associated with the principle operating functions of the system. It was assumed that the skidding time per cycle is a function of the above mentioned variables. The stepwise regression model was applied to develop a model. In this method, if any variable has a significant effect on the RMS (Residual Mean Squares) of the model, it would be used in the model.

## RESULTS AND DISCUSSIONS

Table 2 presents the statistics the operational variables of wheeled skidding in the study area. Table 3 shows the average working time and the share of elemental times of working cycle obtained in the Chafroud logging area with the Chain-saw model Stihl.

Table2. Statistics of operational variables of the Chainsaw felling in the study area

Variable	Mean	Standard deviation	Min.	Max.
<b>Harvest condition</b>				
Diameter	87.62	28.07	40.00	273.00
Slope1	32.86	15.72	0.65	89
Slope 2	25.23	9.68	0	60
Distance among felled trees (m)	35.63	49.36	0	385
<b>Felling cycle time and elemental time (min.)</b>				
Wald to tree	0.49	1.13	0.16	5.16
Acquire	0.06	0.04	0.03	0.27
Under cut	0.94	1.01	0.11	4.62
Back cut	0.73	1.17	0.09	6.57
Delay	0.81	2.18	0.48	68.67
<b>Total felling time</b>	<b>4.57</b>	<b>2.14</b>	<b>0</b>	<b>11.94</b>

Table3. Average time and share of time segments

Elemental times of working cycle	Time	percent
Wald to tree	0.49	16
Acquire	0.06	2
Under cut	0.94	31
Back cut	0.73	24
Felling	0.81	21
Delay	0.18	6
<b>Total felling time</b>	<b>3.85</b>	<b>100</b>
<b>Delays personal</b>	<b>0.22</b>	<b>27</b>
<b>Delays mechanical</b>	<b>0.44</b>	<b>54</b>
<b>Delays operation</b>	<b>0.15</b>	<b>19</b>

The gross and net productivities of Chain-saw for different diameters were 26.1 m<sup>3</sup> and 20.6 m<sup>3</sup> per hour/one person, respectively. Estimates of hourly costs of the chain-saw were computed using the machine rate method (Miyata 1980). The unit costs with and without delay times were 1.05 USD/m<sup>3</sup> and 0.81 USD/m<sup>3</sup>, respectively. On the other hand, the average revenue from selling logs were calculated US\$146 per cubic meter.

The average lost time is 0.81 min. per working cycle lost times (delays) was taken from different places in the working area. The stepwise regression analysis was applied to the time study data base to develop a delay - free cycle time equation. The details of regression model are shown in table4. The significant variables included diameter at breast height (*D*) in centimeter, and distance among harvested trees in meter (*L*). The cycle time equations calculated for the Chain-saw took the following form:

$$t = -2.80 + 0.051D + 0.039L \quad (1)$$

$$R^2 = 84.5 \%$$

Table 4. Details of the regression model

Dependent variable	Independent variable 1	Independent variable 2	Fixed coefficient	R <sup>2</sup>
Time per cycle (minute)	Diameter at breast height (cm)	Distance among harvested trees (meter)	-2.80	84.5%

This multiple correlation coefficient of 0.92 is interpreted as the 84.5 % of total variability, which is explained by the regression equation. The significance level of the ANOVA table (Table 4) shows that the model is significance at  $\alpha = 0.01$ . The SPSS 14 statistical program was applied according to its series of phases in table 5.

Table 5. ANOVA model

Source of Variation	Sum of squares	df	Mean square	F-value	p-value
Regression	841.20	2	420.60	350.64	0.00
Residual	151.14	126	1.20		
<b>Total</b>	<b>992.33</b>	<b>128</b>			



## CONCLUSION

The variables such as distance between harvested trees, diameter at breast height (DBH), slope in stump area, and slope between two harvested trees were entered into the general model for predicting felling time as significant variables, which can be applied in harvesting planning (Kluender & Stokes, 1994). The felling cycle time per tree and felling productivity were mostly affected by DBH of the tree being felled but was also affected by the distance between harvested trees (Behjou et al. 2009). Increasing distance between harvested trees will increase felling time, but if diameter at breast height (DBH) increase the felling time decreases. An average productivity of 26.1 m<sup>3</sup> per productive machine hour (PMH)/one person or 20.6 m<sup>3</sup> per schedule machine hours (SMH)/one person provided a weekly production of 470.58 and 371.1 m<sup>3</sup> with chainsaw felling. Some researchers developed productivity models in your study areas (Wang et al. 2004). Its total hourly cost was 0.81 USD/PMH and 1.05 USD/SMH per cubic meter, respectively. On the other hand, the results indicated that the average revenue from selling logs were calculated US\$146 per cubic meter.

The results in this study can be used to compare the production and cost of other harvesting machines or systems used in the region and will be helpful for the loggers in selecting an appropriate system under certain stand and harvest circumstances. The mean of delay times was 0.81 minute per turn, which was 0.22, 0.44 and 0.15 min per turn for operational, mechanical and personal delays, respectively. Obviously, mechanical delays are the most frequent. After the mechanical delays, operational delays were the most frequent. In order to prevent a decrease in their efficiency and to reduce delay times the maintenance of machinery must be performed according to the technical specification. The results in this study can be used to compare the production and cost of other silvicultural and harvesting systems used in the region and will be helpful for the loggers in selecting an appropriate silvicultural and logging system under certain stand and harvest circumstances.

## Acknowledgement

The authors thank personnel of Shafaroud Company for their field cooperation.

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# AGRICULTURAL MULTIFUNCTIONALITY AND FARMERS' PREFERENCES

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## ABSTRACT

In recent years, changing consumer preferences, as well as social problems resulting with economic crisis, the nutritional need of growing population along with the overuse of chemical fertilizer and pesticide in agricultural production has brought with environmental problems. People, who are having health problems depending on these, changed their point of view for agriculture just like with many other topics. For many years, agriculture which is supposed to be the sole purpose of just producing food and raw material, over the years enlarges the scope of the meaning and substantially falls into real place with a wider meaning.

The agricultural sector plays an important role such as economic, environmental and social senses, is not only the food production, but also well adapted in rural development, employment, food safety, biodiversity and environmental conservation via its multifunctional structure. In this context, it's believed that receiving the consideration of the concept of agricultural sector upon economic, social and environmental elements together with the agricultural multifunctionality by producer part, is critically important.

Accordingly, the aim of the study is examined as considering the matter of agricultural multifunctionality, as well as analysing the standard of attainments, sensitivity and the perception of the producers within this subject by face to face surveys which have been held in the province of Izmir's selected districts of the villages. It was determined that environmental and economic functions of agriculture are more important than other functions. All the functions of agriculture are found remarkably significant by the farmers. However, it is defined that relatively, conservation of agricultural land, improving the food safety and quality and provision of animal welfare, respectively seen very important.

**Key Words:** Agricultural multifunctionality, farmers' preferences, environment

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## INTRODUCTION

People changed their point of view for agriculture by changing consumer preferences and having health problems depending on the nutritional need of growing population along with the overuse of chemical fertilizer and pesticide in agricultural production in recent years.

Agriculture has played a dominant role in the development of rural areas. However, the role of agriculture for the future of rural areas is presently under discussion. Although agriculture remains still today for many rural areas an important economic activity and important factor for the creation of wealth and employment, its dominant role in the rural economy is declining. At the same time, however, there are signs that society formulates some new expectations on the role of agriculture. Besides an economic contribution from food production, society increasingly expects agriculture to contribute to environmental and landscape services, water management and flood control, social care and cohesion and so on (Van Huylenbroeck, et al., 2007).

Agriculture must not only produce a wide range of marketable goods and services, but must also respond to its environmental, social and territorial dimensions, *i.e.* maintenance of villages and rural traditions, rural landscapes, good agricultural practices, etc. Thus, the "new" concept of multifunctional agriculture reflects the "ancient" capacity of agriculture to produce different kind of goods and services covering a wide range of society's demands. Some of these goods and services can be sold in existing markets (private goods as food and fibers), while others are supplied without any monetary compensation for farmers (OECD, 2001; Vera-Toscano et al., 2007). An early recognition of the multifunctional character of agriculture appeared in the documents of the Rio Earth Summit in 1992. The countries of the Organization for Economic Cooperation and Development (OECD, the primary mechanism for economic cooperation among economically developed nations) expanded upon this idea in 1998, noting: "Beyond its primary function of producing food and fiber, agricultural activity can also shape the landscape, provide environmental benefits such as land conservation, the sustainable management of renewable natural resources and the preservation of biodiversity, and contribute to the socio-economic viability of many rural areas. Agriculture is multifunctional when it has one or several functions in addition to its primary role of producing food and fiber."(DeVries, 2000; OECD, 2001).

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In Turkey, agriculture is still a very important sector of the economy. The sector also is playing an important role in foreign trade. In fact, Turkey is a major world producer and exporter in some fruit and vegetables sectors. Agriculture will also have great potential for further development in Turkey. Of course, it is so important to keep abreast of development in agriculture and expectations from agriculture about multifunctionality. In this context, farmers' opinion and attitudes also is important in new role of agriculture.

The aim of this study is to examine the farmers' opinion and attitudes (Participation) on multifunctional agriculture in Turkey. This paper addresses two main questions. (1) What is the farmers' opinion about multifunctionality? (2) What are the attitudes of farmers towards multifunctional activities? The study also shows which elements of multifunctional agriculture the farmers consider the most important ones in their conditions. In the conclusions it is also recommended on the implications of multifunctionality for the sector and policy makers.

## MATERIAL AND METHODS

The suitability of the ecological conditions of Aegean Region for farming is accelerated the development of agriculture in that region. Although Izmir is the economic activity center for the Turkey, it is an agriculturally important area in Aegean Region. Organic agriculture in Turkey has also first begun with the production of raisins and dried figs in one of the most important agricultural center Izmir in Aegean Region (Atış, et al., 2010).

The study is based on original data collected from farmers. The data includes qualitative research which took place in June 2012. It was based on farmer survey. This study uses data collected for farms from two towns (Buca and Güzelbahçe) of Izmir province in June 2012. 55 farms drawn from all farms in two villages (Karacaagaç and Payamlı) of these districts were surveyed, using a questionnaire developed and pre-tested in the field.

In the survey, farmers are first asked about the age, education level of farmers. A second set of questions asked about the farmers' opinion on per function of agriculture. Finally, a number of questions were asked about the farm's participation in multifunctional activities for farmers. In this study, considered multifunctional activities are conservation of agricultural lands, food security, provision of animal welfare, improving of the food safety and quality, environmental responsibility, the continuity of rural life, increasing biodiversity/provision.

The survey included different multifunctionality items measured on a five-point Likert-type scale ranging from 1 (absolutely unimportant) to 5 (extremely important). Therefore, the multifunctional activities were asked to rate on a five-point Likert scale the stated farmer's preferences for agricultural multifunctionality.

## RESULTS

### Characteristics of Farmers

As a result of the surveys, while, the average age of the farmers to whom the surveys conducted in the research area, is approximately 52 and average duration of the engagement to the agriculture is 26 years (Table 1). It is revealed that, duration of education life is approximately 6 years. It is observed that the average number for the household persons surveyed with is 4.

The average of farm size which is one of the important elements of agricultural production is 5.2 hectares and is close to the Turkey's average. While the scale of agricultural land average in EU is 19 hectares, compared to Turkey it is 6 hectares. It even decreases in the Aegean Region. Accordingly, average size of the total farm in research field is consistent with the average of Aegean Region.

Table1. Characteristics of the farmers surveyed

Characteristics of the farmers surveyed	Mean	Minimum	Maximum	Std.deviation
Age (years)	51.82	26	79	11.991
Education (years)	6.05	3	14	2.438
Farm size (decar)	51.62	2	250	49.543
Farming experience (years)	26.24	3	61	14.061
Household member	3.84	2	10	1.697

Almost 55% of the interviewed farmers are having non-agricultural income sources. However, the majority of the farmers' monthly average income is in the range of 1000 – 1500 TL. Accordingly, 76% of the farmers stated that they are not satisfied being engaged in farming. In addition, 69% of the farmers are the members of a cooperative.

#### Adoption of multifunctional activities

It is explained above, conservation of agricultural lands, food security, provision of animal welfare, improving of the food safety and quality, environmental responsibility, the continuity of rural life, increasing biodiversity/provision are considered as multifunctional activities in this study. Concerning agricultural multifunctionality, firstly, farmers are asked his opinion about another function of agriculture beyond primary function of producing food and fiber. Nearly, 58% of the surveyed farmers thought that agriculture has no another function other than production. While, the farmers remarkably give the preference to use of manure in the direction of conservation of agricultural lands, performing soil analysis is seen moderately important (Table 2).

Table 2. Farmer's opinion about conservation of agricultural lands

Important factors concerning the conservation of agricultural lands	1	2	3	4	5	Scale Average
Manure should be used	-	-	2	7	46	4.80
Attention should be paid for the conservation soil tillage	-	1	4	6	44	4.69
Special attention has to be given to sensitive areas	-	1	4	12	38	4.58
Pesticides and chemical fertilizers should not be used excessively	-	1	12	5	37	4.42
Water quality and water use, should be noted	-	-	8	18	29	4.38
Green manure should be applied	2	5	10	9	29	4.05
Soil analysis should be performed	8	8	8	2	29	3.65
1) Absolutely unimportant 2) Less important 3) Moderately important 4) Remarkably important 5) Extremely important						

As a result of the questions asked in terms of the continuity of rural life, development of agro-tourism is very important; the protection of ancient buildings is moderately important (Table 3).

Table 3. Farmer's opinion about the continuity of rural life

Important factors in terms of the continuity of rural life	1	2	3	4	5	Scale Average
Agro-tourism should be developed	-	-	1	5	49	4.87
Agro-industries should be developed	-	2	4	5	44	4.65
Farms which produce sustainable should be established	-	1	5	20	29	4.40
The traditional and local meals should be continued	9	7	5	11	23	3.58
Ancient buildings should be protected	13	10	8	12	12	3.00
1) Absolutely unimportant 2) Less important 3) Moderately important 4) Remarkably important 5) Extremely important						

As a result of the surveys, all of the criteria in terms of increasing biodiversity are remarkably important (Table 4). However, relatively, the conservation of local varieties is taking in the first place, while consideration of using chemical fertilizers is taking in the last place.

Table 4. Farmer's opinion about food security

Important factors in terms of increasing/providing biodiversity	1	2	3	4	5	Scale Average
Local product varieties should be protected	-	2	4	11	38	4.55
Land use and soil tillage methods should be noted	-	3	4	15	33	4.42
The use of pesticides should be considered	2	-	3	19	31	4.40
Organic and sustainable agriculture should be expanded	-	4	7	15	29	4.25
The use of chemical fertilizers should be considered	2	2	7	20	24	4.13
1) Absolutely unimportant 2) Less important 3) Moderately important 4) Remarkably important 5) Extremely important						

As a result of the questions about importance of animal welfare, mistreatment of animals found very important, whereas organic farming found moderately important (Table 5).

Table 5. Farmer's opinion about provision of animal welfare

Important factors in order to ensure animal welfare	1	2	3	4	5	Scale Average
Mistreatment of animals should not be done	-	-	1	2	52	4.93
Animal health should be noted	-	-	1	3	51	4.91
Free movement fields should be done for animals	-	-	1	7	47	4.84
Pasture and meadow should be conserved	1	2	8	10	34	4.35
Organic livestock should be done	4	9	12	10	20	3.60
1) Absolutely unimportant 2) Less important 3) Moderately important 4) Remarkably important 5) Extremely important						

As a result of the questions asked farmers about the importance of environmental responsibility, sustainable use of water resources established as very important, abandonment of monoculture agriculture defined as moderately important (Table 6).

Table 6. Farmer's opinion about environmental responsibility

Important factors in terms of environmental responsibility	1	2	3	4	5	Scale Average
Ensure the sustainable use of water resources	-	-	2	7	46	4.80
Using fertilizers and pesticides should be limited	-	-	5	10	40	4.64
Conservation tillage methods should be preferred	2	7	8	11	27	3.98
Environment-friendly production methods should be applied	3	5	7	16	24	3.96
Organic agriculture should be expanded	1	5	12	17	20	3.91
Monoculture agriculture must be abandoned	9	3	9	18	16	3.53
1) Absolutely unimportant 2) Less important 3) Moderately important 4) Remarkably important 5) Extremely important						

As a result of the questions in terms of food safety and quality, in general, farmers seen all the factors worth considering important but relatively, adaptation the self-control to farmers is more important than the others (Table 7). Also, pricing according to quality is ranked at the last.

Table 7. Farmer's opinion about improving of the food safety and quality

Important factors in terms of improving food safety and food quality	1	2	3	4	5	Scale Average
Self-control should be adopted by farmers	-	-	1	-	54	4.96
Using fertilizers and pesticides should be limited	-	1	5	15	34	4.49
Directed towards organic / sustainable agriculture	1	5	3	16	30	4.25
Pricing should be done according to quality	8	-	5	1	41	4.22
1) Absolutely unimportant 2) Less important 3) Moderately important 4) Remarkably important 5) Extremely important						

In terms of food security, it is observed that stability of production is very important for the farmers (Table 8). Besides, storage of agricultural surplus is seen less important considering the others.

Table 8. Farmer's opinion about food security

Important factors in terms of food security	1	2	3	4	5	Scale Average
Production must be stable	-	-	-	5	50	4.91
Agricultural production should be enough to meet the needs	-	-	2	8	45	4.78
Should be easy to access the product	2	6	5	12	30	4.13
Agricultural surplus should be stocked	14	14	9	9	9	2.73
1) Absolutely unimportant 2) Less important 3) Moderately important 4) Remarkably important 5) Extremely important						

In fact, the farmers whom fulfill the requirements of these functions, know the negative effects of overuse of pesticides and chemical fertilizers, but also believe that using of these are directly relates the efficiency. Even though the farmers are aware of the positive effects of organic farming both in economic and environmental, due to lack of sufficient demand depending on the preferences of the consumers, they couldn't achieve the income they want and thus a reduction occurred heading towards organic agriculture. However, farmers also draw attention to the importance of agriculture in terms of food security, they think stocking is unnecessary and exporting the agricultural surplus would be more appropriate.

#### Importance of multifunctional activities

As a result of the analysis, all the functions of agriculture are found remarkably significant by the farmers (Table 9). However, conservation of agricultural lands, improvement of the food safety and quality and ensuring animal welfare are respectively seen very important.

Table 9. Importance of multifunctional activities for farmers

Perspective of farmers on the degree of importance of agricultural functionality	1	2	3	4	5	Scale Average
Conservation of agricultural lands	-	-	-	2	53	4.96
Improving food safety and quality	-	-	-	4	51	4.93
Ensuring animal welfare	-	-	1	6	48	4.85
Food security	-	1	-	7	47	4.82
Environmental responsibility	-	1	5	14	35	4.51
The continuity of rural life	1	2	5	15	32	4.36
Increasing/ providing biodiversity	-	2	9	18	26	4.24
1) Absolutely unimportant 2) Less important 3) Moderately important 4) Remarkably important 5) Extremely important						

For multifunctionality to become accepted for farmers requires some institutional arrangements and policy incentives. As demonstrated in some publications (Vandermeulen et al., 2006), the choice of local policy instruments (supporting more the nature and environmental aspects or more farm tourism and other types of diversification) is influenced by the participation and influence of farmers on the one hand and of the general public and/or local action groups on the other hand.

In this study, farmers are asked about the possibility of farmer's participation in multifunctional activities getting incentives. In terms of getting incentives, the applications of the stated functions are all applicable for the farmers (Table 10). But the most applicable ones are food security and improving the food safety and quality.

Table 10. Possibility of Farmer's participation in multifunctional activities

Views of the farmers about application of functions in terms of getting incentives	1	2	3	4	5	Scale Average
Food security (increasing the production)	1	2	10	2	40	4.42
Improving food safety and quality	1	2	9	4	39	4.42
Ensuring animal welfare	1	3	7	8	36	4.36
Conservation of agricultural lands	3	3	7	3	39	4.31
Environmental responsibility	1	5	8	8	33	4.22
The continuity of rural life	3	4	8	4	36	4.20
Increasing/ providing biodiversity	3	5	9	7	31	4.05
1) Not apply at all 2) Partially apply 3) Moderately apply 4) Apply 5) Strictly apply						

## DISCUSSION AND CONCLUSION

In this study, the agricultural sector which is not only the food production, but also with the multifunctional structure heading for subjects such as rural development, food safety, biodiversity and environmental conservation, approached with the farmer based. According to the survey results, majority of the interviewed farmers expressed their opinions about the agriculture hasn't got a function other than production in general. But, when the multifunctionality of the agriculture has been described individually, it is assessed that the farmers are aware of the importance of agriculture, especially in economic and environmental functions.

Considering the research results, level of perception and awareness of the farmers' in relation to the multifunctionality of agriculture is not enough. However, it is seen that the farmers are not too far from the concept of multifunctionality and in need of specific incentives and information. In this instance, taking into account of local needs in some of the functions, education and extension activities are needed. Especially, when the research area and farmers' predisposition to eco-friendly production methods such as organic farming taken into account, it is thought to be implemented easily. Policy decisions need to be taken, in accordance with the farmers' opinion, without ignoring their problems.

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# CONSUMER ATTITUDES TOWARDS ORGANIC PRODUCTS IN THE ECOLOGIC MARKET OF IZMIR

Sule AZAK<sup>1</sup> Bulent MIRAN<sup>1</sup>

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## ABSTRACT

The first open air ecologic market was established on 25th of June, 2010 in Izmir. It is located in Bostanli/Karsiyaka and called Ekopazar. It is a very important place because all products have certificate of being organic and are sold under control from the very beginning of the production. Unfortunately, the sellers are unhappy because of less sales volume. The product sellers are concerned that customers are unaware of the significance of the organic products. Therefore, the main objective of this study is to determine the level of consumer awareness about organic products in Ekopazar. This study shows the measurements of consumer attitudes based on the questionnaires of the Mavisehir households. The data is analysed by applying statistical analysis techniques. Also Fuzzy Pairwise (FP) method is used for analyzing the decision making process of the consumers. To our surprise, the survey outlined that more than the expected number of people has the awareness of Ekopazar. The main result of the study showed that ecologic markets were the first preference of the respondents in purchasing the organic products.

**Key Words:** Organic product, ecologic market, customer attitude, FP method

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## INTRODUCTION

Turkey is one of the most suitable countries for organic farming due to the presence of a wide variety of agro-food products well adapted to different agro-ecosystems, rich biodiversity and traditions in agriculture.

In Turkey, Izmir is the leader in organic farming, first started in 1985. It spread to other regions and the number of organic products reached to 216 products in 2011 (Eker, 2011). Especially retailing chains are the most important in terms of marketing the organic products in the world (Pezikoğlu, 2012). One of the retailing chains for marketing the organic product is the ecological markets in Turkey. There are almost 15 open air ecologic markets in Turkey. One of them was established in 2010 in Izmir /Karsiyaka, called Ekopazar. Ekopazar is the marketplace with "certificate of organic" not only for the products sold in it but also for its market area.

Ekopazar is opened only on Bostanli market area of approximately 4000 square meters on Fridays. Approximately there are 20 sellers, some of them are farmers who produce their organic fruits and vegetables based on organic farming rules, the others only sell the organic products including not only fruits and vegetables but also *some legumes, olive oil, dried food, egg, meat and dairy products even textile, hygienic products and toys etc* (ETO, 2012).

Specifically, the study tried to gain knowledge about consumers' attitude towards organic food products, to investigate the reasons why customers neglect Ekopazar, to investigate the reasons that may influence the intention of buying organic food products, and to identify factors that might influence purchase intention of organic foods among consumers (Siti Nor and Nurita, 2010).

## MATERIAL AND METHODS

Mavisehir is a part of Karsiyaka located by the sea, and almost 5500 households are counted there. There are lots of highest apartments with 20 floors and also houses with gardens. The people who live in the area of Mavisehir have got high standart of living. The location of the area is very close to Ekopazar, ten minutes by walk or three minutes by car. Therefore the people who lives in Mavisehir was chosen as target market to determine consumer attitudes towards Ekopazar.

The data were collected from a consumer study on opinions about organic products in Ekopazar. A random sample based on street number was obtained from Mavisehir. The sample was chosen by the formula and probability was taken 0.50 to get the possible largest sample size. For 90% confidence interval and 7.5% error, the sample size was calculated as 118 (Miran, 2009). The households were randomly selected within the area where the organic market is set up. Survey was done through face to

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face interviews using structured questionnaire. Five point Likert scales (1: Unimportant ; 5: Important or 1: Never ; 5: Always or 1: Unlikely ; 5: Very likely etc.) and the close-ended questions were used concerning the attitudes and behaviour of the consumers towards organic products and Ekopazar. The data was analyzed via nonparametric statistical techniques such as Friedman test, Kruskal Wallis test and Mann Whitney test. Furthermore, Fuzzy Pairwise Comparison was used to get the priorities of some important issues.

## RESULTS

Demographic characteristics of the respondents were summarized in Table 1. The most important element of a survey sample was sufficient numbers of respondents in sub-classifications (i.e., age, sex, education, and income) to warrant statistical analysis.

*Table 1. Demographic Characteristics of Mavisehir households*

Characteristic	N	Percent
<b>AGE</b>		
18-25	5	4,2
26-30	26	22,0
31-40	14	11,9
41-50	34	28,8
51-60	22	18,6
61>up	17	14,4
<b>Total</b>	<b>118</b>	<b>100,0</b>
<b>SEX</b>	<b>N</b>	<b>Percent</b>
Female	81	68,6
Male	37	31,4
<b>Total</b>	<b>118</b>	<b>100,0</b>
<b>EDUCATION</b>	<b>N</b>	<b>Percent</b>
Master and PhD	9	8,8
University	65	63,6
More than high school	4	4,0
High school	20	19,6
Less than high school	2	2,0
Primary school	2	2,0
Missing	16	NA
<b>Total</b>	<b>118</b>	<b>100,0</b>
<b>ANNUAL HOUSEHOLD INCOME (₺) (1</b>	<b>N</b>	<b>Percent</b>
<b>USD ≈1.7 Turkish Liras (₺)</b>		
1000-1999	8	8,2
2000-2999	8	8,2
3000-3999	17	17,5
4000-4999	8	8,2
5000-5999	17	17,5
6000-6999	12	12,4
7000-7999	3	3,1
8000-8999	8	8,2
9000-9999	2	2,1
10000>up	14	14,4
Missing	21	NA
<b>Total</b>	<b>118</b>	<b>100,0</b>

Table 2 showed that 98.3 percent of the respondents knew the organic products. 97.4 percent of them defined the organic products correctly (Table 3).

Table 2. Awareness of respondents about the organic products

Answers	N	Percent
Yes	116	98.3
No	2	1.7
<b>Total</b>	<b>118</b>	<b>100.0</b>

Table 3. Awareness of the respondents about the definition of the organic products

Definitions	N	Percent
1.High productivity products	2	1.7
2.Cultural and biological methods are used any without artificial fertilizers and agricultural chemicals	113	97.4
3.Damage to soil, air and water	1	0.9
4.Missing	2	
<b>Total</b>	<b>118</b>	<b>100.0</b>

80.2 percent of the respondents indicated that they knew about the organic production (Table 4). 37.9 percent of them said that they were mostly informed by newspapers and magazines followed by 33.7 percent saying that they were mostly informed by the radio and TV (Table 5).

Table 4. Awareness of respondents about organic production

Answers	N	Percent
Yes	94	80.3
No	24	19.7
<b>Total</b>	<b>118</b>	<b>100.0</b>

Table 5. Knowledge source of the respondents about the organic productions

Source	N	Percent
1.Newspaper and magazines	36	37.9
2.Radio and TV	32	33.7
3.Internett	6	6.3
4.Agricultural Organisation	3	3.2
5.Private sector	3	3.2
6.Education Organisation	7	7.4
7.Farmers	8	8.4
Missing	23	
<b>Total</b>	<b>118</b>	<b>100.0</b>

In regard to the question of the knowledge about organic product certification, 67.8 percent of the respondents knew about organic product certification (Table 6) and 97.6 percent of them correctly defined of the organic product certification (Table 7).

Table 6. Awareness of the respondents about organic product certification

Answers	N	Percent
Yes	80	67.8
No	38	32.2
<b>Total</b>	<b>118</b>	<b>100.0</b>

Table 7. Awareness of the respondents about definiton of the organic product certification

Answers	N	Percent
1.It is not necessary organic product certification for selling of the organic products	1	1.2
2.It is prepared by sales man before Selling of the organic products.	1	1.2
3.It shows that the business produce organic products under controlled in all production steps	81	97.6
4.Missing	35	
<b>Total</b>	<b>118</b>	<b>100.0</b>

82.8 percent of the respondents indicated that they knew Ekopazar (Table 8) and almost 50% of them said that they visited Ekopazar at least once a month (Table 9).

Table 8. Awarness of the respondents about Ekopazar

Characters	N	Percent
Yes	96	82.8
No	22	17.2
<b>Total</b>	<b>118</b>	<b>100.0</b>

Table 9. The frequency of shopping of the respondents from Ekopazar

Frequency	N	Percent
1.Every week	13	11.5
2.Once every fifteen days	14	12.4
3.Once in a month	26	23.0
4.Once every 3 month	8	7.1
5.Once every 6 month	5	4.4
6.Once in a year	6	5.3
7.Never	41	36.3
Missing	5	
<b>Total</b>	<b>118</b>	<b>100.0</b>

**Table 10. Reasons for neglecting Ekopazar ranking from unimportant to very important**

	Mean*
The distrust of the organic products	2.64
The distrust of the organic certification	2.55
Type of the product is less	2.56
High price	3.22
Less quality	2.10
No credit card	1.70
Inadequate control	2.20
Difficult transport	1.38
Igronant sellers	1.45
Bad customer interest	1.40
Organic products are not fresh	2.14
Small number of sellers	2.50
Wrong market location	1.29
Wrong market day	1.48
No awarness of ekopazar	1.46
No advertisement	1.74

\* / 1=Unimportant and 5=Very important

The test results in Table 10;

1. High price of the organic product was moderately important reason for not going to Ekopazar, with mean 3.22.
2. The distrust of the organic product and organic certification is moderately important with mean 2.64 and 2.55.
3. Poor type of the products and small number of the sellers were also moderately important with mean 2.56 and 2.50.
4. Non-fresh and less quality of the product and inadequate control in ecologic market were less important.
5. No advertisement and no credit card were also less important.
6. Access to Ekopazar, location, market day, and the others were not important.

Table 11 was used to see if there was a difference in the frequency of the purchasing for organic products applying by Friedman test. Friedman test confirmed organic egg mostly preferred with a mean rank 5.53 (Significant by Friedman test for  $\chi^2 = 77.047$ ;  $p < 0.00$ ).

*Table 11. Frequency of purchasing organic products of the respondents*

Frequency	Mean Rank*
Bread	3.98
Egg	5.53
Fruit	4.55
Meat	3.53
Milk	4.36
Vegetable	4.46
Yoghurt	4.71

\* / 1=Never and 5=Always

Significant by Friedman test for  $p < 0.000$

*Table 12. Probability of purchasing organic products in the future of the respondents*

Probability	Mean Rank*
Bread	4.13
Egg	4.78
Fruit	4.70
Meat	4.03
Milk	4.53
Vegetable	4.50
Yoghurt	4.77

\* / 1=Unlikely and 5=Very likely

Significant by Friedman test for  $p < 0.000$

In regard to the question to the consumers about likelihood for them to buy organic products in the future, according to the analyzed results; the mean of the scale for all variables was almost 4, so the consumers likely wanted to buy organic products in the future (Table 12). Friedman test was also used to see if there was a difference in the probability of purchasing organic products in the future. Friedman test confirmed organic egg mostly preferred with a mean rank 4.78. (Significant by Friedman test for  $\chi^2 = 39.641$ ;  $p < 0.00$ ).

*Table 13. Descriptive statistics of Fuzzy Alternatives*

	Mean	StDev	Minimum	Maximum	Median
Ecologic market	0.6659	0.2078	0.3348	1.0000	0.6394
Greengrocer	0.3543	0.0865	0.1000	0.6031	0.3500
Supermarket	0.5501	0.1884	0.1891	0.9000	0.5000
Internet	0.3440	0.1243	0.0740	0.9000	0.3481
Organic shop	0.4325	0.1527	0.1000	0.9000	0.3979

Compared to mean values seen in Table 13, ecologic market is more preferable than the others according to Kruskal-Wallis Test for Fuzzy Alternatives.

When the answers to the question of "Where do you buy the organic products from" asked to the respondents were analyzed by Fuzzy Pairwise method and it was concluded that ecologic markets were the first preference in Table 13. Also, Table 14 showed that the difference between gender in purchasing

location of the organic products. According to the test result the least preferred option was internet for buying organic products for the female and male respondents with mean value of 0.34.

*Table 14. Organic product purchasing location preferences by gender of the respondents*

Sex	Ecologic market Mean	Greengrocer Mean	Supermarket Mean	Internet Mean	Organic shop Mean
Female	0.6683398	0.3514069	0.5569138	0.3440897	0.4259456
Male	0.6601076	0.3612348	0.5341258	0.3437892	0.4480343

*Significant by Mann-Whitney U test for  $p > 0.1$*

Mann-Whitney U test was used to see if there was a difference between female and male for the purchasing location alternatives of organic products. According to the test result did not confirm any differences between them (Significant by Mann-Whitney U test for  $p > 0.1$ ) (Table 14).

Regardless of educational status of the respondents, they mostly preferred ecologic markets for buying organic products. Ecologic markets were being preferred mostly by the respondents with master and PhD with a mean value of 0.93. Greengrocer were mostly preferred by those with educational level of university with a mean value of 0.36, supermarkets were mostly preferred by those with educational level of university with a mean value of 0.57, internet mostly by those with high school degree with a mean value of 0.37 and the organic shops were mostly preferred by those with educational level of primary school with a mean value of 0.49 (Table 15).

*Table 15. Organic product purchasing location by educational status of the respondents*

Education	Ecologic market Mean	Greengrocer Mean	Supermarket Mean	Internet Mean	Organic shop Mean
Primary school	0.7697224	0.3558214	0.4762630	0.3181131	0.4886808
Master and PhD	0.9333333	0.3228158	0.4421594	0.2526161	0.3269509
High school	0.6577323	0.3522027	0.5393333	0.3734710	0.4064683
University	0.6322134	0.3579977	0.5687929	0.3435280	0.4499784
More than high school	0.8559041	0.3394510	0.4772064	0.3416913	0.3484393

The respondents in the age group of 18-25 years and 51-60 years indicated that they bought the organic products mostly from the supermarkets with a mean value of 0.77 and 0.57. Those in other age groups indicated that they preferred the ecologic markets (Table 16).

*Table 16. Organic product purchasing location by age group of the respondents*

Age	Ecologic market Mean	Greengrocer Mean	Supermarket Mean	Internet Mean	Organic shop Mean
18-25	0.4785494	0.3568883	0.7695446	0.3132147	0.4724213
26-30	0.6227609	0.2981596	0.4686931	0.4176364	0.4836706
31-40	0.6933970	0.3414246	0.5534547	0.3173682	0.4322244
41-50	0.6970789	0.3674183	0.5591344	0.3590440	0.3874841
51-60	0.5561726	0.3881453	0.5652974	0.3799294	0.4752050
61>up	0.7768951	0.3477561	0.4885888	0.2814773	0.4234592

It was understood that the customers with low income usually preferred ecologic markets for buying organic products, when the customers with higher level of income preferred supermarkets and greengrocers (Table 17).

*Table 17. Organic product purchasing location by income level of the respondents*

Annual income (₺)	Ecologic market Mean	Greengrocer Mean	Supermarket Mean	Internet Mean	Organic shop Mean
1000- 1999	0.9000000	0.4458712	0.3106227	0.1933068	0.3766381
2000- 2999	0.5736312	0.3713489	0.5075395	0.3746258	0.4970723
3000- 3999	0.7291923	0.3336479	0.4654687	0.3726803	0.4341080
4000- 4999	0.6740506	0.3605187	0.5584129	0.3419979	0.4207052
5000- 5999	0.6630652	0.3267597	0.5853966	0.3396578	0.4153788
6000- 6999	0.6063117	0.3267863	0.6500512	0.2781125	0.4852700
7000- 7999	0.8887628	0.3637750	0.3839972	0.3777563	0.3059695
8000- 8999	0.5256586	0.4003975	0.6152267	0.4298031	0.3907974
9000- 9999	0.6000000	0.6031373	0.4591673	0.3958477	0.3958477

## DISCUSSION AND CONCLUSION

On the basis of the survey on household of Mavisehir results, it was concluded that the respondents had knowledge about Ekopazar, an organic products market set on Fridays in Bostanli market area in Mavisehir and that the most important reason for the respondents to neglect Ekopazar was high price of the organic products as well as the doubts that they have in organic products and their certificates. In addition, they find diversity of the organic products very low.

They also stated out that access to Ekopazar was easy and day and location of the market were suitable (Table 11). According to the analyzed results; the consumers likely wanted to buy organic products in the future (Table 13).

When organic product preferences of the respondents were compared based on their demographic characteristics created by Fuzzy Pairwise method (Table 14), ecologic market was usually the first preference of the respondents in purchasing of the organic products, if some age groups and income levels are not considered.

Increasing the number of the market sellers would increase product supply and keep the price stable. If the expenses of the sellers' in terms of transportation could be covered by the local authorities, the prices of the products would reduce and organic product market would expand.

Furthermore, increasing trust in organic products and their production, promoting advertising the ecologic market in order to emphasize its importance in terms of health would raise attitudes of consumers to organic products in a positive manner.

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# MEASURING ECONOMIC CONNECTIVITY OF ORGANIC AND CONVENTIONAL FARMS IN ALBANIA

Majlinda ÇAKALLI<sup>1</sup> Eglantina PAZAJ<sup>1</sup>

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## ABSTRACT

Organic sector in Albania has received particular attention by Government and civil society considering it as a valid instrument, which in combination with tourism can vitalise the rural areas. A major concern for both conventional and organic sector is market infrastructure therefore, the economic connectivity. This research has aimed in measuring the economic connectivity (both in terms of purchases and sales) on the proportion (by value) of sales/purchases made by farm businesses locally, regionally, nationally and internationally and also the actual value (totals and means) of these economic transactions. As a result, it was possible to distinguish between businesses that are 'highly connected' in terms of the proportion of their sales and purchases made locally but which nevertheless make a relatively small impact due to low sales and purchase values and business which may be associated with a greater local impact even though their business is oriented towards more distant markets. Thirty-four organic farms and 189 conventional ones were interviewed during 2009 – 2010. Both organic and conventional samples contain mostly very small or microholdings. The results indicate that in the organic sample, 47 % of purchases (by value) were made locally (within 10 km) and a total of 50% were made either very locally or within the rest of the commune. For conventional farms, these figures were significantly different (55% very locally and 67% within the rest of commune). Such a great linkage can be explained with the size of farms as smaller farmers are more strongly tied to local economies.

**Key Words:** Purchase and sale pattern, economic connectivity, organic vs. conventional

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## INTRODUCTION

Organic farming in Albania has experienced a limited growth in the last decade with a limited register of organic farmers and a minute market for organic produce (Kullaj, 2010). Interest in the organic sector however, stretches far beyond such limited growth and market. Organic farming is promoted on the basis of the multiple benefits it provides; healthier food, improved farmed environment and a contribution to the rural economy (Pretty 2002; Soil Association 2003).

More recently researchers have turned their attention to the role of organic farming in the rural economy and specifically, the potential for organic farming to contribute to rural development (Hird 1997; Midmore and Dirks 2003; Pugliese 2001, Lobley et al. 2006). Thus, any policy measure which aim is to promote organic farming development, would also promote sustainable development of rural Albania. It is frequently argued that organic farming can promote employment in rural areas.

Parallel with the growth of and interest in the organic sector, 'local food' has taken on increased economic, environmental and symbolic importance. Much of this is concerned with reducing environmental costs, particularly food miles but also a desire to increase local economic multipliers and contribute to the (re)connection of farmers and consumers (e.g. Pretty et al. 2005). Although organic products are not necessarily 'local', there is nevertheless a close alliance between local food and organic food. Combining a greater degree of localness in food sourcing with increased organic production would lead to a considerable savings associated with the reduction of environmental externalities (Pretty et al. 2005). Although the economic and social benefits of reducing negative externalities and increasing positive externalities are recognised, the potential for organic farming (or other forms of farming) to contribute to rural economies is much more wide ranging than the focus of previous research would suggest (Lobley et al. 2006).

For the purposes of characterisation, we have compared organic with conventional farmers. The approach adopted involved examining the socio-economic linkages associated with different types of farming such as sales and purchasing patterns.

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## MATERIALS AND METHODS

A survey undertaken was designed to capture a range of organic and non-organic farming situations in different Albanian regions for the purposes of proper comparison. The goal of the survey was to gain a deeper insight into the production structures and conditions of organic farms and also to identify the organic farmer's assessment of selected aspects of policy implementation and policy induced production adjustments.

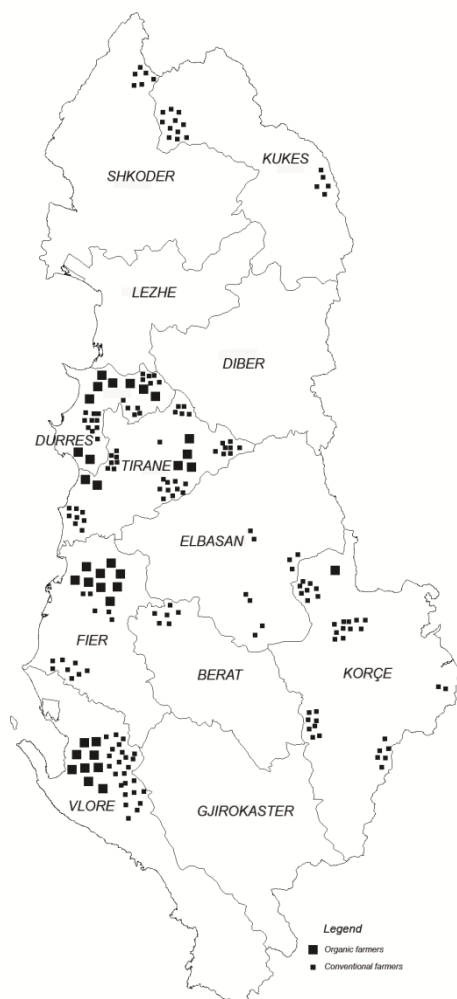


Figure 1. Location of organic and conventional farms participating in the survey

The total sample comprised 223 farm businesses in Albania, of which 34 were registered organic. On the basis of the previous analysis regarding the different types of farming characteristics, a genuine attempt was made to cover all these regions (see Figure 1). Conventional farmers were randomly selected from the national farm register, especially from those regions where it was preliminarily known that organic farmers were located. Very large farms, or highly specialised ones were removed from the register. On the contrary, considering the small number of organic farmers in Albania, virtually all of them were interviewed. In terms of farm size, there were no significant changes between the two groups.

The survey ran from October 2009 to January 2010 and achieved an overall response rate of 75%, of which 5% were discarded as they had been insufficiently completed. The aggregate response rate however, varies considerably between the organic and non-organic sub-samples with a 80% (34) response rate for organic farms and 75% (189) for non-organic farms. This refers to farmers who did not agree to be interviewed. The interviews were finally conducted during February - March 2010. They generally took between 10 to 90 minutes per visit and thus were on the limit of what was possible.

A particular constraint in completing the questionnaire was related to the provision of financial data from the farmers.

As farmers in Albania do not pay taxes on agricultural production, they do not keep book records, lacking accuracy on the figures given. Moreover, many did not provide these figures as they think that the scope of this interview might be to collect financial data in order to start taxing them.

In measuring economic connectivity (both in terms of purchases and sales) data was collected on the proportion (by value) of sales/purchases made by a business locally (same location or within 10 km), regionally (above 10 km up to 50 km), nationally (above 50 km), internationally (exports) and also the actual value (totals and means) of these economic transactions. Consequently, it was possible to distinguish between businesses that are 'highly connected' in terms of the proportion of their sales and purchases made locally but which nevertheless make a relatively small impact due to low sales and purchase values and business which may be associated with a greater local impact even though their business is orientated towards more distance markets.

To test the hypothesis that several means were equal, we used ANOVA at 5% probability. Furthermore, while not shown, all 'significantly' different means are also reliable in terms of the test for variance homogeneity.

Values are reported in Albanian currency, 'Lek' (ALL). At the time of the study, 1 EUR = 135 ALL.

## RESULTS

As Figure 1 shows, for farms in the organic sample, 47% of purchases (by value) were made very locally (within 10 km) and a total of 50% were made either very locally or within the rest of the commune. For conventional farms, these figures are significantly different (55% very locally and 67% within the rest of commune).

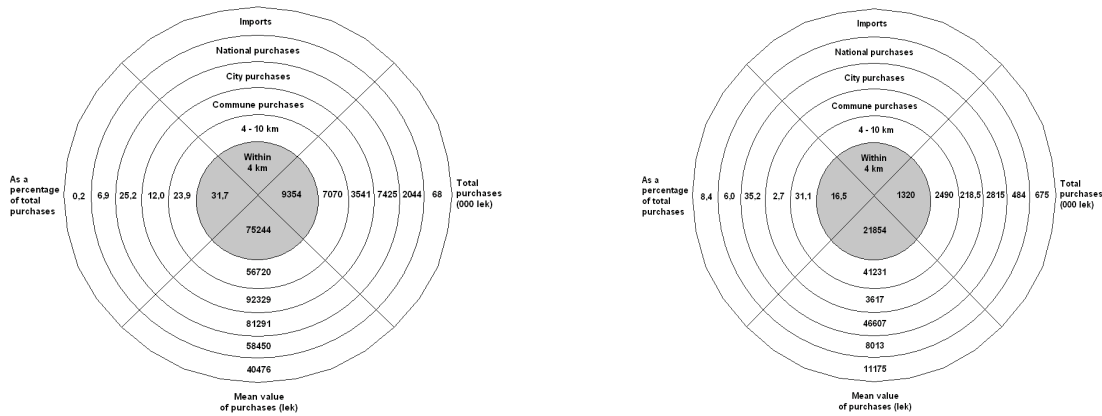


Figure 1. Purchases by conventional (left) and organic (right) farm businesses. Mean purchases per hectare between organic and conventional farms were significant ( $F = 19,06$ ;  $F_{crit} = 6,61$ )

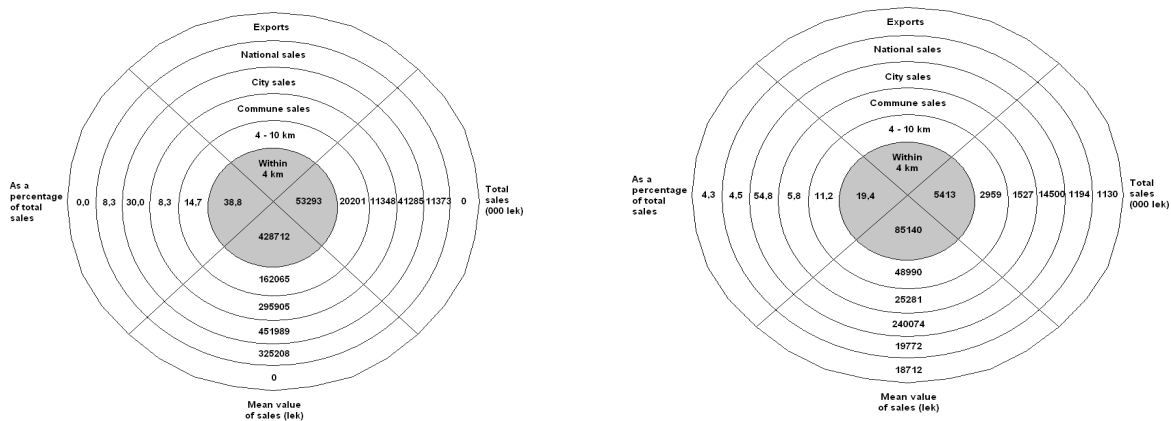


Figure 2. Sales by conventional (left) and organic (right) farm businesses. Mean sales per hectare between organic and conventional farms were significant ( $F = 38,19$ ;  $F_{crit} = 7,70$ )

As we can see, organic business have multifunctional farms and they are more sustainable in terms of securing their food own food. As the agricultural system implies and the respective legislation requires, they have to ensure their inputs within the farms or nearby, therefore we have sufficient cattle and other farm animals to sustain their living. It should be noted also that as organic inputs (bio – fertilizers, bio – pesticides, organic seeds, etc) are produced in developed countries, these are only available at the main cities, where the organic farmers have to buy. On the contrary, the conventional farmers are rather more specialized in producing a certain crop for market and they have to purchase the rest of their food. Anyway, it should be noted that the level of “specialization” is not that found in Western European countries. Notwithstanding, if we compare the common categories of purchases (general cropping, horticulture, mixed) the differences in value are not significant either at total, local and city level.

When it comes to the sale behavior (Table 2, below) we still have limited categories of products from the organic farmers as the market is yet under development and the only products which can be properly diversified are mainly horticulture (fruits and vegetables). There is virtually no demand for organic cereals in the domestic market and the local meat and dairy products are perceived as natural, “organic” by default. Significant changes were found between conventional and organic producers only at local level ( $F = 109,84$ ;  $F_{crit} = 18,51$ ).



**Table 1. Farm business purchasing behaviour by farm type and organic/conventional status (000 Lek)**

Farm type	Total purchases		Local purchases			Commune purchases			City purchases			National purchases			Imports		
	Value	Mean	Value	%	Mean	Value	%	Mean	Value	%	Mean	Value	%	Mean	Value	%	Mean
<b>ORGANIC</b>																	
Cereals	0	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
General Cropping	200.0	100.0	160.0	80	80.0	0	-	-	40.0	20	20.0	0	-	-	0	-	-
Horticulture	7653.0	255.1	3590.4	47	156.1	218.5	3	31.1	2685.1	35	157.9	484.0	6	80.66	675.0	9	225
Pigs & Poultry	0	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Cattle & Sheep	0	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Dairy	0	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Mixed	150.0	75.0	150.0	100	75.0	0	-	-	0	-	-	0	-	-	0	-	-
Other	0	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
<b>CONVENTIONAL</b>																	
Cereals	1182.8	131.4	702.1	59	140.4	148.6	13	148.6	253.6	21	126.8	77.3	7	77.3	1.2	0	1.2
General Cropping	6643.7	166.1	3775.9	57	171.6	769.4	12	153.9	1671.4	25	167.1	412.6	6	137.5	14.4	0	14.4
Horticulture	6452.6	169.8	3602.1	56	171.5	700.9	11	157.2	1692.9	26	169.3	441.0	7	147.0	15.7	0	15.7
Pigs & Poultry	502.5	125.6	237.6	47	118.8	63.9	13	63.9	157.1	31	78.6	42.3	8	42.3	1.4	0	1.4
Cattle & Sheep	1096.8	121.8	682.1	62	454.7	158.6	14	79.3	153.6	14	76.8	98.3	9	49.2	4.2	0	4.2
Dairy	951.7	135.9	518.3	54	129.6	140.2	15	140.3	215.0	23	107.5	76.7	8	76.7	1.5	0	1.5
Mixed	12515.6	154.5	6818.8	54	154.9	1540.5	12	154.1	3242.2	26	154.4	885.0	7	147.5	29.1	0	29.1
Other	156.2	156.2	86.9	56	86.9	18.7	12	18.7	39.4	25	39.4	10.8	7	10.8	0.4	0	0.4

**Table 2. Farm business sales behaviour by farm type and organic/conventional status (000 Lek)**

Farm type	Total sales		Local sales			Commune sales			City sales			National sales			Exports		
	Value	Mean	Value	%	Mean	Value	%	Mean	Value	%	Mean	Value	%	Mean	Value	%	Mean
<b>ORGANIC</b>																	
Cereals	0	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
General Cropping	300.0	150.0	90.0	30	45.0	210.0	70	105.0	0	-	-	0	-	-	0	-	-
Horticulture	25643.5	854.8	6221.5	24	311.1	1487.0	6	495.7	16550.5	65	973.6	1174.3	5	146.8	210.2	1	210.2
Pigs & Poultry	0	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Cattle & Sheep	0	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Dairy	0	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Mixed	510.0	255.0	204.0	40	102.0	0	-	-	306.0	60	-	0	-	-	0	-	-
Other	0	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
<b>CONVENTIONAL</b>																	
Cereals	5547.6	616.4	2999.74	45	599.9	462.4	7	462.4	1643.9	25	574.9	441.6	7	441.6	0	0	0
General Cropping	28100.5	702.5	14776.7	51	703.7	2401.7	8	600.4	8615.5	30	717.9	2306.6	8	768.9	0	0	0
Horticulture	29645.5	780.1	15776.7	53	788.8	2781.6	9	695.4	8600.6	29	781.8	2486.5	8	828.8	0	0	0
Pigs & Poultry	2710.1	677.5	1425.4	53	712.7	220.2	8	220.2	827.8	30	411.9	240.7	9	240.7	0	0	0
Cattle & Sheep	6747.6	749.7	3899.7	58	779.9	540.4	8	540.4	1865.9	28	621.9	441.6	7	421.6	0	0	0
Dairy	5192.6	741.8	2722.0	52	680.5	420.3	8	429.3	1639.1	32	819.5	411.2	8	411.2	0	0	0
Mixed	58828.5	726.3	31497.7	54	732.5	4563.4	8	760.6	17793.4	30	711.7	4973.9	8	829.0	0	0	0
Other	727.5	727.5	238.5	33	238.5	300.4	41	300.4	118.4	16	118.4	70.2	10	70.2	0	0	0

## DISCUSSIONS AND CONCLUSIONS

The large share of local purchases, as shown in Figure 1 by both conventional and organic farms can be explained with the size of farms. This is due to their small average farm size. Smaller farmers are more strongly tied to local economies. Both organic and conventional samples contain mostly very small or micro-holdings. However, the statistical analysis demonstrated that there is a significant difference between organic and conventional farmers ( $F = 19,06$ ;  $F_{crit} = 6,61$ ) with the latest being less locally connected.

Both groups are suffering in terms of marketing. Whilst conventional farmers are aiming at the local (city) market, organic farmers are looking for access to the market of Tirana and for exports in order to benefit from price premium. Despite this, there is no great difference in the characteristics and organisation of the business in terms of diversification, maybe due to the recent conversion and the lack of market for organic products.

Although the interviewers were instructed to persuade the farmer in order to give their financial data, we still are not very sure about the accuracy of the figures given. Firstly, farming activities in Albania are not taxed as other businesses and therefore most of the farmers do not keep accounts. Secondly, as a taxation scheme may eventually start, farmers are inclined to report lower figures. As the two samples are not proportional, we will not consider the absolute figures but the relative values in terms of patterns of distance. Methodologically speaking, such definitions of 'locality' may be debatable as while pragmatic and easily understood by respondents, perhaps such distances employed are not ideal and changing the definition of local will clearly have an impact on results. There is no fixed definition of local and distances travelled to access 'local' services will vary considerably between remote upland areas for instance compared to urban fringe countryside. There is a need to recognise "degrees of localness".

Another limitation of the methodology is the fact that it was impossible to identify if the purchases, although nominated local may be from an outlet of a regional, national or even international supplier and apparent local spending will largely and quickly leak from the local economy to the parent company.

In terms of public policies for the development of organic market, important activities in this regard would be the encouragement of local producer/consumer networks as well as marketing organizations for small organic producers, facilitation of the integration of the production chain by contract arrangements between actors and the emergence of inter-professional agreements, and the adoption of a number of carefully designed indirect support measures.

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# RURAL DEVELOPMENT IMPLEMENTATIONS AND ALTERNATIVES FOR THE FUTURE: THE CASE STUDY OF MILAS DISTRICT -TURKEY

Figen CUKUR<sup>1</sup> Gamze SANER<sup>2</sup>

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## ABSTRACT

Agricultural sector is one of the most important sectors for development of the economy in Turkey. On the other hand, development of agricultural sector is related to success of rural development implementations. Rural development is contributed to agricultural producers for the purpose of agricultural, economical and social development in micro basis. At the same time, it is important that economic growth in macro basis. The success of implementations for rural development are based on its sustainability and diversification. For this reason, determination of new alternative implementations and evaluation of the existing potential activities are significant subject for supporting rural development. All sub-sectors of agriculture has an important agricultural potential in Milas district of Mugla Province in Turkey from the past to present. In this research, rural development implementations will be examined in Milas District for various years. Then new alternative implementations were determined about diversification of rural development in the future. In addition to, possible contributions of new alternative implementations for rural development in Milas district in Turkey were discussed.

**Key Words:** Rural development, implementation, Milas, Turkey

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## INTRODUCTION

Development is defined by World Commission on Environment and Development as satisfying the needs of current generation without removal of the ability of satisfying the needs of next generations (Celik, 2006). The definition clarifies the relation between the concept of development and sustainability. Rural development is involved in development concept and gradually considered as one of the leading actors of economical development both in the world and in Turkey. In addition, rural development is a process with economical, social and cultural dimensions (AREM, 2012). Agricultural sector and rural development are intertwining concepts. Thanks to it, all the improvements in subsectors of agriculture have great effects on rural development at the same time. Milas district of Mugla Province has an important agricultural potential in Aegean Region with its rich product range. A large part of olive tree areas in Turkey is located in Milas. In addition to that, it is one of the most important districts of Mugla with dairy farming, beekeeping, field fishery and citrus fruit production. This study includes investments and projects carried out in Milas district in the scope of rural development investments support program (RDISP). Also, suggestions for alternative implementations which might contribute to rural developments are discussed with the ongoing rural development projects.

## LEGISLATIONS AND REGULATIONS REGARDING RURAL DEVELOPMENT INVESTMENTS SUPPORT

The Decision on Rural Development Investments Support suggests that farmers should be supported for their individual and/or joint equity-oriented investments during five years between 1/1/2006 and 31/12/2010 within the framework of Development plans and programs and National Agriculture Strategy (Official Gazette of Republic of Turkey, 2006a).

The declaration regarding rural development investments was put into force after it was issued in the Official Gazette dated 6 April 2006 and numbered 26131. The aim of this declaration is to determine the methods and principles of increasing level of income in the rural areas, improving the infrastructure, enabling agricultural production and agricultural industry integration, strengthening food safety, creating alternative income resources in the rural areas, increasing the level of essential public services, enhancing the access to the services and forming a certain capacity in the rural areas by taking the conservation of natural resources into consideration.

Within the scope of development plans and programs and 2006-2010 National Agricultural Strategy, this declaration includes subjects regarding the steps to take in order to promote and support economic activity investments on processing, using, and marketing agricultural products of real and legal persons and investments on rehabilitate the institutions' current infrastructural facilities within the provinces

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determined in the rural areas for the equity-oriented projected investments of the farmers (Official Gazette of Republic of Turkey,2006b).

Within the framework of the rural development investments support program, a declaration on supporting the agricultural investments was issued in the Official Gazette dated 14 February 2007 and numbered 26434 and it was put into force (Official Gazette of Republic of Turkey, 2007a). As part of the rural development investments support program, a declaration of machine and equipment purchasing was also issued in the Official Gazette dated 14 February 2007 and numbered 26434 and it was put into force. The aim of this declaration is to determine the methods and principles of decreasing the production costs by generalizing plowless farming technique, sponsoring the purchase of plowless agricultural machines to increase the competitiveness of the farms and to preserve the environment, sponsoring the purchase of baling and silage machines to minimize the quality loss of roughage, sponsoring the purchase of pressure irrigation system equipment to decrease the water loss and to increase efficiency, sponsoring the purchase of refrigerated transport vehicles to convey the products to the markets. This declaration includes the principles regarding what is needed to be done in order to support by granting 50 % of the machine and equipment purchase costs which will contribute to the economic and social development within the determined provinces located in the rural areas (Official Gazette of Republic of Turkey, 2007b). In this declaration, the investment items of the purchasing support program consist of new plowless agriculture machines, baling and silage machines, goods required for pressured irrigation system and cold storage transferring vehicles.

In accordance with the 19<sup>th</sup> article of the Agricultural Law numbered 5488, Council of Ministers decided to put the Decision on Agricultural Investments within the Framework of Rural Development Support and Machine and Equipment Purchase on 18<sup>th</sup> of January in 2011 (Official Gazette of Republic of Turkey, 2011). It is stated in the decision of the Council of Ministers issued in the Official Gazette dated 19 February 2011 and numbered 27851 that rural development program of 2011-2015 period would be supported by 110 various agricultural investment projects.

Greenhouses with heating system working by residue oil, honey processing and packing facilities, trickle irrigation, facilities of processing and packing medical aromatic plants, cold storage room facilities, tomato packing facilities, fisheries processing and packing facilities, machine purchasing project in citrus fruits packing facilities, wax extraction and honeycomb production facilities, investments regarding olive and olive oil, citrus packing facilities and collective pressured irrigation facility projects are among the titles of the investment project within the support program (Mugla Provincial Directorate of Food, Agriculture and Livestock, 2012a).

#### PROJECTS IN THE SCOPE OF RDISP IN MILAS DISTRICT

In the framework of rural development investments support grant program, rural development studies with various project topics have carried out. Within this scope, there are various projects in Milas district on olive oil, fishery products, cold storage room and irrigation investments in stages II, III and IV. Project of olive oil factory technology renovation and capacity increase has been carried out within the scope of stage V (Table 1).

Table 1. Projects in the scope of RDISP (2006-2011) in Milas District

	Name of the Project	Number	Place of Implementation
RDISP-Stage II	-Project of Cold Storage Room	1	Kemikler-Milas
	-Project of fishery products processing and packing facility	1	Ekinambari-Milas
RDISP-Stage III	-Project of technology renovation in olive oil factory	1	Alatepe-Milas
	-Project of fishery products processing and packing facility	1	Gulluk-Milas
RDISP-Stage IV	-Project of olive oil establishment technology renovation*	2	Center-Milas Balcik Locality-Milas
RDISP-Stage V	-Project of olive oil establishment technology renovation	1	Goldere-Milas

Source: Mugla Provincial Directorate of Food, Agriculture and Livestock, Rural Development Investments, Department of Rural Development, 2012b.

\*1 unit of the project is implemented in cooperative base.

- **Project of cold storage room** :The investment topic of this project is technology renovation and total project cost is 459223,73 TL. Grant amount within the scope of RDISP is 174999,99 TL, investment capacity is 1000 tons/year. 6 people are employed by this project.
- **Project of fishery products processing and packing facility**: In this facility, capacity increase project is about technology renovation. The total cost of the project is 341050 TL, grant amount within the

scope of RDISP is 170525 TL. Investment capacity for the project is 10 tons/day and 40 people are employed.

- **Project of technology renovation in olive oil factory:** It is planned as a new facility and its total project cost is 338360 TL. 169180 TL of this amount is separated as grant within RDISP. Investment capacity of the project is 60 tons/day. Provided employment is 10 people.
- **Project of fishery products processing and packing facility:** Planned as a new facility, total project cost is 732808 TL and grant amount within the scope of RDISP is 130600 TL. Investment capacity of the project is 20 tons/day and it has provided employment to 250 people.
- **Project of collective sprinkler irrigation system:** Having the feature of new facility technological renovation project, its total cost is 408353,23 TL. Grant amount within RDISP is 281484,91 TL. Investment capacity is 2171 decares and provided employment is 52 families.
- **Project of olive oil establishment technology renovation:** Total project cost is 500000 TL, and grant amount is 234500 TL. Investment capacity of the project is 180 tons/year and provided employment is 35 people.
- **Project of olive oil factory technological renovation and capacity increase:** 516905 TL is the cost of the project, and 245556 TL of this amount is given as grant within the scope of RDISP. Investment of the project is 60 tons/day and four people have been employed for this project.
- **Project of olive oil establishment technology renovation:** total project cost is 416000 TL, and grant amount is 196500 TL. Investment capacity is 45-60 tons/year, and provided employment is 11 people.
- **Project of olive oil establishment technology renovation:** Total project cost is 104000 TL, and 42775 TL of this amount is given as grant. Investment capacity of the project is 40 tons/day and provided employment is five people.

As a part of rural development investments support program (RDISP), another support issue is machine and equipment purchasing. The number of the beneficiary producers of machine and equipment support increased gradually in Milas district between the years of 2007 and 2011. Especially for the producers who still do handpicking or picking by sticks, the support of olive harvester machine has considered as a first step towards high quality olive and olive oil production in Milas district in 2010 and 2011. Also the support of milking unit in daily farming, which has an essential potential in Milas district, and cooling tank to establish the cold milk chain will be able to make important contributions to a healthy, hygienic and high quality milk production (Table 2).

Table 2. Machine and Equipment Supports in Milas District within RDISP (2007-2011)

Machines and equipments	Number of RDISP beneficiary farmers				
	2007	2008	2009	2010	2011
Bailing machine	-	5	2	-	-
Bailing- Silage machine	-	1	-	-	-
Silage machine	-	4	4	9	13
Walking tractor and equipments	-	7	13	-	43
Strimmer	-	1	-	-	-
Drop irrigation	-	1	-	-	-
Atomizer	-	5	7	9	52
Feed grinder machine	-	-	10	-	-
Feed grinder equipments	-	2	-	-	-
Milking machine	-	1	5	-	-
Extruded meadow clove machine	-	-	-	-	-
Olive harvester	-	-	4	100	166
Grain drill	-	-	1	-	12
Cool storage transferring vehicle	1	-	-	-	-
Rotary tiller	-	-	16	-	-
Lawn mower	-	-	9	-	25
Milking unit and cooling tank	-	-	-	18	48
Beekeeping machine and equipments	-	-	-	-	1
Motor scythe	-	-	-	-	1
Grain threshing machine	-	-	-	1	-
Disc harrow	-	-	-	-	10
<b>TOTAL</b>	<b>1</b>	<b>27</b>	<b>71</b>	<b>137</b>	<b>371</b>

Source: Mugla Provincial Directorate of Food, Agriculture and Livestock, Rural Development Investments, Department of Rural Development, 2012b.

## **RURAL DEVELOPMENT PROJECTS IN MILAS DISTRICT**

### **Milas-Bodrum Rural Development Project**

This project aims a wise usage of the natural resources and their organic agricultural production potential in order to increase the income of local people. At that point, with the aim of providing life standards as farmers used to have, encouraging and supporting them are the main factors to obtain sustainable income from regional and international sales of organic agricultural products and to encourage and motive the development of the region. This project also gives tourists a chance to see local cultures in harmony with natural environment of Turkey. The scope of the project is to analyze the viability assessment of the investments based on organic agriculture and ecotourism. Also these investments are thought to be able to contribute a lot to sustainable economic and social development of Gokceler- Camseki Valley rural area. Gokceler-Camseki Rural Development Project is defined as a feasibility study focused on providing sustainable social development by strengthening organic agriculture, ecological tourism and cooperatives. As a joint project with Spain, the villages of Alacam, Balcilar, Beyciler, Demirciler, Gökceler, Hasanlar, Kisirlar, Kuzyaka, Sogutcuk and Karapinar are in the scope of this project. It is financed by Spain Government (Anonymous, 2011).

### **The Projects of Southern Aegean Development Agency (GEKA)**

GEKA is a development agency aiming to globally increase the competitiveness of the rural area and to rise the prosperity of local people in order to supply a wise usage of the resources in Southern Aegean region, deploy local potential with the whole sharers, provide investment and innovation capacity (GEKA,2012a). GEKA supports the prospective projects in Aydin, Denizli and Mugla provinces within the scope of effective usage of the regional resources. By 2010, two projects have been carried out within the scope of economical development and financial support program; Cold Milk chain and Milk Quality Enhancement Project in Milas and Workforce Improvement in Inland Fishery Production and Rise of Export Project in Milas District.

### **Cold Milk Chain and Milk Quality Enhancement Project**

Carried out by milk producers association in Milas district with the participation of Milas district Directorate of Agriculture, the project has been implemented in 7 villages including Kircagiz, Kizilcayikik, Bahceburun, Epce, Cinarli, Meselik and Kafaca. Within the scope of this project, it is aimed to establish cold chain by placing 1 or 2 milk cooling tanks depending on the village capacity. It is planned that ISO 22000 standard is going to be purchased in terms of traceability (Milas Onder Newspaper, 2011).

### **The Project of Labor Improvement in Inland Fishery Production and Increasing Export in Milas District**

In the project, as the project owner Milas Chamber of Commerce and Industry (MİTSO) and participants as project partners including Mugla University Faculty of Fisheries, Milas Inland Fishery Production Producers Association and Milas Chamber of Agriculture, it is aimed to train workers and prospective workers of inland fishery production and its export sector. It is also aimed to support sustainable economic development of the region in order to be risen of product quality and employment by promotions in domestic and foreign markets and creating a market (MİTSO, 2012).

## **OTHER PROJECTS CONTRIBUTING TO RURAL DEVELOPMENT IN MILAS DISTRICT**

### **Projects for Rural Tourism Support**

#### **-Sleep Valley Theme Park Project**

Governorship of Mugla has generated “Themed Park Project” consisting of culture camp, Karia Open-air Exhibition, Anatolian Handicrafts Village where local handicrafts and agricultural products are sold, view terrace, small lake, cave administration unit, resting points, café, buffet and walking tracks. Studies on the project are still continuing (Yucel, 2008).

**- Comakdag Cloth Doll Project**

Carried out under the responsibility of Mugla Provincial Directorate of Tourism and Milas District Governorship, Comakdag Traditional Clothes Doll Project is created with the aim of enabling both employment and financial input for Comakdag village (Yucel, 2008).

**ALTERNATIVE IMPLEMENTATIONS FOR THE FUTURE RELATED TO RURAL DEVELOPMENT IN MILAS**

Besides the implemented projects, Milas district is in need of studies for rural developments in new and different areas. Although organic agricultural implementations has been carried out in a pilot region in the scope of Milas-Bodrum rural development project, studies on spreading the pilot projects like organic agriculture and good agriculture implementations are very important for the district. Olive production potential of Milas district shows that organic olive and olive oil production and marketing might be seen as one of the rural development projects. Especially projects providing olive and olive oil branding need to be brought to the foreground. As Milas has a great potential of dairy cattle breeding and beekeeping, projects for generalization of organic milk and organic honey should be considered in a serious manner. Due to its coastal line, pond fishery (field fishery) should be one of topics of the rural development projects in Milas where fishery production is very important. Aiming much more effective field fishery which have been founded in Milas district, GEKA project can be seen as an important step in terms of its contributions to rural development implementations in the region. Rural tourism implementations are also quite appropriate for Milas district thanks to its natural and historical beauties. Especially with the help of generalization of organic agriculture, ecological agriculture can be seen as an alternative implementation in the scope of rural development. For this purpose, projects based on generating ecological villages will be able to provide essential contributions to rural development. The sustainability of regional handicrafts has an important place in terms of rural development projects for rural tourism in Milas known by its hand-knotted carpets throughout the history. Therefore, being one of the most important cultural values of Milas district, Cultural Promotion Handbook Series by GEKA will help to pass it down to next generations. Cultural Promotion Handbook Series titled ‘The Treasure Laid on your Hearts’ can be seen as an important step for the promotion of Milas carpets (GEKA, 2012b).

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# THE IMPORTANCE OF THE PARTICIPATION TO AGRICULTURAL FAIRS FOR FARMERS

Tayfun ÇUKUR<sup>1</sup>

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## ABSTRACT

Agricultural fairs are important agricultural organizations gathering all the stakeholders of the sector and presenting recent developments, new products and technology to the producers. In agricultural fairs, producers have chance to meet with all the stakeholders of the sector especially with the company representatives; and to obtain detailed information about recent technologies, method and application, legal regulations, etc. In addition to that, by sharing agricultural methods they applied, common problems and expectations from the sector, producers realize an information transfer from farmer to farmer. In this study, secondary data have been used as a material. For this purpose, related previous studies have been examined. First, general information about fairs then the importance of the fairs in terms of producers are presented in this study. Also, agricultural fairs organized in Muğla province Milas district examined as a case study.

**Key Words:** Fair, farmer, sales development, information

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## INTRODUCTION

Throughout history, as long as trade has existed, fairs and exhibitions have existed, as well. At first, fair organizations started in certain places with basic and practical exhibitions for the purpose of selling or exchanging the goods that people produced. But today, fairs have turned into worldwide activities thanks to advanced technological developments (Çoşkunurt, 2007).

Fairs are activities that its organizer, title, type, place, theme, date and duration are predetermined. Fairs aim to transfer and promote related technological developments, information and innovations; enable information interchange between visitor and participant; establish and enhance trade relations in order to expand the market size and collaboration. Fairs support the rights of the field, sector and society (Anonymous, 2007).

In fairs with their gradually growing commercial and economical dimensions, participant firms or companies have meetings with the visitors at their separated area, exhibit their products or promote their products or services by using their corporate images and corporate identity (Anonymous, 2011). In a commercial fair, it is possible to get the customers' attention through five senses. By face-to-face communication, enhancing the commercial relations is highly possible (Göksel & Yurdakul, 2007).

The organization of the agricultural fairs provides basis to promote recent technological machines of the manufacturers. Manufacturers come together with the institutions, companies and farmers and present their manufacture to both rivals and visitors (Anonymous, 2008). In agricultural fairs, producers have chance to meet with all the stakeholders of the sector especially with the company representatives; and to obtain detailed information about recent technologies, method and application, legal regulations, etc. In addition to that, by sharing agricultural methods they applied, common problems and expectations from the sector, producers realize an information transfer from farmer to farmer. Although farmers access information from different resources, agricultural fairs keep their great importance with regards to bring the farmers together and provide them to learn from each other (Skillman, 2002). Agricultural fairs, through that point of view, can be seen as an important activity providing agricultural information to farmers. Likewise, it is specified in a research done in India that fairs supply beneficial information for producers (Malhan & Rao, 2007).

## MATERIALS AND METHODS

In this study, secondary data have been used as a material. For this purpose, related previous studies have been examined. First, general information about fairs then the importance of the fairs in terms of

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producers are presented in this study. Also, agricultural fairs organized in Muğla province Milas district examined as a case study.

#### **FAIRS IN THE SCOPE OF SALES DEVELOPMENT**

Sales development is sale efforts generally conducted interruptedly like fairs, exhibitions, etc. apart from personal sale, advertisement and promotion efforts (Megep, 2008b).

Fairs are involved in sales development activities as a part of marketing promotion studies. Today, competition among companies has highly increased. The access of the companies to target markets, promotion of the products that satisfies company-specific requirements and needs by good communication with the customers have become very important. One of the best means to accomplish this is commercial fairs. The most important feature of those fairs is using the promotion tools at the same time and place with a decreased cost. Various public relations methods can be used by the companies participated to the fairs. These methods can be listed as brochures for the visitors, directly written letters, commercials, catalogs published in different languages, press conferences, posters prepared for the interior and exterior walls of the fair, news for press, opening day invitations, specific events related with trade sector and the public (Megep, 2008b).

#### **THE IMPORTANCE OF THE FAIRS**

##### **1. The importance of the fairs in terms of customers**

Observing the various products of different companies at the same place, customers can easily identify the most appropriate product or service according to their needs. It gives customers to save time and sensible shopping opportunity (Megep, 2008a).

##### **2. The importance of the fairs as a mean of mass communication**

Fairs have great benefits in terms of knowing the other countries in commercial, economical, social and cultural aspects and maintaining the solidarity and relation between them. Today, fairs are one of the modern communication facilities just like advertisement or public relations. Fairs have made great progress about giving information of the company to the target group, promotion and strengthening the corporate image (Megep, 2008a).

##### **3. The importance of the fairs in terms of the contributions to region/city**

Fairs have become important by gathering people from different regions, countries and cultures. These organizations helped to establish communication and cultural sharing among these. Fairs enable notable mobility to the fields that organized about. During the fair period domestic and foreign tourism are increased. Thanks to the participants and visitors coming from foreign countries or other cities to visit the fair, mobility in the market is seen for a short period of time but it makes significant contributions to economy (Megep, 2008a).

##### **4. The importance of the fairs in terms of marketing communication**

Under the current conditions of the market, no matter how good and qualified products a company produces, it cannot be successful in the field unless the company promotes its products with the correct strategies. At this stage, being one of the major elements of marketing communication process, commercial specialized fairs help to increase the efficiency of the other communication efforts (Megep, 2008a).

#### **THE IMPORTANCE OF THE PARTICIPATION TO FAIRS FOR FARMERS**

The participation to the fairs where new products and technologies are presented is quite important for the farmers. By this means;

- Farmers have knowledge about agricultural technological developments (agricultural product and inputs).
- Farmers have knowledge about agricultural systems (organic agriculture, good agricultural practices, integrated product management, etc.).

- Farmers have knowledge about the alternative products they might cultivate.
- Company representatives present very detailed information to farmers.
- Farmers have the opportunity to apply the innovations in agriculture to their farms.
- Farmers are informed about various agricultural fields (plant production, animal production, aquaculture, etc.).
- New products/models can be developed in accordance with the feedbacks, demand and suggestions of farmers.
- Farmers make much better and conscious production.
- Farmers apply the new technology whenever they want thanks to the demonstration areas.
- Farmers have chance to come together with research institutions, extension institutions and university staff members thanks to scientific activities organized during the fair (seminars, panel discussion, etc.).
- Farmers update their knowledge with various competitions organized during the fair.
- Farmers have chance to see the tools, equipments and machines collectively especially about agricultural mechanization. Thus, they can make comparison between the alternatives.
- Fairs create a social environment. During the fair, farmers have chance to share their ideas, experiences, expectations and problems.
- Producers participating to fairs might benefit from special sale campaigns.
- Brochures and leaflets collected by farmers during their stand visits have value of essential resources for the process of agricultural production.

#### **AGRICULTURAL FAIRS IN TURKEY**

The number of the fairs planned to be organized in 2012 in Turkey is 425, 46 of them are about Agriculture, Greenhousing, Animal Husbandry and Technologies (TOBB, 2012). As well as general subjects, fairs are organized about various specialized fields (Gürüz, 2003). By the year of 2012, 414 specialized fairs and 11 general fairs are planned to be organized (TOBB, 2012). Specialized fairs are activities that last less than ten days and have twenty participants minimum. These fairs aim to improve information exchange about technology and its practice; create an atmosphere of the information exchange for commercial cooperation; place an order for the products in need for the participants who produce certain products or product groups and goods and services for the sector or directly-related to the sector (Sülün, 2006). Agricultural fairs have the characteristics of the specialized fairs.

#### **AGRICULTURAL FAIRS IN MILAS DISTRICT**

Milas is a district within the boundaries of Muğla province. Milas has vast agricultural potential. Especially olive and olive oil, beekeeping and aquaculture have essential contributions to the district economy.

Agricultural fairs started in 2010 in Milas district. 1<sup>st</sup> Milas Food, Agriculture and Animal Husbandry Fair is organized in 2010, and 142 companies participated all over the country and more than 30 products presented. Two hundred thousand people visited the fair (Anonymous, 2012a).

Milas 2<sup>nd</sup> South Aegean Agricultural Fair was organized between 3- 6 May in 2011 in Milas. Mostly engaging in agriculture technologies, agricultural mechanization, animal husbandry technologies, animal health, feed, seed, nursery, irrigation, manufacture of packaging and marketing, 168 companies participated to the fair. The number of the people visiting the fair was 133000 (Anonymous, 2012b). Olive oil competition, women farmers' competition and a panel discussion themed crop production and animal production are also organized as a part of the fair.

145 companies participated to 3<sup>rd</sup> Milas Food, Agriculture and Animal Husbandry Fair and 400 different products are presented and sold. 113000 people visited the fair (Anonymous, 2012c).

## DISCUSSION AND CONCLUSION

**Agricultural fairs can be considered as important agricultural organizations in terms of both providing information about the new technology and exchanging ideas between producers. There are some remarkable points and some precautions to be taken in order to increase the efficiency of the agricultural fairs and contribute much more to the region and producers:**

**-First of all, the promotion of fairs is very important. Both local companies and farmers have to be informed about fairs. Fairs must be organized as specialized fairs and the participants must only be the visitors who are related to the fair and its theme. On the other side, the participation of the companies carrying on an irrelevant business must be restricted.**

**-Farmers institutions (chamber of agriculture, cooperatives) must support and encourage the participation of the farmers.**

**-Fair areas should be created in the districts; awareness of fairs should be increased for local people and regularity of fairs should be maintained. It is important that fair areas should be close to the city centers.**

**-Timing is the other important point for fairs. Fairs should be organized in post-harvest period rather than the period of agricultural activities.**

**-The stands of the rival companies should be side by side. Hence, farmers compare the products easily.**

**-Panel discussions and conferences should be held; application and demonstration areas should be created in fairs.**

**-Fair organization has a great importance. The needs of both participant companies and visitors such as toilette, food, etc. should be satisfied. Hygiene should be thought as a delicate subject. Light and sound system in the area has great importance. Also internet should be supplied to the companies participating to the fair.**

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# THE IMPORTANCE OF AGRICULTURAL MARKETING EXTENSION

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## ABSTRACT

Agricultural marketing is a long process continuing between pre-production and consumption. Agricultural production, supply, demand, sale and price formation topics are all included in this process. So farmers need both technical information and information related breeding technique, economics and marketing as well. Agricultural marketing extension can be described as an education program which provide information to farmers to solve marketing problems. Taking into consideration characteristics of agricultural products the importance and necessity of agricultural marketing extension is arised. Agricultural products are produced and marketed in a short period, due its shelf life. Although some are stored in industrial silos or other means for use in shortage and or famine. Today finding the market and a suitable price presents a challenge to farmers in rural areas who has no access to big markets. The presence of a centralised and effective marketing organization involved in the purchase of inputs and selling of goods are important for farmers. In this study, secondary data were consulted extensively and opinions from related previous studies were examined. The concept of agricultural extension and its importance were examined and the agricultural market information and its importance to agricultural marketing were also studied.

**Key Words:** Agricultural marketing, agricultural extension, agricultural marketing extension

## INTRODUCTION

In Turkey, agricultural sector has a significant role based on macro-economic parameters. A great amount people live in the rural areas and work as farmers. Agriculture contributes to agro-based industries by producing raw materials and also has a major role in foreign trade. Turkey has 3,022,127 agricultural holdings and an average farm size is 6.1 hectare. In Turkey, agriculture contributes 9.2% to the GDP<sup>4</sup>. The share of agriculture in total employment is 25.2% (Table 1).

Table 1. Indicators on Turkish Agriculture (2010)

Total agriculture area (1000 hectare)	39054
Total employment (1000 people)	22594
Agricultural employment (1000 people)	5683
Agricultural employment share (%)	25.2
Agricultural gross domestic product* (1000 TL)	9703312**
Agricultural gross domestic product share in total (%)	9.2
Share of agricultural products export in total export (%)	13.23
Total agricultural holdings ***	3022127
Average farm size (hectare)	6.1

\*1998 fixed prices \*\*Temporary information \*\*\*Information from 2001

Sources: -TÜİK Tarım İstatistikleri Özeti, 2010, Yayın No: 3640, Ankara.

-TÜİK Türkiye İstatistik Yıllığı, 2011, Yayın No: 3665, Ankara.

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Marketing is a very important activity for farmers as they would have to sell their crops for income. Due to this, it is necessary that the farmers adopt modern marketing methods and techniques and market information reach to enable them maximize profits.

With the help of agricultural marketing extension workers, farmers will have the opportunity to learn and use the basic principles and concepts of marketing. This way, they can prepare their production and marketing plans; investigate local, national and international markets' agricultural inputs and product prices, and gain interpretation and analyzing skills.

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<sup>4</sup>GDP: Gross Domestic Product

## MATERIALS AND METHODS

In this study, secondary data were used. For this purpose, related previous studies were also examined. First, agricultural extension concept and its importance for farmers were examined. Agricultural market information and its importance in agricultural marketing extension were studied.

### THE CONCEPT AND IMPORTANCE OF AGRICULTURAL EXTENSION FOR FARMERS

Agricultural extension is a voluntary training system that helps farmers socially, economically and culturally. Technical information and research results about agricultural subjects are delivered to farmers through agricultural extension activities (Yurttaş, 2000). Agricultural extension plays the most effective role in the increasing production with the transfer of new technology. Beside this, agricultural extension is the basic element of production increase and as a production factor; it's an effective factor of the human factor development (Özçatalbaş and Gürgen, 1998). Extension is the milestone of research and progress (Qamar, 2005). Agricultural extension acts as a bridge between research institutions and farmers, transfers farmers' problems to the research institutions. This way, solutions for the farmers' problems can be found through planned research. Competition in agricultural sector has been growing both locally and globally. Because of this situation, farmers have to use their sources efficiently to be superior. There is no doubt that agricultural extension activities have an important effect on how farmers use their sources efficiently. On the other hand, lately, technology in agricultural sector has been changing as well as the technology in other sectors. As a result, the significance of the information about new technologies has been increased. Agricultural extension accomplishes an important service by transferring new technologies to the farmers.

Countries have to do some regulations to improve the agricultural structure, use their resources effectively, increase farmer incomes etc. Agricultural extension services do another important duty by delivering these changes to farmers.

### AGRICULTURAL MARKET INFORMATION AND THE IMPORTANCE OF AGRICULTURAL MARKETING EXTENSION

Agricultural market information can be defined as the information related to agricultural products, service, and supply and demand for inputs (Wandschneider and Kim Yen, 2012). Examples about the agricultural market information are presented in Table 2.

Table 2. Categories and examples of market information

Market information categories	Market information examples
Inputs	The distance of input providers The type and quality of inputs achieved Prices of different inputs
Demand	The size of local, regional and national markets The trend of development of demand Seasonality of demand
Clients	Distance and contact Quantity requirements Quality characteristics Packaging requirements Seasonal demand Recommended deals Terms of payment Provided support services (credit, etc.).
Prices	Prices in different markets Different prices based on quality Seasonal prices Price variations during the season Price trends
Competition	The main supply areas Quality of products supplied from different areas Seasonality of supply of products from different areas Import
Import	Transportation Market prices Unofficial fees Other

Source: Wandschneider, T., N. Kim Yen, 2012, Module 1, Guide to Agricultural Marketing Extension with Special Reference to Vietnam,

<http://www.eap.lehagere.com/sites/default/files/Guide%20to%20Agricultural%20Marketing%20Extension%20with%20Special%20Reference%20to%20Vietnam%20Module%201%20P3.pdf>

Function of market information covers collecting, analyzing and spreading data and helps some functions to fulfill; for example, the purchase, sale, transportation, storage, grading, finance, risk taking (Durmaz, 2000). Market information makes agricultural market system easier. It eases decision-making; organizes the process of competitive market and makes marketing mechanisms easier. Market information increases the efficiency of marketing system and influences high-price formations (Amrutha, 2009).

Farmers have to make many decisions about production and marketing during the process. Information about the market helps farmers to evaluate their options. Some of these options are can be listed this way:

- i. What and how much should the farmers produce?
- ii. What kinds should be grown?
- iii. What should the farmer do after harvesting?
- iv. Should farmers store the crops?
- v. Who should farmers sell their crops to?
- vi. Should farmers sell their crops individually or in groups?
- vii. How should farmers bargain with consumers? (Wandschneider and Kim Yen, 2012)
- viii. Which section of the market is the best for crops?

Marketing extension can be defined as an educational program that provides information to help to solve problems that farmers, consumers, commissioners, other attendants and/or institutions have about marketing (Olgun, 1995). There are 3 main points of agricultural extension activities related to marketing:

Farmers should know their sales opportunities based on place and time, and watch the price movements. Information about the market should be delivered to farmers.

Farmers should be more efficient in marketing activities and attention should be given to training and organizing in this field.

In order for these two elements to be executed properly, the development in organization of farmers' and cooperative activities should be considered more important (Ceylan, 2010).

Marketing extension helps farmers to see their future and is also an important factor to eliminate the constraints related to marketing. Marketing extension aims to educate farmers, consumers and traders, and make a remarkable change in their knowledge, behaviors and interests. Marketing extension includes the following: Recommendations on production planning, Finding markets for farmers, Training and giving advice about important marketing practices and recommendations on establishing and running rural markets (Anonymous, 2012a). Farmers need some advice on cultivating marketable products, current prices, market access, market trends, forecasts and post harvest management practices. Because of this matter, it is important to have a strong marketing extension network. Through marketing extension, farmers can access information about production planning, finding markets, advanced marketing practices and post harvest management practices (Anonymous, 2012b). Marketing extension can be described in six processes: evaluation of existing products, analysis of selected products, market research, market research analysis, selection of marketing strategies, develop and implement action plan (Poitevin and Hossain, 2006). With the agricultural marketing extension, the producers can determine and have information about the consumers' choices and potential buyers, demand for their product and payment capacities, marketing strategies for their products (Boz and Candemir, 2007).

## **OVERVIEW OF AGRICULTURAL EXTENSION STUDIES IN TURKEY**

In Turkey, pluralist agricultural extension system is more common than other systems. Regulations about Agricultural Extension and Advisory Services Arrangement had been published in an official gazette as a government policy. Regulations clearly states that independent agricultural consults, agricultural consults, agricultural consultancy organizations/foundations, agricultural consulting firms



and agricultural extension enthusiast and or practitioners will take part in extension activities. Agricultural extension has a very broad subject area. Agricultural extension organizations services include various topics such as production techniques and environmental protection. Most of the agricultural extension studies in Turkey focus on issues that are related to production techniques. However, agricultural marketing has gained importance lately. Agricultural Strategy (2006-2010) has many goals as improving the agricultural marketing infrastructure, increasing market access for farmers, developing agro-industry integration, ensuring the quality of raw materials that will increase the competition in processing industry, and meeting consumer preferences. The IPARD<sup>5</sup> program emphasizes on marketing as well. It can be inferred that the precaution, titled 'processing and marketing agricultural products' is supposed to be listed under rural development measures and will help solve one of the typical problems in Turkey: finding markets (Akın and Yıldız, 2005). IPARD has 3 priorities. One of these priorities is improving market efficiency and implementing community standards. Measures about this priority are:

- Investments in agricultural holdings to restructure and upgrade to the EU standards
- Investments in processing and marketing of agriculture and fishery products to restructure and upgrade to the EU standards
- Supporting the setting up of producer groups (Anonymous, 2012d).

## RESULTS AND DISCUSSION

Marketing is a very significant activity for agricultural businesses as well as other businesses. Because of this situation, it is very important to find and fix agricultural marketing problems for economic sustainability. Agricultural extension services, in addition to technical extension studies, should also provide enough, necessary and up-to-date information about market/marketing for farmers, and help selling the products at higher prices. The importance of producing crops according to market demands should be taught to farmers. Marketing mix should be explained to the farmers in the main and auxiliary services of marketing with an extension program. On the other hand, farmers should be financially supported for processing, classifying and packaging etc. Extension organizations should emphasize on the issue of financing and provide technical support to farmers' agricultural credit usage.

Extension services should develop programs to strengthening the capacity of farmer co-operatives to be involved in the marketing stages of inputs and products. Contract farming should also be introduced to producers, farmers should benefit from the advantages of contract farming. In recent years, the growing importance of food safety which directly impacts on human health in gaining global attention especially on the quality of crops produced for human consumption. In this respect, quality management standards should made known to farmers and how to produce crops with better quality and health management standards.

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<sup>5</sup> IPARD: Instrument for Pre-Accession Assistance for Rural Development

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# SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACTS OF BIOFUELS; AN EVALUATION FOR THE FUTURE GENERATIONS

Funda GENCLER<sup>1</sup>

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## ABSTRACT

For several decades, alternative solutions are being seeking to ensure energy flow for the future generations. One of the alternative solutions is biofuel. Biofuel is a type of fuel whose energy is derived from biological carbon fixation. According to the energy market reports the global biofuel consumption market grew by 24.4% in 2010 to reach a value of 127,586.8 million US dollars. In 2015 the global biofuel consumption market is forecast to have a value of 250,511.5 million US dollars, an increase of 96.3% since 2010. Due to this rapid growth, there have been some consequences like food crisis and several environmental issues. Regarding these problems some of researchers are strongly reinforcing this rapid growth as a solution for energy consumption. On the other hand, others are opposing to this idea.

In this paper, socio-economic and environmental impacts of biofuels are evaluated within the opposite scopes. The data will be derived from international statistics. Besides the EU and US biofuel policies, this paper also aims to analyze the impacts of the global approaches in the transition countries like Turkey.

**Key Words:** Biofuel, enviromental issues, food crisis

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## INTRODUCTION

Biofuels have become a leading alternative to fossil fuel because they can be produced domestically by many countries, require only minimal changes to retail distribution and end-use technologies, are a partial response to global climate change, and because they have the potential to spur rural development (Rajagopal et al., 2007). Biofuels can include relatively familiar ones, such as ethanol made from sugar cane or diesel-like fuel made from soybean oil, to less familiar fuels such as dimethyl ether (DME) or Fischer-Tropsch liquids (FTL) made from lignocellulosic biomass. A relatively recently popularized classification for liquid biofuels includes “first-generation” and “second-generation” fuels. There are no strict technical definitions for these terms. The main distinction between them is the feedstock used. A first-generation fuel is generally one made from sugars, grains, or seeds, i.e. one that uses only a specific (often edible) portion of the above-ground biomass produced by a plant, and relatively simple processing is required to produce a finished fuel. First-generation fuels are already being produced in significant commercial quantities in a number of countries. Second-generation fuels are generally those made from non-edible lignocellulosic biomass, either non-edible residues of food crop production (e.g. corn stalks or rice husks) or non-edible wholeplant biomass (e.g. grasses or trees grown specifically for energy). Second-generation fuels are not yet being produced commercially in any country (UNCTAD, 2008).

Liquid biofuels can today be classified into three main sources of production: sugarcane ethanol from Brazil, corn ethanol from the United States, and rapeseed biodiesel from Germany. Brazil and the United States together produce about 90% of the 36 billion litres of ethanol produced globally, while Germany accounts for over 50% of the 3.5 billion litres of global biodiesel production (Martinot, 2005).

The major factors that account for the explosive growth of the biofuel sector and widespread enthusiasm for the technology are:

- 1) The opportunity to reduce dependence on fossil fuels through renewable energy;
- 2) The search for energy independence or energy security in emerging economies and in countries such as U.S.;
- 3) Its potential to reduce the net emissions of carbon dioxide into the atmosphere and help address global warming; (European Commission, 2006) and
- 4) Its potential to raise commodity prices, improve farmer income and increase rural employment opportunities (FAO, 2006).

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Biofuel development has been increasingly portrayed as a strategic way to address many current social and ecological problems around the world. International financial institutions (IFIs) such as the World Bank and regional banks are promoting biofuel development as a sustainable development strategy for meeting the world's growing transportation fuel needs (Varghese, 2007).

*Table 1: Total biofuels production (thousand barrels per day)*

	2006	2007	2008	2009	2010
North America	340.1505	472.8301	666.4791	768.71809	914.4242
United States	334.9505	457.3301	649.6791	746.51509	887.6242
Central & South America	330.5395	425.8854	533.6738	533.48639	588.25312
Brazil	307.3092	395.6761	486,3488	477.52839	527.32212
Europe	123.66	153.6	196.95	231.48	248.311
Eurasia	0.82	1.37	3.2	5.1	4.36
Asia & Oceania	44.901	49.222	75.573	93.767	99.211
World	840.3705	1103.107	1476.221	1633.06158	1855.6488

Source: US Energy Information Administration ([www.eia.gov](http://www.eia.gov)), 2012

According to Table 1, it can be seen that biofuel production is increasing year by year from 2006 to 2010. The most of the production is done in USA and followed by Brazil.

*Table 2: Total biofuels consumption (thousand barrels per day)*

	2006	2007	2008	2009	2010
North America	379.9463	494.2271	676.27757	768.49596	888.303
United States	374.5463	472.5271	650.47757	740.58296	853.703
Central & South America	201.6762	275.60815	364.37384	438.07631	455.46686
Brazil	195.2259	268.47785	355.65284	420.26531	424.33586
Europe	123.021	173.386	238.18	292.545	329.635
Eurasia	0.594	1.3914	1.8886	1.98	2.6
Asia & Oceania	42.0605	45.79	68.85	83.1501	91.9705
World	747.398	990.90265	1350.30501	1584.49737	1768.27536

Source: US Energy Information Administration ([www.eia.gov](http://www.eia.gov)), 2012

Table 2 shows the biofuel consumption. As it can be seen from Table 2 biofuel is consumed mostly in USA and Brazil where the biofuels mostly produced.

In this paper, firstly biofuel policies are examined and then socio-economic and environmental impacts of biofuels are evaluated within the opposite scopes. Besides the EU and US biofuel policies, this paper also aims to analyze the impacts of the global approaches in the transition countries like Turkey.

#### BIOFUELS POLICIES IN THE U.S., EU AND BRAZIL AND IN OTHER TRANSITION COUNTRIES

Support for the production and distribution of biofuels continues to expand in many countries. The magnitude and impact of these subsidies is imperfectly understood, as is their relation to the reporting and monitoring of subsidies in the WTO.

The incidence of mandates and their accompanying subsidies is complicated both by the number of ways in which subsidies are paid and by the various stages involved in the production and distribution of biofuels.

Support for the production of biomass (predominantly corn and sugar cane for ethanol and oilseeds and tree oils for biodiesel) is both through direct and indirect subsidies to producers. Trade policies sometimes increase availability of biomass, but more commonly make it more expensive by protecting

local producers. Support for the production and distribution of the biofuels themselves includes cost-reducing measures, guaranteed prices and tariffs on imported biofuels (Table 3). Support for the use of biofuels comes in the form of tax credits for blenders and blending requirements. In addition, subsidies are common for research, in particular into second and third generation biofuels (from plant waste, non-food crops and algae). Calculations of the level of support have been in the range of \$7 billion in the U.S., \$4 billion in the EU; Brazilian support has not been quantified, but investment subsidies and flexible mandates support the industry - though as the biomass used is produced at low cost, the need for subsidies is arguably less than in other countries.

Table 3: Classification of types of government incentive for the biofuel sector

Classification of program	Instruments used	Examples
Support for Production of Biomass	Direct Subsidies for biomass production	EU ECA introduced in 2003 (subsequently removed); eligibility of biomass for conservation payments
	Indirect subsidies for biomass production	Fuel, fertilizer and water subsidies; crop insurance and income subsidies to biomass producers
	Trade policies on biomass	Tariff concessions; export restrictions
Support for Biofuel Production and Distribution	Reduction of capital and infrastructure costs	Capital grants for biofuel plants; concessional loans for ethanol producers in U.S. under ESA (1980); "enhanced capital allowances" under the tax code
	Reduction of production costs	Income tax credit (U.S. Energy Policy Act (2005))
	Direct subsidies for production of biofuels	Subsidies per unit of production
	Guaranteed prices paid by distributor	Minimum price for biofuels; "feed-in tariff"; "green bonus" for biofuels
	Trade policies on biofuels	Tariffs on imported biofuels
	Reduction of distribution costs	Fuel excise tax credit to blenders as in U.S.; direct subsidies for distribution (Sweden)
	Quantitative promotion	Quota obligation schemes and infrastructure (e.g. fuel pump) mandates; subsidies for infrastructure
Support for Consumption of Biofuels	Price reductions for biofuels	Excise tax exemption, VAT exemption; income tax credit
	Quantitative requirements for blending	Quota obligation schemes; blending requirements
Support for Research and Development	Support for research into biofuels	Development of second and third generation biofuels

Biofuels have made rapid inroads in recent years into the market for transportation fuel. According to the UN Environmental Program, world ethanol production for transport fuel tripled between 2000 and 2007 from 17 billion to more than 52 billion liters worldwide, while biodiesel production expanded eleven-fold from less than 1 billion to almost 11 billion liters (UNEP, 2009). A period of high oil prices further boosted production of ethanol and biodiesel in 2008. Although biofuels only provided 1.8 percent of the world's transport fuel in 2007, the share of ethanol in gasoline-type fuel use reached 5.5 percent by 2008, and the share of biodiesel in diesel-type fuel use reached 1.5 percent in that year. Ethanol use in the U.S. rose to 10.75 billion gallons in 2009 and accounted for the equivalent of 7 percent by volume of the total gasoline and blended fuel sold.

The mandate for total renewable fuel for USA is increased under Energy Independence and Security Act (EISA) to 36 billion gallons by 2022. The mandated use of advanced biofuels increases to 21 billion gallons and there is a cellulosic biofuel requirement of 16 billion gallons. The cellulosic requirement counts against the advanced mandate such that the difference (5 billion gallons less any extension of the mandate on the use of biomass-based diesel) will probably be made up by imported ethanol from Brazil (Yano *et al.*, 2010). The actual use of biofuels exceeded the mandated levels in 2008, as high oil prices made blending ethanol attractive (with the help of the tax credits). In future years one could see imports of ethanol from Brazil to meet the "advanced fuel" criteria, while U.S. ethanol is exported as demand reaches the blending wall (Josling *et al.*, 2010).

The EU passed legislation in 2008 that mandated the use of biofuels in the transportation sector. As a part of its "Climate Change Package", the EU adopted the Directive for Renewable Energy (DRE) in 2009, which established an EU-wide binding target of 10 percent of transport energy from renewable sources by 2020 (EU 2009) along with a requirement that 20 percent of all energy come from renewable sources (up from 8 percent in 2009). Implementation is in the hands of the Member States, many of which have legislation in place to achieve these levels. In the United Kingdom, for example, electricity suppliers must source a specified proportion of their supplies from renewable sources or pay a penalty (the "buy-out" price), creating a financial incentive (borne by the consumer) to generate electricity from renewable sources. For road transport, a lower road-fuel tax applies on biofuels in the UK, and in addition a Renewable Transport Fuel Obligation is implemented, so both users and taxpayers in effect support the uptake of biofuel.

In anticipation of these growing demands in the EU as well as its own entry into the EU, Turkey has modified its laws to permit the sale and use of biofuels. Today a blend of 2% biodiesel in regular diesel is permitted, compared to EU law which will soon permit up to 10%. Various companies in Turkey have begun active R&D programs to achieve compliance with the higher EU targets in mind. Development of the knowledge base and production capacity in Turkey for biodiesel production represents a huge opportunity, both for Turkish domestic consumption as well as for technology and product exports to the EU and elsewhere (Kleindorfer and Öktem, 2007)

## SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACTS OF BIOFUELS

The biofuels debate focuses on an analysis of the pros and cons of using plants to produce fuel. The benefits of using biofuels may include reduced reliance on foreign oil, reduction of pollution, the production of a byproduct that cattle may eat, and economic benefit to American farmers and processors. The detriments of biofuels may include vehicle safety issues, increased pollution, soil erosion, deforestation, and increased food prices.

### Food Versus Fuel – High Food Prices

Biofuel production has pushed up prices of some food crops, an expected outcome when they are also used as feedstock. For example the price of maize increased by 23 percent in 2006 and some 60 percent during the past two years, largely because of the U.S. bioethanol program.

Some food price increases are anticipated but, as with most aspects of biofuel, estimates vary. The International Food Policy Research Institute (IFPRI) projects maize prices to rise 20 percent by 2010 and 41 percent by 2020, with similar increases for oilseeds (26 percent by 2010, and 76 percent by 2020), and wheat (11 percent by 2010 and 30 percent by 2020). FAO, on the other hand, projects that prices of coarse grains will increase by 15 percent by 2016, whereas the price of wheat would remain unchanged. Historically, agricultural prices have been affected by energy prices, especially in countries that employ intensive farming practices, because the increased cost of fossil fuel based inputs, such as diesel, fertilizers and pesticides eventually lower output. Now, with rising energy prices and improved bio-energy conversion technologies, energy prices and feedstock prices are increasingly being linked. These linkages are more readily visible in the more integrated markets of sugar and bio-ethanol in Brazil but most probably will soon emerge in other feedstock prices as well.

### Climate Change and the Environment

One of the big selling, but most debated, points of biofuel is its carbon neutrality. This means that the growing plants absorb carbon and, when harvested, release only the amount of carbon they absorbed. There is little doubt that most biofuels emit fewer greenhouse gasses than fossil fuels when used for energy, thus mitigating the effect on climate change. The debate is over the *net* carbon savings which means factoring in the amount of fossil fuel energy needed to produce the biofuel energy throughout its entire production cycle. At issue is whether the calculation should include only inputs used directly for growing the feedstock such as the nitrogen fertilizers or the energy used by farm machinery or if it should include even the energy used to make the agricultural machinery. The results will vary, depending on the type of feedstock, cultivation methods, conversion technologies and energy efficiency.<sup>4</sup> Sugarcane-based bio-ethanol saves between 80 and 90 percent of GHG emissions per mile while biodiesel from soybeans can save 40 percent. In general, biofuels from grains have lower performance, reducing carbon emissions by 10 to 30 percent per mile or, in some cases, even producing higher emissions than fossil fuels.

Impact on soil is another environmental concern that, again, is not unique to biofuels. For rural areas that fertilize with crop wastes and manure rather than external inputs, biomass production could lead to dramatic declines in soil fertility and structure. But, *there are also exceptions*. Biofuel plants such as *jatropha* and *pongamia* that grow on marginal lands have potential to improve soil quality and coverage and reduce erosion while their oilcakes can provide organic nutrients for improving soil (Kantha, 2006)

#### Land Use And Tenure Security

In reality, biofuels are not different from other cash crops but high demand and rapid expansion of biofuel production could increase conflict over land rights and utilization. If land tenure systems are weak, there is risk of appropriation of land by large private entities interested in the lucrative biofuels markets. The poor, who often farm under difficult conditions in remote and fragile areas and generally have little negotiating power, may be tempted to sell their land at low prices or where land is "*de jure*" owned by the state (typical in most African countries), find their land allocated to large, outside investors. Moreover, many developing countries have large areas of land better suited for biofuel production than for food crops. Marginal and unused lands in developing countries are suitable for cultivation of biofuel crops that grow under adverse agro-ecological conditions. India's Ministry of Rural Development reports that, of the 306 million ha of land, 173 million ha are under cultivation with the rest classified as eroded farmland or non-arable wasteland (Fairless, 2007).

#### Impact on Poverty Alleviation

Poverty alleviation and energy provision are linked: availability of local energy is fundamental to intensifying agriculture and agricultural development is essential to poverty alleviation. Biofuels provide an opportunity for developing countries to enhance national energy security by reducing their expenditures and dependence on oil imports and exposure to the volatility of international oil prices. Economies of scale are necessary for farmers and developing countries to take advantage of biofuel opportunity. Yet, small-scale farmers face obstacles in accessing supply chains, transporting crops to processing plants or selling through middlemen and policy measures would be required to ensure that small farmers are part of the national drive to promote biofuel production.

### CONCLUSION AND RECOMMENDATIONS

Appropriate policies for biofuels should be developed and integrated into a broader strategy of protecting land rights of the poor and disadvantaged, including Indigenous People, who are mostly at risk of becoming "bio-fuel refugees", to ensure that they retain ownership or usufruct rights to their land. Prioritizing improvement of land policies and land administration systems will be important to maximize the extent to which poor smallholder farmers can benefit (particularly those with insecure or customary tenure) or, in some cases, to protect them.

Despite its high bio-fuel processing potential in the world, Turkey cannot appreciate this potential due to problems related to raw material, high private consumption tax, problems in legal procedures and bureaucratic impediments. Particularly, application of high private consumption tax causes to increase production costs and consequently, companies that cannot produce biodiesel economically cease their production. Turkey is among the countries that can play an active role in biodiesel production and trade, can do so by appreciating its resources. A reevaluation of biodiesel production from the raw material stage to production and marketing stages by taking into consideration of the national characteristics will give Turkey an ability to have an active role in this area in the future (Yaşar, 2009).

Finally, for there to be sustainable domestic biofuels industries, there is a need for strong international biofuel and/or biofuel feedstock trading systems, since countries relying on domestic production alone would be subject to weather- and market-related vagaries of agriculture. In the context of global trade, sustainability certification may be instrumental to ensure that widespread biofuel production and use will be conducive to the achievement of social and environmental goals, without, however, creating unnecessary barriers to international trade. Given the still-early point in commercial development of second-generation biofuel technologies, it is difficult to project the role that developing countries will take in a global biofuel economy in the long term. One possibility is that they will simply become exporters of second-generation feedstocks, taking advantage of their favorable natural climates and low labor costs for growing biomass. A more attractive evolution would be their becoming producers, users and exporters of finished biofuels, thereby retaining domestically more of the considerable added value involved in the conversion of the feedstock to finished fuels.



**In conclusion, with new developments in technology every day, created largely because of economic incentives from the government, there is no reason to abandon the biofuels initiative. Indeed, it is only when the inertia from fossil fuel and automobile industries is overcome that true environmental progress can be made. The environmental potential of creating fuel from waste products or plants not consumed by humans is enormous. Additionally, when the very fuel that is burned to create biofuels is itself made from plants, the energy cycle will become a much more positive one.**

**There are important roles for Governments in fostering the development of biofuels industries in developing countries. The development of competitive second-generation industries will be facilitated by establishing regulatory mandates for biofuels use. Direct financial incentives could also be offered, but clear “sunset” provisions and/or subsidy caps should be designed into such provisions. Policies supportive of international joint ventures would help provide access for domestic companies in developing countries to intellectual property owned by international companies. For there to be sustainable domestic biofuels industries, there will be a need for strong international biofuel and/or biofuel feedstock trading systems, since most countries that rely on domestic production alone would be subject to weather- and market-related vagaries of agriculture. In the context of global trade, sustainability certification may be instrumental to ensure that widespread biofuel production and use will be conducive to the achievement of social and environmental goals (UNACTAD, 2008).**

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# NEW TRENDS AND INNOVATIONS AT THE FOOD MARKET: LOCAL VERSUS GLOBAL IMPACTS REFLECTIONS (CASE OF SLOVAKIA AND TURKEY)

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## ABSTRACT

In current globalized world the customers have many choices at the food market coming either from local or global producers. Some of them represent traditional values and norms and satisfy fundamental needs, but some of them show new ways how to behave, what, when and how to consume as a part of the process of acculturation. Noticeable effects of acculturation often include changes in food, clothing, and language. The paper summarizes overall consumer expectations based on latest trends as they are defined by analysts and producers and consequently categorizes them different groups used by the world's manufacturers to meet these expectations. There is a case study methodology used in the research to show some relevant examples of good practice from Slovak and Turkish food market. Examples from both markets consider social, economic and cultural impact of globalization at one side and localization/regionalization at another side, just with the only ambitious that is the most appropriate satisfaction of consumer needs and wants at the food market.

**Key Words:** Food market, innovation, customer, local tradition

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## INTRODUCTION

Food innovations are one of the most important driving forces at the food market. As the people are human beings with different values and wishes and of course, changing patterns, food innovations are those ones reflecting any changes in consumer behaviour and market trends. In food marketing, topics such as test marketing, segmentation, positioning, branding, targeting, consumer research, and market entry strategy are highly relevant. Food marketing involves other kinds of challenges or obstacles such as dealing with a perishable product whose quality and availability varies as a function of current harvest conditions. Today, processing and new distribution options provide increasing opportunities available to food marketers to provide the consumer with convenience and other innovative or attractive solutions (Horska, 2009). Marketing, services, and processing added do, however, result in significantly higher costs. For food marketing purposes the demographics plays an important role because it may help firms understand the current market place or predict future trends, market needs including. Economic and cultural diversity is to be considered at reflecting new food trends, too (Horska, 2011). According to the "GfK Purchasing Power Europe" study, European consumers had a net household income of approximately €7.9 billion available for consumer purchases in 2010 ([www.gfk-geomarketing.com](http://www.gfk-geomarketing.com)). Comparing different countries it was found many both similarities and differences, e.g. comparing the economic indicators of Central European countries, etc. Considering the case of Slovakia and Turkey we can state that purchasing power parity in terms of GDP per capita is below the EU level (over 17 000 € in Slovakia, over 11 000 € in Turkey as the estimation for 2011, comparing to the EU averagewhich is over 25 000 € ). All the economic and cultural factors are playing the very important role in the way how the latest trends and innovations are accepted by the local consumers.

## MATERIAL AND METHODOLOGY

The paper summarizes overall consumer expectations based on latest trends as they are defined by analysts and producers and consequently categorizes them in different groups used by the world's manufacturers to meet these expectations. There is a case study methodology used in the research to show some relevant examples of good practice from Slovak and Turkish food market. Examples from both markets consider social, economic and cultural impact of globalization at one side and localization/regionalization at another side, just with the only ambitious that is the most appropriate satisfaction of consumer needs and wants at the food market. Gathering the data for this research a

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secondary sources of information and publications on latest trends at the food market were mostly used. . As the research period it was considered the period from 2010, but to show the development trends, in some cases it was used also the data before 2010.

## RESULTS AND DISCUSSION

Traditional food and beverage consumption in Turkey meat, fish, vegetables, fruit, milk, tea and coffee has a significant share. Meat consumption increased by 13.14% between 2004 and 2012 and it means 24.10kg per person, in the same period fish fruit, vegetable, milk coffee and tea consumption increased respectively 6.93%, 2.12%, 9.71%, 40% and 12.50%. Also their percapita consumption is respectively 7.30 kg, 112.50kg, 231.10kg, 138.90 litres, 0.70 kg and 2.70kg (Table 1). In 2002 while the share of food expenditure ratio is 26.70%, it has become 21.90% in 2010. In 2010 the ratio is 28.60% for rural areas and 19.80% for urban areas (Table 2).

Table 1: Food and Beverage Consumption Per Capita in Turkey

	2004e	2005e	2006e	2007e	2008e	2009e	2010f	2011f	2012f
Meat (kg)	21.30	22.60	23.40	23.90	23.90	23.00	23.2	23.70	24.10
Fish (kg)	7.00	6.90	7.00	7.20	7.20	7.00	7.10	7.20	7.30
Fruit(kg)	105.20	105.30	107.20	109.40	109.50	108.50	109.40	111.10	112.50
Vegatables (kg)	226.30	224.20	228.00	230.40	230.30	225.80	227.10	229.10	231.10
Milk (Lt)	126.60	129.90	132.00	134.50	134.80	134.00	135.20	137.20	138.90
Coffee(kg)	0.50	0.60	0.60	0.70	0.70	0.60	0.70	0.70	0.70
Tea(kg)	2.40	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70

Source: Republic of Turkey Prime Ministry Investment Support and Promotion Agency, Turkey Food Industry Report, 2010.

Table 2: The ratio of food expenditure in household expenditure (%)

Years	Rural	Urban	Turkey
2002	32.50	23.90	26.70
2003	36.40	24.10	27.50
2004	35.40	23.10	26.40
2005	32.60	21.90	24.90
2006	31.20	22.30	24.80
2007	31.30	21.60	23.60
2008	30.70	20.50	22.60
2009	33.90	20.30	23.00
2010	28.60	19.80	21.90

Source: Turkey Statistical Agency, 2011

Growing population in Turkey, the last 10 years, the rise of the cultural level, the increase in per capita national income, changes in consumption patterns and consumption has led to an increase in the rate. The share of food in total consumption expenditure in Turkey that was identified as 21.9% (Table 2). Low-income households spends more than twice the food. Depending on the global economic crisis, consumers reduced spending in products such as household appliances do not require mandatory. However, the basic need for food and beverage products, such as spending remained stable. Despite the quality and healthy food consumption patterns change in the economic crisis continues to trend. Food and beverage industry in Turkey, the major sub-markets, meat and meat products, bakery products, dairy products, vegetables and fruits, fats, sugar and chocolate products, alcoholic and soft drinks, ready-made meals and baby food. Comparing the food consumption data with the situation in Slovakia it can be see a great difference in terms of qualitative structure. In Central Europe in generally, and also in Slovakia, there is a higher consumption of meat and milk products (over 50 kg of meat per one person in 2010, and over 150 kg of milk per one person in 2010 in Slovakia). However, the consumption of fruits and vegetable is higher in Turkey. We can assume there is a partial influence of Mediteranean diet and Asian impact, with higher proportion of fruit and vegetable. From this point of view there is a chance for enriching mutually both cultures with new elements in cuisine and nutrition. With the rise and the income level of the spread of organized retailing, the Turkish consumers ready meals and frozen foods, such as consumer preferences shifted from packaged and processed foods. In addition, increasing the number of working women, frozen and supported by the increase in the demand for prepared food. Turkish consumers even though they are small grocery stores and groceries, doing the shopping, supermarkets and hypermarkets consumers, retailers, this small market share declined. Cooperatives in Turkey while the share of food products, domestic markets, domestic, foreign and domestic-foreign partnerships are increasing the share of. Food products market share of large companies and multinational firms with foreign capital has increased in recent years. This change in product, market share and the activities of firms, varies depending on the sales promotion activities. Organized retail market in Turkey, Tansaş Migros, Gima, Carrefour, Metro, Real, Tesco, BIM and the Pantry is the major food retail chains. Their own private label food products to major shopping centers in rapidly growing market and gained a competitive advantage by providing a price advantage in these products also be seen. (Albayrak, M .et al.,2010). Considering the economic development of the society, innovation trends, real food outcomes of the food industry and food services, releases of the most important food exhibitions, trade fairs, researchers, journalists as well as the biggest players in the field of food production and retailing, there are defined several categories of the most important trends at the food market.

New challenges and opportunities at the food market can be defined as follows (Horská, 2012):

- considering a modern family/household and its needs and wishes
- considering health and well-being trends
- considering sustainability issues
- considering the existence of both global versus local impacts and movements
- considering IT tools in the sphere of marketing and communication

At one side, there is still a tendency to keep a family as a fundamental unit of the society, at the another time there is a growing number of new form of living in household, including growing number of solo households. This requires the new forms of food products and their external/internal features. Also, there is a growing tendency to accept a child as a opinion leader, in many times, just because to satisfy children needs and wishes. Modern families accept also changing position of men, willing to help with basic roles in households. Convinient food is welcome also nowadays because of our busy life. To eat healthier, but tasty is a wish of many consumers. Healthier products can belong to the category food plus (with elements added), food minus or functional products. Slow food trend is another fenomen how to be closer to the nature, eat locally and support local business. Sustainability labels are the most visible features of sustainability marketing. Smutka, et al. (2012), mention several examples including clean food label, eco-labels, fair trade labels, made with renewable energy, child labour-free and labels promoting local or regional food. Turkish agriculture and food industry can benefit from producing organic food in the category of fruit, vegetable, nuts or edible oil. Different viewpoint is the question of price when many Slovak and Turkish consumers declare the low interest because of lower purchasing power. From this

point of view the organic food are the best item for international trade. Considering both history and traditions at one side and globalization movement at another side, we can observe different types of consumption practices. Hollensen (2011) uses the example of food market where food specialists distinguish among four different types of food culture:

- the global food culture, represented mainly by fast food and uniform consumption patterns,
- expatriate food refers to the search for authentic meals and products (real Slovak Goose Fest) and focuses on differences between local food cultures,
- nostalgia food represents a search for local authenticity from cultural heritage which is threatened by the internationalization of national cooking patterns,
- creolization of food involves blending various traditions into new ones, such as Chinese dishes omitting ingredients considered unappetizing in European culture. This creolization, or localizing of foods, is found in many European countries. In the Netherlands, Indonesian food has been adapted to fit the tastes of the mainstream culture, just as Turkish sandwiches have been modified in Germany, or spicy Hungarian food in Slovakia.
- the ethnic food revolution. Tendency to market ethnic foods both in original and creolized way.

Finally, IT revolution provide many opportunities for marketing interactive communication with customers either at local, regional or global level.

## CONCLUSION

Consumer life is about changes and development. In some cases it is a question of comeback, in another ones the question of futuristic wishes. Nevertheless, the only important thing is to satisfy our customer, but nowadays, do not forget sustainability issues in broaden understanding. Sustainability is a matter of economy, environmental issues and responsible human being lives. Quality and safety of daily food, right values, originality and appropriate compromise between materialism and spiritual way of life is the best cocktail both for personal recommendations and marketing implications as well. Traditional values, communicated using modern social marketing tools is not a marketing parody but marketing excellence to fit the movement in the society both from global and local point of view.

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- <http://portal.statistics.sk/>

# PRODUCTIVITY AND COST IN THE COURSE OF TIMBER SKIDDING WITH A TIMBER JACK 450C WHEELED SKIDDER IN NORTHERN FORESTS OF IRAN

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Alireza ABDPOUR<sup>2</sup>

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## ABSTRACT

This study was carried out on steep and difficult terrain. Trees were logged downhill to the landing by a Timber jack 450C wheeled skidder. Investigations were carried out by time studies for which the repetition time measurement method was selected. Through time studies, the productivity and cost of the Timber jack 450C skidding system were evaluated. In this study, the elemental times and effective factors on turn time were identified while 50 turns being studied. The model of skidding turns time as a dependent variable is a function of independent variables including skidding distance, volume per turn, winching distance and winching slope. Total production either with or without delays were 16.57 and 17.90 cubic meter per hour, respectively. The production cost with and without delay times were US\$1.31 and 1.22 per cubic meter, respectively. On the other hand, the average revenue from selling logs was calculated US\$146 per cubic meter.

Key Words: Timber jack C450 wheeled skidder, skidding system, productivity, cost, logging.

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## INTRODUCTION

Forest transportation should be considered in two stages. The first one is called primary transportation, which covers all activities from felling to the landings, and the second one is called secondary transportation, which covers hauling activities between landings and sawmills. The extraction of forest products from compartments is a very difficult, expensive and time-consuming operation. This problem is very important because the North forests of Iran are located in mountainous areas. The extraction of forest products without loss of quality and quantity is an important problem. Iran has 1.9 million hectare of commercial forests, which makes up 15.2% of total forests in this country. Approximately the total of the commercial forests are located on steep lands with slopes greater than 20%. Due to this, harvesting in mountainous regions has always played a significant role. The transportation of forestry products can be divided into two stages. The first stage is primary transportation, which involves the haul of timbers. The second stage is secondary transportation, which involves the transport of timbers, generally realized by trucks on forest roads (Aykut, 1986). The productivity of forest harvesting depends on various ecological factors and their positive and negative effects. Primary transportation is currently done at two different types in Iran's forestry. These are animal power and mechanization. Ground skidding is applied for the extraction of a large amount of timber and a large amount of fuel wood over long distances. Animal skidding, mainly by mule, is used for skidding for distances between 20 and 150m. Mechanical skidding is carried out by skidders of all types like Timber jack 450C, HSM, Tracktors. Cable systems are not used for primary transportation (Cubbage & Gorse, 1984). Rubber-tire skidders are a proven method of logging for both efficiency and cost effectiveness (Behjou et al. 2008), even on moderate slope conditions. On steeper slopes, however, road costs, environmental impacts and logging costs increase significantly (Ozturk, 2005). The mechanization of transportation mainly progressed in the 1960s and 1970s resulting in special machines like skidders, forwarders, or clam-bank skidders (Dvorak, 2005).

With regard to logging practice by the timber jack 450C in the Shafaroud region, the productivity values for transportation of hardwoods were determined as 13.38m<sup>3</sup>/h. furthermore, the cost of extraction of timber was calculated as \$2.86 per m<sup>3</sup> for transportation of hardwoods. In the study of Naghdi et al. the productivity of timberjack450C is calculated \$1431.02 per hour. This study was carried out in the Shafaroud forests in Iran and the slope of the area is determined as between 20 – 60% (Naghdi, 2005). Minett et al. in 2003 stated that the forwarders operation cost is US \$60.70/ha and the production costs were US\$1.74/m<sup>3</sup> and the energy consumption rates were 2.76g/kW\*m<sup>3</sup> (Minette, 2004.). Another study was carried out at the eastern Amazon by Holmes et al. in 2002. In this study, the productivity of

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skidder in conventional logging and reduce impact logging is calculated 22.39, 31.66m<sup>3</sup>/ha, and the production cost is calculated \$1.99, 1.24/m<sup>3</sup>, respectively (Holmes et al. 2002).

This paper deals with the research of primary transportation of timbers by the timber jack 450C skidding system. The purpose of this research contributes to a growing knowledge of the productivity of a Timber jack450C skidding system in timber extraction from Iran's mountainous forests. This study reports on the productivity and cost of timberjack450c.

## MATERIALS AND METHODS

This study was conducted and analyzed in the Chafroud region of Iran and this region has dense forest areas. Extraction studies with the Timber jack 450c were realized in the site in the Chafroud watershed forest district of Guilan. The stands contained a mixture of *Fagus orientalis* (beech), *alnus subcordata* (alder) and *carpinus betulus* (hornbeam). The timber jack C450 was used in the felling area. The silviculture system was selection method. The average altitude of felling area is 1360m above sea level and the average slope gradient is 30%. The timber jack 450C skidding system designed for skidding. Three workers are employed in operating the skidding system.

In this study, the method of repetition measurement of timber was employed. The complete timber skidding operation performed in this study using the skidding system described above consists of seven stage measurement below. The timber required for completion of each was measured by a chronometer (Aykut, 1986). A detailed time and motion study was conducted using the repetition timing method to determine the total skidding cycle times. Seven skidding elements were identified and timed to determine the total cycle time (Ledoux & Huyler, 1997).

- A) Travel empty
- B) Opening the winching cable
- C) Closing the winching cable
- D) Winching
- E) Travel with load
- F) Unhook
- G) Setting and removing the logs
- H) Delay times

The time data were recorded by on person who was trained in repetition timing study techniques. In the study process, 50 total cycle times were recorded which comprised the data base for the cycle-time regression analysis.

In addition to the total skidding cycle time, delay time must be considered. Delay time is important to the harvesting operation because it has a direct impact on the final cost of production. The cause of each delay at this study was recorded. Four categories of delays were used in the delay analysis as follows:

- 1) Mechanical delays
- 2) Operational delays
- 3) Non production delays
- 4) Weather condition delays, which represent delays associated with the principal operating

Functions of the system.

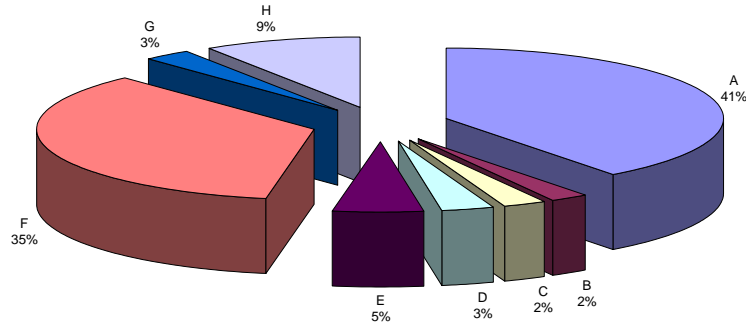
In addition to skidding activities, the following skidding variables were recorded and summarized:

- 1) skidding distance
- 2) volume per turn
- 3) the number of logs per turn
- 4) winching distance
- 5) ground slope

In the study area, production operation were carried out using a timber jack 450C skidding system for a total of 4months 3257m<sup>3</sup> timber. The 96% of the production realized in the district was transported by the skidding system.

## RESULTS AND DISCUSSION

The share of time taken by each stage of operation in the total time is shown in Fig.1.



A) Travel empty, B) Opening the winching cable, C) Closing the winching cable, D) Winching, E) Travel with load, F) Unhook, G) Setting and removing the logs, H) Delay times

Figure 1. Share of time taken by each stage of operation in the total time

Timber transportation was made from different distances and time measurements were made at these distances. Productivities of the timber jack 450C skidding system at these different distances with and without delays were found as 16.57, 17.90 m<sup>3</sup>/h. The volume of average piece of timber was 2.54 m<sup>3</sup> and was 7.8 m long. The average lost time is changed between 7.87 and 10.98 min per phases. Lost times were taken from different areas in working area. These areas were loading area, unloading area and sometimes on skid trails. The production cost with and without delay times were US\$1.31 and US\$1.22 per cubic meter, respectively. On the other hand, the average revenue from selling logs were calculated US\$146 per cubic meter. Daily fuel consumption was measured by volume method. The average fuel consumption per operating hour is approximately 7.5 l/h. In operating the skidding system, were a total of three workers one operator and two workers at next to the logs for winching. The wide of skid trails in average were 4.9m. Regression analysis was performed on the 450C time study data to develop a delay-free cycle time equation for the machine under the stand conditions stated in the study. The variables included skidding distance in meter, volume in cubic meter, winching slope and winching distance (Table 1).

The cycle time equations calculated for the Timber jack 450C took the following form:

$$\text{Cycle time (in minute)} = 0.935 + 0.369V + 0.0244D + 0.0285L + 0.0573I$$

$$R^2 = 0.92$$

Where V is the volume per turn (in m<sup>3</sup>), D is the skidding distance(in m), L is winching slope(in percent) and I is winching distance(in m).

The Minitab 13.1 statistical program has been applied, according to its series of phases:

- A) Travel empty
- B) Opening the winching cable
- C) Closing the winching cable
- D) Winching
- E) Travel with load
- F) Unhook
- G) Setting and removing the logs

Table 1. Details of the regression model

Dependent variable	Independent variable 1	Independent variable 2	Independent variable 3	Fixed coefficient	R <sup>2</sup>
Time per cycle (minute)	volume per turn ( m <sup>3</sup> )	skidding distance(meter)	winching slope(percent)	0.935	92%



**These series are independent variables. The dependent variable is total time (I). Regression analysis was done with the stepwise method between independent variables. The most effective variables with 99% confidence intervals are:**

$$I = 0.279 + 0.712A + 1.20B + 5.78C + 4.21D - 1.20E + 1.08F + 0.63G + 1.85H$$

$$R^2 = 0.90, F = 45.53, \text{Durbin-Watson} = 3.08$$

**Durbin-Watson coefficient value was found as 3.08. If this coefficient is near 2 or above, this means that autocorrelation between the independent changeable that form the model, which are completely separate from each other.**

## **CONCLUSIONS**

**Productivity functions are often used to describe the performance of forestry machinery as it relates to varying stand and terrain variables. Productivity models can be used to compare machinery, optimize work conditions, or formulate compensation rates (Heinimann, 1999). Operation phases most effective on total time and productivity were determined as skidding distance (D), volume per turn (V). The felling sequence should be chosen with consideration for efficiency and choker should be used for loading (Behjou et al. 2008). Further yearly working times of machines should be increased.**

**The results of this study have shown that the skidding system is a more permanent and efficient skidding method in mountainous forests when combined with forest roads. For more efficient operation of timber jack 450C skidding system, a minimum of two workers should be employed at the loading stations (Cubbage & Gorse, 1984). In addition to this, products should be bucked before the machine not following the coming of machine. This would enable the tying of hook to the load in a shorter period of time thereby minimizing of time (Behjou et al. 2008).**

**In order to prevent decrease in their efficiency and to reduce fuel consumption, the maintenance of machinery must be performed according to the technical specification and in a timely manner. An adequate manner of spare parts should be maintained in order to prevent any loss of time in case of urgent maintenance-repair works.**

## **ACKNOWLEDGEMENT**

**The authors thank personnel of Shafaroud Company for their field cooperation.**

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# CERTIFIED FOOD COMPANY EXPERIENCE – POSITIVE AND NEGATIVE EFFECTS OF QUALITY SYSTEM ADOPTION

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## ABSTRACT

In order to survive at local and international markets BH food industry have to offer attractive, high-quality and safe products. Implementation of different standards within developed quality management system (QMS) is the most efficient tool to satisfy those requests. According to some authors, BH food industry is reluctant to introduce those standards and thus try to affect its competitiveness. Therefore, the general objective of this work was to improve BH food companies' ability to fully understand all components of quality system adoption benefits by sharing certified companies' experience. For that purpose, it was necessary to demonstrate source of motivation that lead companies to implement quality standards as well as to outline both the benefits, and main barriers which companies faced. In order to fulfill the research goal, the questioner was sent to 100 certified companies in BH, but only 37 replied. According to research results, the main effects that implementation of quality standards brings were: compliance with legislation, bigger export opportunities, waste reduction, reduction of product returns, higher customer satisfaction, better process review and better quality of final products. There was no statistically significant difference between small and large enterprises regarding the effects of quality standards implementation, except in waste reduction where large enterprises showed better results. However, existing problems such as lack of resources and knowledge inhibit further development and maintenance of implemented QMS. Therefore, effects that those systems bring are incomplete or not expressed enough.

**Key Words:** Quality standards, motives, barriers, effects, small and large companies.

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## INTRODUCTION

Previous, not so extensive research, highlighted that low competitiveness of BH economy and its food industry is driven by low companies' capabilities to build competitiveness based on technical and technological abilities to meet market needs (Silajdžić, 2007, Nikolic et al., 2010, Domazet et al., 2009), followed by inadequate institutional framework (Nikolic et al., 2010, Domazet et al., 2009), which prevents faster development of both BH economy and the food sector. The adoption of quality assurance schemes (QAS) is widely adopted strategy to increase competitiveness and market recognitions (Kim et al., 2011, Kaziliūnas, 2010, Poksinska et al., 2006). However, obtaining the quality certification is a necessary, but not in itself sufficient condition to construct an effective QMS and to increase organizational performance (Kim et al., 2011). In addition, there are number of studies reporting either mixed success or negative effects such as too expensive, time consuming, resource-consuming, formalized and impersonal QMS and, also, reporting that the implementation costs are greater than the benefits derived (Kaziliūnas, 2010). Therefore, the benefits achieved from the QAS adoption are surrounded by many controversies and disagreements, as it is not a risk-free undertaking. According to Poksinska et al. (2006) the benefits achieved from the system are not provided by the standard itself, but by the method of implementation and the way of operating it. The benefits of QAS adoption are shaped by the two main factors that are mutually dependent:

(i) The first one is the source of motivation to adopt quality system. If quality system is build to meet external pressure (such as market recognition, export ability improvement, compliance to regulations) there is a real risk that quality requirements are not in line with real business needs of company. As a consequence of such approach many opportunities for internal improvement, improvement of operational performances and development of sustainable competitive advantages were lost. In such approach obtaining certificates or awards become an aim in itself, or in other words, quality as a mere advertising tool which means nothing more than short-term success (Saizarbitoria, 2006).

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(ii)The second one is the lack of top management commitment and lack of knowledge and understanding of all internal and external components of quality adoption benefits (Srdoc et al, 2005, Poksinska et al., 2006, Lakhali et al., 2006, Aggelogiannopoulos et al., 2007, Jang and Lin, 2008, Kaziliūnas, 2010, El Tigani, 2011, Kim et al., 2011, Raja et al., 2011).

Bearing in mind all aforementioned the main research assumption was that BH food companies lack knowledge and understanding of all internal and external components of quality adoption benefits which decrease its capability to raise real commitment to quality improvement and to customize quality requirements to be aligned with their real business needs, shaped by own organizational goals and strategies. Therefore, in order to strength BH food companies knowledge and capability to adopt QAS the objective of this research is to present, share and promote experience of certified BH food companies, outlining its motivations, benefits, but also, main barriers with which companies faced during the process of quality standards adoption.

## METHODS AND MATERIALS

The focus of research was BH certified food companies grouped according the size. In literature there are different criteria used to differentiate companies according to size. EU Commission use two criteria: number of employees and annual turnover (Iffour, 2003)<sup>2</sup>. Due to weak business performances (eg. very low annual turnover) it was decided to use only number of employees as criteria to group BH food companies into four groups: micro, small, medium and large. In addition, because of small sample size all surveyed companies were grouped into two groups: *small companies* (micro and small companies) and *large companies* (medium and large companies).

The questioner (measurement instrument) was designed using extensive review of literature offered in previous research such as Poksinska et al. (2006), Karipidis et al. (2009) and Kim et al. (2011). Questionnaire was divided into several sections such as: basic data about companies, motives for implementation, barriers during implementation and final effects. Each question included answers that were graded with seven point scale where 1 meant strongly disagree, 2 meant disagree, 3 meant partly disagree, 4 meant neither agree nor disagree, 5 meant partly agree, 6 meant agree, 7 meant strongly agree.

The qualitative survey was administrated as e-mail and mail survey, sent to managers of certified food companies selected from the list available at web site of BH accreditation body BATA ([www.bas.gov.ba](http://www.bas.gov.ba)). The questioner was sent to 100 companies, but only 37 replied. The reliability of sample was check by the Cronbach – alpha coefficient that measure internal consistency of the sample that shows how closely related the test units. The value of alpha coefficient for definition of internal/external motivation and for definition of barriers and effects of adopted system were 0,60 / 0,95 and 0,75 / 0,93 respectively, which represents acceptable level of measurement reliability. Finally t-test was used to assess the level of significance of the differences between small and large companies.

It is very important to outline that this study is subject of few limitation. First, the data of this study were obtained through the survey and relied on the perceptions of the respondents, which provide a limited possibility to investigate the context of designing and operating a QMS. In spite of this disadvantage quality survey of managers or workers is widely used as data collection methods (Zu, X. 2009, Poksinska et al. 2006, Karipidis et al. 2009 and Kim et al., 2011). Second, sample size is relatively small. The results of this study should not be generalized more than it is reasonable, given the nature of the sample.

## RESULTS AND DISCUSSION

According to extensive literature review done by Kim et al. (2011) most companies admit that external pressure instead of needs for the internal improvement is behind their decision to introduce quality standards. It is reason why they view the standard to be a paper-driven tool, lack flexibility, contain no

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<sup>2</sup> micro companies are those who employ ten employees and have a turnover of less than 10 million €; small companies are those who employ less than fifty employees and have a turnover of less than 10 million € and medium companies are those who employ less than 250 employees and have a turnover of less than 50 million €.

guarantee of product quality or market value and have high implementation costs. In another words, objectives, strategies, costs, and the results of quality management systems are highly dependent on the source of motivation to introduce quality standards. Therefore it is important to understand motives behind decision to become certified company.

As it could be seen (Figure 1), the surveyed managers were more prepare to agree that main motives behind company decision to introduce quality standards were external in its essence (higher average marks are given to external than internal motives). In addition, it has to be outlined that the best graded internal motivation was "focus on product quality", while the lowest graded internal motive was "cost reduction". Given the aforementioned and fact that survey was self-administrated by respondent, we believe that answers about internal motivations were created under the influence of the perceived and experienced benefits raised by standard adoption process. So in reality, respondents gave their opinion about the QAS effects as they answered questions related to internal motives of introducing standards.

According to large companies perception the most important points are better image in the market, reducing the number of complaints and a greater focus on customer satisfaction with average grades above the six. On the other hand, small companies emphasize greater focus on customer satisfaction and greater export opportunities and a better image in the market. Analysis by t-test leads to the conclusion that there is no statistically significant differences when it comes to external motives for small and large firms ( $p = 0.08$ ).

The three most important internal motives were: greater focus on product and service quality and process improvement (see Figure 2). However, the most important internal motive pointed by large companies' managers is in the area of better documented work. This finding suggest high likelihood that most responded answers about internal motivations was done under the influence of perceived internal benefits raised by the process of standard implementation (see chart 4). Analysis using t-test leads to the conclusion that there was a statistically significant difference between small and large companies when it comes to internal motives ( $p = 0.04$ ). In other words, large companies are aware of the importance of improving internal operations. It means that large companies have better understanding of the different components of benefits of quality system.

According to manager perception the strongest barrier to standard implementation are high certification, establishment and maintenance costs (Figure 3). This is in line with other authors findings (Poksinska et al., 2006, Kaziliūnas, 2010, Kim et al., 2011) This problem is more pronounced in small companies (Mady, 2004, Aggelogiannopoulos et al., 2007, Karipidis et al., 2009). Sometimes it is the main single barrier for them.

The next most important issue is extensive documentation. Many other studies (Kaziliūnas, 2010, Kim et al., 2011) reported that extensive documentation is one the most common problems in quality standard implementation. The increased documentation is bigger burden for small than for large companies. On the other hand it has to be outlined there was no statistically significant difference between small and large companies whit respect to mentioned problems ( $p = 0.84$ ).

According to research results, most of large companies agree to bear the positive effects related to: strengthening the brand and promotions, better compliance with legal requirements, increased export opportunities, reduced waste, reduced product return, greater customer satisfaction, better visibility of the process, and improved quality of products and services (Figure 4.). In spite of the fact that in average small companies have been less enthusiastic regarding the intensity of mentioned effects, the average rating not less than 4,5 indicate slightly positive attitude of the respondents (small companies).

The most important improvements after quality system adoption in case of large companies are: transparency of business process, improved compliance with law and higher customer satisfaction. Those effects had average rating above the six. Small companies also showed improvements in same area as large companies but instead of higher customer satisfaction they highlighted "strengthening the brand and promotion". Analysis by t - test leads to the conclusion that there are significant differences when it comes to external improvements between small and large firms ( $p = 0.0008$ ). In general, it can be sad that companies are satisfied with improvements they expected to be shown after implementation of quality standards.

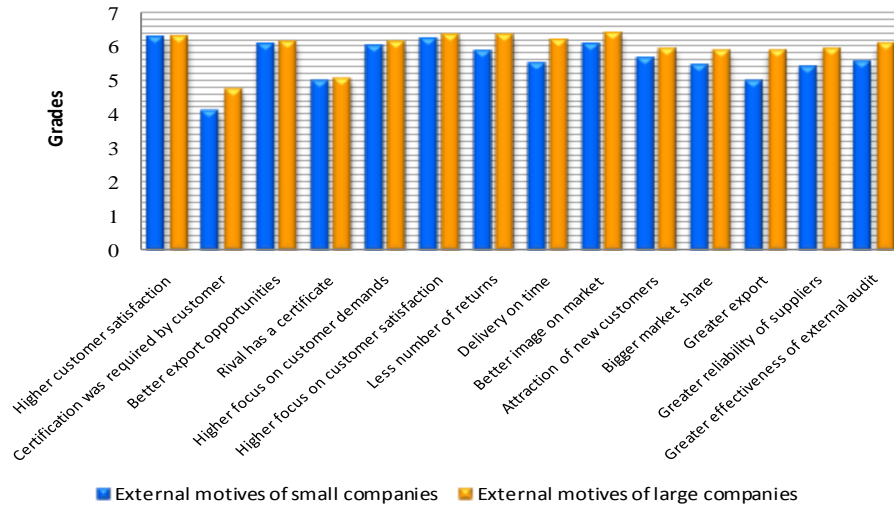


Figure 1. External motives for quality standards adoption

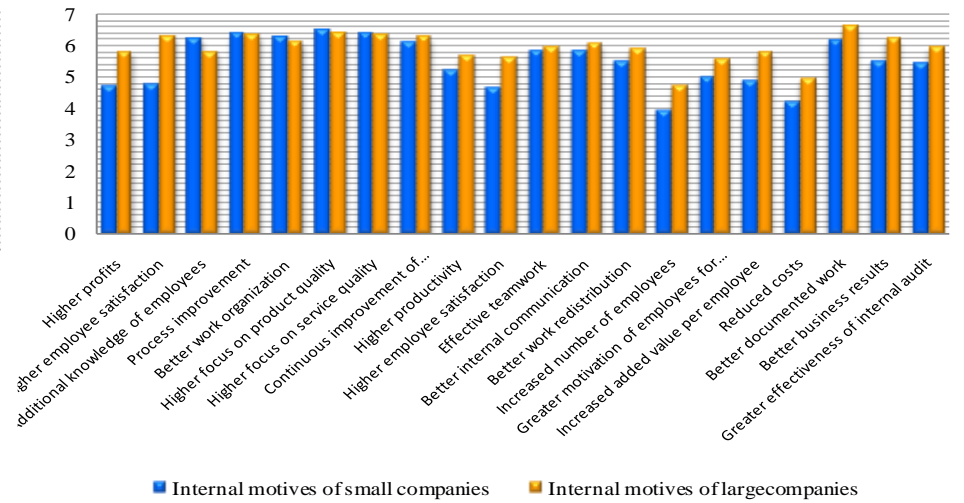


Figure 2. Internal motives for quality standards adoption

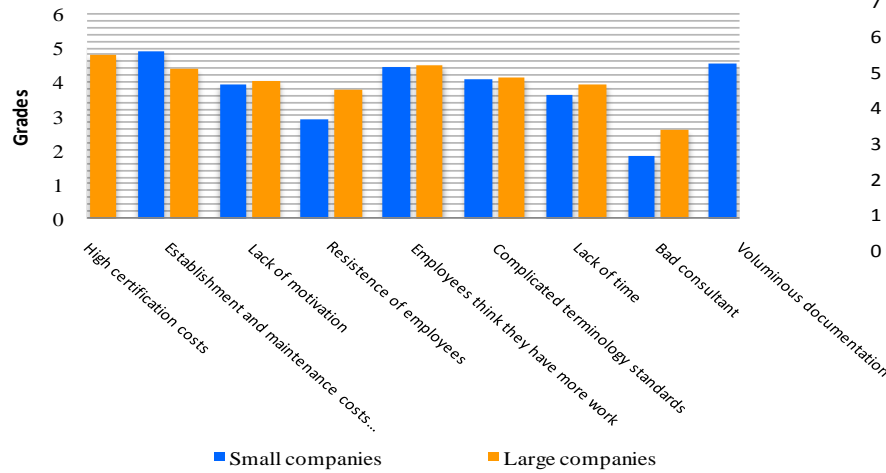


Figure 3. Barriers to quality standards adoption

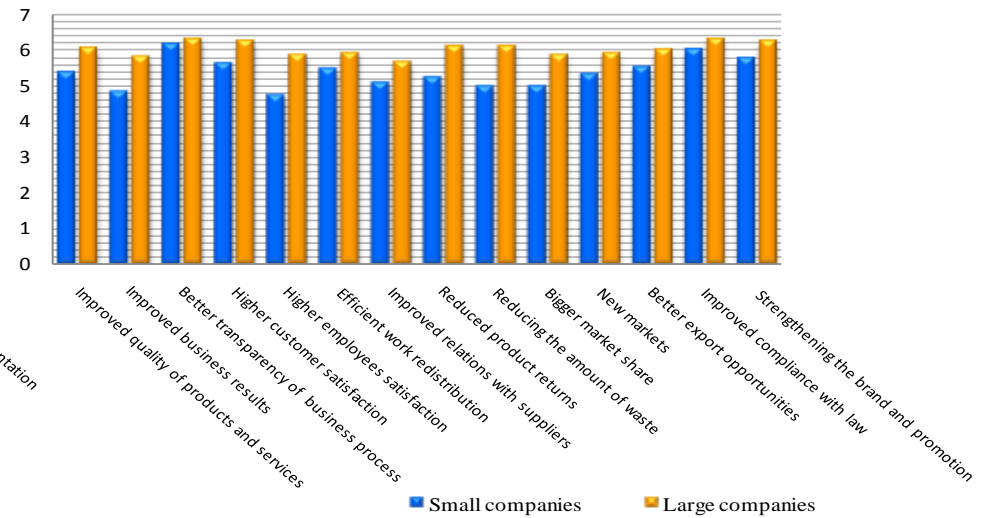


Figure 4. Effects of quality standard adoption

Note: 1 meant strongly disagree, 2 meant disagree, 3 meant partly disagree, 4 meant neither agree nor disagree, 5 meant partly agree, 6 meant agree, 7 meant strongly

## CONCLUSION

At the highly liberalized domestic market, BH food companies face strong and sophisticated international competition. Therefore, BH companies have to employ all sound strategies to gain higher market visibility and recognition. One of the most appealing and accepted strategies to improve competitiveness is an adoption of the QAS. It is especially true at EU market because these systems are in accordance with the EU policy which aims to encourage small enterprises to apply best practices and adopt successful business models that will enable them to flourish in the global market (Karipidis et al., 2009). So, for the future faster development of BH food sector and for its successful integration into neighboring EU market it is of crucial importance to find the way to encourage weak and vulnerable BH food companies, not only to adopt quality systems, but to use as much as possible opportunities for both internal and external improvement. To do so companies have to be able to customize quality requirements to be aligned with their own organizational goals and strategies. Only those companies, who are capable to understand all components of quality adoption process, will be in position to benefit the most. There are few research results suggesting that BH companies still lack this capability:

- (i) no matter of company size, the adoption of quality standards is still mainly driven by external motives which together with the high likelihood of fact that most respondents' answers about internal motivations was done under the influence of perceived internal benefits raised by the QAS, pointing out lack of knowledge about internal business benefits that could be induced by effective quality adoption process;
- (ii) the few following points: (i) costs of establishment and maintenance of quality systems were recognized as a main barrier to quality system adoption; and (ii) increased documentation was recognized as a main effect of quality standard adoption; suggest that BH food companies lack capability to customize quality requirements to their real business needs, shaped by its strategies and objectives.

Aforementioned is and will remain to be main reason behind BH food companies slow adoption of quality systems as a main tool to build up sustainable competitive advantages, that are shaped by increase of both business and operational performances. In the end of the day, this could be main obstacle to faster BH food sector development and it could decrease ability of sector to find proper place at integrated EU market, but also on highly liberalised domestic market.

Given the high public interest in human health and quality of life, social welfare, employment, and competitiveness and the fact that these issues are influenced by the efficiency of quality system adaptation in companies, there are need to craft public policy able to support companies to overcome mentioned obstacles and to promote quality culture. Therefore, instead public support programs of questionable efficiency that are focused on certification costs recovery, public policies should to be focused to the creation of collaborations among companies and of an external business environment that will encourage the application of QAS, with emphasis on research, training, and information, in addition to market information and transparency, as it was suggested by Karipidis et al., (2009).

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# MARKET SEGMENTATION BASED ON CUSTOMERS PERCEPTION OF LIVNO CHEESE

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## ABSTRACT

Livno cheese is a traditional product that is produced on farms in Livno's wider region. It adds value to farms production and therefore contributes to wellbeing in rural areas. To realize Livno cheese existing market potential it is important to understand factors that shape customer behaviour. So, the aim of this paper was to determine market segments according to customer behaviour and perception, and define level of distinctions between them, and according to those information's recommend a "winning" marketing strategy for Livno cheese. To fulfil research aim market survey has been organized at Sarajevo market. Non-random, survey sample (180 examinees) was validated by Spearman-Brown and Cronbach alpha test. Two different customers' clusters have been identified. First market cluster, "curious customers", believes that they are cheese connoisseur and quite familiar with Livno cheese, but who nevertheless think they should have more information about these types of food products. Second, the "traditionalists", are less involved, for whom the external quality characteristics (price, quality etc) are very important. Therefore, producers of traditional Livno cheese should determine who are their target customers, cluster 1 or cluster 2, and create marketing strategy that will satisfy their needs.

Key Words: Livno cheese, marketing mix, market segmentation, traditional products

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## INTRODUCTION

In 2010 trade deficit of Bosnia and Herzegovina (B&H) agricultural sector was 1,949 million BAM<sup>2</sup>, out of which the cheese production trade deficit was 39 million BAM or 2% of total trade deficit of B&H food sector. Such huge trade deficit shows that B&H cheese producers currently do not have adequate competitive advantage (Nikolić et al., 2011, Nikolić, 2008) which can pose a major problem in the process of convergence and integration of B&H into the European Union (EU). There are various ways by which the competitiveness could be improved, but it is of major significance that they include product diversification and adequate communication with costumers. It is therefore very relevant to understand costumer's desires and needs to build up a winning marketing mix that will make the products distinctive and will build a proper "environment for creating a positive customer perception of the product or service quality". All this increases the level of customer loyalty, promotes the sales of products, and thus ensures the success of the company or sector. Therefore, customer's perception and satisfaction is a base on which the companies should build up its success and competitiveness. However, it is not an easy task to define customer's perception because it is based on the attributes that the customer's use to distinguish products and they will pay a higher price for everything they perceive as better. Apart from the product one must mention the importance of customer's behaviour, their willingness to spend time and money to get a better insight of the desired product. According to Samardžić (2010) that type of willingness is called "the level of involvement". It is accepted that there are customers who are highly involved and those with low level of involvement. Highly involved customers are those who put additional effort to learn about product, and expect the producer to inform them and, also, they will gladly spread that knowledge to other potential customers. Therefore, highly involved customers devote more attention to internal attributes, especially to the flavour. Customers with low involvement do not know much about the product, and very often need "additional resources" to make sure that they made the best possible purchase decision. These customers, which are mainly "the new customers", devote more attention to external attributes, meaning that their decision to purchase is based on previous experience with product and product price (Nikolić et al., 2011).

Hence, in order to create adequate marketing strategy, producers need to know who are theirs target customers, are they highly or less involved, and how they perceive the product and product attributes (Samardžić, 2010). This task is not easy, but it represents a base of the success on the market. Precisely because of the complexity of the concept of quality perception there are different methods that are used to research customers needs and desires. Cluster analysis (Radman, 2001, Mumel i Snoj, 2002, Leko-Šimić

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<sup>2</sup> Source: Foreign Trade Chamber of Bosnia and Herzegovina; 1€ = 1,9582 BAM



et al., 2005, Samardžić, 2010) is often used to determine market segments, according to customers behaviour and perception, so that producers can create a winning marketing mix. So, the aim of this paper was to define market segments that are different enough, in order to enable producers of Livno cheese to define better targeted customer group and accordingly to create a marketing strategy which is going to satisfy better their needs, and thereby upgrade competitive position of producers on the market.

## MATERIAL AND METHODS

Primary data was collected through the survey. Questionnaire consisted of 35 questions sorted in several thematic groups: level of recognition of cheese and Livno cheese; Livno cheese as a product; price, promotion and distribution of Livno cheese; buying behaviour (attitude about product quality and appearance, attitude about quality-price ratio, attitude about product origin, view on product information, opinion on the product promotion and distribution), and basic socio-demographic information of examinees (sex, age, level of education, social status, monthly income).

Sample was created as non-probability quota sample (180 people). The examinees were selected according to cheese consumption. Only persons who are cheese consumers have been included in survey. Therefore, the target population were cheese buyers, and Table 1. shows the planned survey sample.

Table 1. Survey sample

	Number of examinees	Number of examinees (%)	Number of female examinees	Number of female examinees (%)	Number of examinees in age group 36-55	Number of examinees in age group 36-55 (%)
Supermarkets <sup>3</sup>	90	50	54	30	72	40
City markets <sup>4</sup>	90	50	54	30		

Sample validity was checked using Spearman-Brown (split – half) test, which, in our case is 0.49, and it is a slightly lower value than recommended for this coefficient for exploratory type of research (Markovina, 2009). Reliability of results for total sample is 0.703 (Cronbach alpha coefficient), which represents an acceptable level of measurement reliability. Cluster analysis was used to define market segments. Squared Euclid distance was used to measure distance (differences) between clusters, while Ward method was used to connect objects into clusters, and optimal number of clusters was defined on “Agglomeration schedule”, while validity of defined clusters was verified by Monte Carlo method.

## RESULTS

Total of 72 (40%) male examinees and 108 (60%) female examinees were surveyed. Out of total number of examinees, most of them were in the age group of 36-55 (40%), while the minimum of the examinees were in the age group 56 or more (6.67%). The structure of the sample is satisfactory, because it supports the assumption that females (60% of examinees) and age group 36-55 (40% of examinees) are most frequent buyers of cheese.

Slightly more than half of the examinees answered that they buy Livno cheese. However, when they were offered a picture and description of three kinds of cheese, most examinees (57.78%) chose Gouda cheese. This confirms that the examinees were honest when they evaluated their knowledge of Livno cheese with average mark of 2.07 on a scale from 1 to 5 (1 was no knowledge and 5 was excellent knowledge). On the other hand, most examinees, 80.56%, think that the Livno cheese is traditional product and they prefer cheeses produced in B&H (78.33%). Out of a total number of examinees who buy Livno cheese, 64.89% of them buy this cheese rarely or occasionally as a delicacy, and it has been consumed during the holidays and sometimes with a meal, while its consummation on business lunch or dinner is very rare. In terms of the place of Livno cheese purchase, examinees usually buy it in supermarkets.

The cluster analysis was performed on the basis of the set of input variables, which includes answers to the questions how much examinees know about cheeses and Livno cheese, whether they buy Livno

<sup>3</sup> Supermarkets: Konzum, Mercator, Robot, Interex.

<sup>4</sup> City markets: Market Markale, Market Grbavica, Market Ciglane.

cheese, which out of three offered cheeses do they prefer, important attributes of product when buying (brand, flavour, attractiveness of packaging design, quality, lifetime, production tradition, prices, sales actions, the impact of promotional activities, promotion at the place of sale), and characteristics related to the promotion (at what time of day do they watch television). The main variables shaping customer behaviour are grouped into two identified and validate clusters (Table 2). Validation of the cluster showed a statistically significant difference between the clusters.

Table 2. Cheese attributes grouped into the identified clusters

	Cluster 1	Cluster 2
Variables	Knowledge about cheeses	Brand
	Knowledge about Livno cheese	Flavour
	Sales action	Packaging design
	Impact of the promotional activity	Quality
	Promotion at the place of sale	Duration
	Television	Production tradition
		Price

Cluster 1 – “curious customers” are the customers who believe they are quite familiar with the cheeses and Livno cheese, but who nevertheless think they should have more information and better communication with producers. These customers have responded that product quality is very important to them, which is characteristic of highly involved customers, while the exterior of the product is neither important nor unimportant to them. Regarding the price as element of marketing mix, these customers do not agree with the presumption that higher prices mean that the product has better quality, and they are willing to give 20 BAM/kg for Livno cheese. This cluster buys quality products regardless of whether they are always present in the markets or stores, which confirms the claim that these are highly involved customers. There are more females in this cluster, age group 36-55, highly educated, employed, and have a monthly income of 1,000 BAM or more. Out of a total number of examinees, there are 31.67% of males in this cluster.

Cluster 2 – “the traditionalists” are customers for whom all elements of marketing mix are important, except promotion. These customers have responded that product quality is very important to them, but the exterior of the product is also very important, which is characteristic of low involved customers. Customers in this cluster do not disagree nor agree with statement that higher price means that product has better quality, but they pay attention to the price when buying and they are willing to give 15 BAM/kg for Livno cheese. Although promotion does not affect their decision to purchase a product, they still want to have more information about the products they consume. These customers buy products that they can afford regardless of whether they are always present in the markets or stores, meaning they are price sensitive customers and likely less involved. There are more females in this cluster, age group 36-55, with lower education (secondary education), employed, and have a monthly income from 501 to 1,000 BAM. Out of a total number of examinees, there are 8.33% of males in this cluster, which is less than share in the first cluster.

Customers from both clusters prefer smaller packages of Livno cheese (less than 500 grams) and buy cheeses produced in B&H. The clusters do not differ by the way of consuming Livno cheese, both clusters consume it during the holidays and sometimes with a meal, and customers from cluster 2 consume it during business lunch or dinner. Clusters do not differ by the place of purchasing the Livno cheese, due the fact that customers from both clusters buy this product in supermarkets. This is because customers are no aware of the difference between traditional Livno cheese produced by family farms and the one produced by Livno dairy.

## DISCUSSION AND CONCLUSION

The survey results show that the majority of examinees (57.78%) chose Gouda cheese when they were offered a picture and description of three kinds of cheese. This is not surprising given the mild smell and flavour of Gouda cheese and its high market share at B&H market. It is important to note that the customers are surrounded with Gouda cheese given the import quantity of this cheese in 2010 was 8,190,991.12 BAM or 17.07% of total import of all kinds of cheeses. Only a quarter of examinees chose Livno cheese, and a possible reason is distinctive aroma and flavour of this cheese. Another possible reason for such results is an inadequate promotion of Livno cheese. Certification, designated origin, etc., can improve recognition of this cheese on the market. However, preference toward mild flavoured cheeses, like Gouda, can have major consequences for the sector development in the future.

Examinees rated their own knowledge of Livno cheese with a very low average grade, and even those who frequently buy Livno cheese have expressed that they need more information about this cheese and its characteristics. Therefore, the main conclusions and recommendations to producers, and all NGO's working in rural areas and governmental institutions, is that they should put more energy to increase the level of knowledge about Livno cheese in order to preserve its potential for improving the quality of life in rural areas, and also in order to protect the cultural heritage of B&H.

For cluster 1 customers it is necessary to create additional value. This can be done through providing additional services such as individual and small packages, as well as ready-to celebrate package. It is further necessary to provide more information about Livno cheese at the place of sale and on the packaging, using images of farms, cows, and producers, beautiful pastures or native plants, etc. For these customers it is also important to innovate and open up new marketing channels, such as e-marketing.

For cluster 2 customers it is important to provide a stable product quality, to highlight the region of origin and production tradition on a label, and label design should be innovated and attractive. Cluster 2 customers are price sensitive, so it should be respected by setting prices up to 15 BM/kg Livno cheese.

Both clusters consume Livno cheese during the holiday, therefore it is important to pack Livno cheese for special occasions, so it would become a luxury product and a product that can be sold together with other products, e.g. wine. Clusters are interested in culinary shows and buy culinary magazines, so producers should consider sponsoring one of the culinary programs and/or promote the cheese in the culinary magazines. Hence, producers should determine who are their target customers, customers from cluster 1 or from cluster 2, and then to create marketing strategy that will suit targeted customer desires and needs. However, in the short term it is necessary to change the size of the Livno cheese package, start with the production of smaller packages, because customers usually buy small packages of cheese. It is further necessary to ensure stable quality, because for customers stable product quality is very important when buying food products.

Livno cheese producers have numerous unresolved issues related to better knowledge of their market and customers behaviour. On the other hand, customers need a strong education in order to recognize traditional Livno cheese more easily and separate it from the cheese that is produced in industrial way. Livno cheese can become one of the strong brands of domestic food sector. To contribute to this aim, B&H institutions and producers should make more effort into the protected geographical indication as many countries in the Western Balkans have; for example, Slovenia has protected geographical indication of Kraski cheese (Renčelj et al., 2008) and Croatia Pag cheese (Savić et al., 2011). As strong brand, Livno cheese can extend its market share and contribute to creation of opportunities for income generation in rural areas through better utilisation level of currently highly unused pastures.

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# INTERNAL QUALITY SYSTEM IN THE FOOD INDUSTRY IN BOSNIA AND HERZEGOVINA – CASE STUDY OF TWO COMPANIES: COCA-COLA AND MILKOS

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Alen MUJČINOVIĆ<sup>1</sup>

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## ABSTRACT

The aim of this study was to investigate the process of quality management establishment and efficiency of quality systems (QS), and to determine whether there are differences in the motives and the process of establishing QS in the investigated companies. During the study, it is used the „case study method“. Data for the case study were obtained from semi-structured interview. These results indicate that there are differences in the motives and the process of QS establishing in two companies investigated. Also, the results indicate the importance of QS development, focusing on the most important benefits of introduced system. To make the system more efficient and enable the realization of these benefits it is necessary to pay particular attention to the critical success factors, especially to top management commitment and high level of employees involvement. Otherwise, just as the research showed, the implemented QS will not provide the expected contribution to the company performance improvement, and may create resentment among the workers, which eventually may again lead to "the emergence of non-quality".

**Key Words:** Quality, quality systems and quality management

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## INTRODUCTION

Economically, globalization, affects the expansion of existing and emergence of new markets, while strong market liberalization "erase" borders between states, creating a unified global market (Lončar, 2005). Only companies whose product satisfies customer's needs would be able to survive on such hypercompetitive market. For these reasons, customers, who are more and more demanding, become the epicenter of every business. All product characteristics including physical-chemical, nutritional one, level of convenience, safety, quality variation have to be shaped in a way to match customer's needs in order to build up customer commitment and loyalty. Therefore, the overall product quality and business process shall be fully in line with to customers' needs. Although this is seemingly a very simple market success concept, it should be noted that in practice it is very difficult to implement. It is due to a misunderstanding of quality systems purpose and benefits, or lack of top management quality commitment (Juran, 1993, Thaddeus et al. 2008). Usually, top management, no matter of economy sectors, or educational backgrounds, do not believe that quality and quality systems are the major factors ensuring success at today's highly turbulent globalised market (Dilber et al., 2005). According to them it's only an additional expenditure of time and money, or "something" that must be done to meet the administrative requirements. This management's attitude leads to the establishment of inefficient of internal quality system (IQS), which does not create an additional value, but it just creates new problems, such as resentment and lack of motivation of employees, poor working environment, low levels of efficiency, productivity, and low levels of business and operational performance (Kim et al., 2010). Such approach makes it impossible to induce change of corporate culture, to define responsibilities, authorities, and to monitor the entire process, which all will lead to continuous business performance improvement, which in turn will ensure higher customer satisfaction and increased level of competitiveness of both company and economy as whole. Therefore motivation of top management and process of IQS development attract attention of both academic and expert community. So, overall research objective is to analyze process of IQS development performed within different types of company in order to define key factors that can decrease efficiency of quality system and its benefits.

## MATERIALS and METHODS

The study assumes that there is a difference between a company which is part of large, experienced multinational and national companies in terms of motives, and methods or processes of QS

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establishment, which is due to difference in companies capacity (human and material) and capabilities. Starting points of research is assumption that the local companies lack adequate knowledge and skills and therefore process of IQS establishment will be given to external consultancy team. In contrast, local part of the multinational company, which leader position at the market was created by efficient application of quality concept and maintained by efficient quality systems, will form and develop internal capacity (quality team) to lead and implement process of IQS establishment. The difference in approach would have the effect on the efficiency level of the created system. It is expected to see better performance of IQS that is developed as a part of everyday business practice and by internal company capacity. Such approach to IQS development is based on, high level of top management commitment and internal team, ensures full employees involvement, motivates all to care about quality, and it is likely to see system responding fully to the real needs of companies to establish continuous quality improvement. In the companies where that job is given to external experts, there is significantly higher risk to see created IQS which does not respond to the company needs, so therefore it does not contribute to the quality culture improvement and it does not call for higher employee involvement in the process of quality improvement. That's why two case studies were developed. The first was for the local privatized company "A", that lack experience in quality management. The second case study was about local company "B", which is part of very successful multinational company, which main general business policy pillar is quality management based on customer satisfaction.

Case study method was used to prove the research hypothesis, because it can provide better more detailed insight into the qualitative characteristics of the process conducted. It is according to (Raya, 1984) first time used in the work of Frederic Le Playa (1829) and it represents scientific examination of "something" - whether they are individual persons, social groups, institutions or the wider communities. The case method is often used in socio-economic analyzes, which are based on detailed analysis of several individuals (cases) to identify common features and differences, making conclusions about the overall appearance (Law et al., 1998). Also, this method is not sufficiently reliable for the general conclusion due to fact that it belongs to the method of incomplete / partial observation and data collection. So, the research limitation is the fact that it does not fully reflect the situation in the sector.

Questions, of semi structured interview were formed in line with the principles of the modern quality concept, which unlike of retrospective quality concept based on "end-of-pipe" solutions, promotes prevention and added values, becoming a "value driven" business concept (Sorak et al., 2003). That's why quality management represents continuous search for better techniques, technology, marketing and any other improvements and enhancements that will eventually produce the desired result (Pike and Barnes, 1994) in regard with fulfilling of wider set of customer's needs, while increases efficiency and reduces costs. In this concept it becomes clear that design, and implementation of IQS, and its efficiency largely drives the company success and sustainability. Therefore, the quality management system (QMS) represents set of interdependent processes of supervision over the whole business process, aimed to maintain and improve quality continuously (Deming, 1986). Because of this IQS consist of static and dynamic elements. The first one is "building bricks" and second one is the processes that allow a proactive approach and continuous improvement (Figure 1).

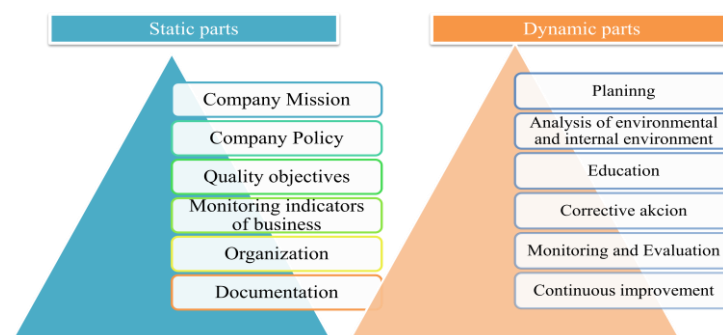


Figure1. Integral part of internal quality systems

Additionally, the case studies questionnaire incorporates in the literature often mentioned positive and negative effects of quality system introduction (table1)

Table 1 Positive and negative effects of the implementation of quality systems

Positive	Negative
Better customers communications (Mezher et al., 2005)	Temporary loss of markets (Maldonado, 2005)
Higher degree of quality awareness (Jang and Lin, 2008)	Inadequate and sudden changes in organizational activities (Kim et al., 2010)
Improved quality of products (Iffour, 2003)	Misunderstanding documents (Hashem and Tann, 2007),
Increased satisfaction (Soh and Markus, 1995).	Increased (Kim et al., 2010)
The possibility of monitoring and measurement realization of company goals (Weaver, 1996)	The lower level of employee satisfaction (Yapp and Fairman, 2004)
Better understanding of customer needs (Jang and Lin, 2008)	Lack of interest of employees (Yapp and Fairman, 2004)
Clearly defined responsibilities for all employees (Piskar and Dolinsek, 2006).	The necessity of permanent education (Balta et al., 2006)
	Lack of resources (Kim et al., 2010)
Education (Bata et al., 2006)	Lack of understanding the functional and processing responsibilities (Mezher et al., 2005)
Higher degree employees satisfaction, motivation and engagement (Piskar and Dolinsek, 2006).	Lack of flexibility and poor compatibility with other standards (Zeng et al., 2007)
Improving internal communications (Yahya and Goh, 2001)	Success is not guaranteed (McGuire and Dilts, 2008)
Documentation (Anderson et al., 1999)	
Business events quantitative analysis (Yahya and Goh, 2001)	
Additional control reduced (Sila and Ebrahimpour, 2005).	
Erors prediction and number of errors reduced (Fuentes, 2000)	
Improved profitability (Sila and Ebrahimpour, 2005).	

On the basis of all mentioned data semi-structured questionnaire consisted of 29 questions, which were grouped into 5 major groups according to pre-made case study structure (basic information about companies, decision makers impact on the establishment of IQS, establishing motives, the process of establishment and the benefits and problems which appeared after the implementation of IQS) was conducted in July, 2011 with representatives of the Team for the quality of the investigated companies.

## RESULTS

Research has shown that there are certain similarities and differences in the process of IQS establishment. In the company "B", which is a part of multinational company, the decision about IQS development was made under the influence of internal factors, especially overall holding business policy to promote quality. Therefore the IQS development was seen as an internal project, aimed to improve overall business performance. So, in this company, top management appointed Quality team and approved budget for this internal project. The high top management commitment was clearly expressed. The Quality team formation was the first step in the process of IQS development. The whole process, lead by team, had been created in line with both company needs and general quality standards requirements, such as making the decision about the system development, setting goals to be achieved by the system (the quality objectives that fully corresponds with customer needs and request to build added value for customers), selection of management structure in line with standards, analysis of current business performance, construction IQS, introducing the employees with an IQS and getting its verification, application of certification process, maintenance and improvement of the system. In addition company "B" had invested in quality education for all employees, but especially for the created internal Quality team. Looking at our own employees as the key factor which creates overall company quality, special

attention was given to the internal communication to promote and explain IQS true significance and benefits for all employees, and especially for company success. It was followed by explanation of each employee role and contribution in the process of quality maintenance and improvement, which was the key factor to motivate employees to cooperate, learn through the process of experience exchange (what is working, what does not), so they were willing to adopt new way to conduct business. Quality team are trained to be internal auditors, so they developed capability to perform analysis of the company to identify real company needs and propose corrective actions. Company "B" approach based on strong top-management commitment and internal people capacity development resulted in more efficient quality system which creates more benefits and less problems, as it could be seen on table 2.

Table 2 - The intensity of the problems and benefits faced by the company "A" and "B"

Problems	Intensity		Benefits	Intensity	
	„A“	„B“		„A“	„B“
Lack of interest of management - difficult implementation, lack of resources, lack of internal knowledge	5	2	Improved quality	4	3
Adapted to the needs of the company's quality system	5	2	Increased standardization of processes	4	5
Needless paperwork	5	5	Increased customer satisfaction	4	5
Inappropriate system of education	4	1	Construction of Documentation System	3	5
Management is delegated, after obtaining certification activities of the process of continual improvement was stopped, there is resistance of the employees	4	2	Improving organizational performance	4	5
No clear perspective - no clear goals and can not be defined indicators of success or evaluate performance of company	4	2	Improving the system of control	4	3
The process of continual improvement ignored-standard necessary to overcome some barriers	5	1	Improvement the system of prevention	5	4
Lack of interest of employees	4	1	Enhancing the competitiveness	3	0
Lack of resources	2	3	Improvement of human resources	4	4
Monitoring and maintenance of standards	4	2	Pleasant relationship to environment	4	5

Note: intensity of benefits/problems was judged by Likert scale 1 to 5 were 1 means no benefit/problems expressed and 5 means high level of benefits/problems expressed.

In contrast to company "B", company "A", is adopted decision to introduce an IQS under the influence of external factors, in fact the main motive behind was to ensure access to the international market. It means, manager/s of the company see QS only as "must step" to export, without understanding which kind of benefits it can bring to overall company business performance. This process is seen as an "additional administrative burden" for the company. This suggests low top-management understanding and commitment to modern quality concept. Therefore, company "A" was not willing to invest in additional education of internal team and all employees. Most comfortable solution was outsourcing, or better to say inviting external company to develop IQS and prepare set of documents. External consultancy company was in charge to develop IQS. As result companies developed "generic ISO 9000 system" with recommended eight procedures without identification of specific business processes and the related specific work procedures, in fact without real attempt to adopt quality needs of company. In the scope of this process following actions were missing: (i) the comprehensive employee training, (ii) creation of internal audit team, needed for system maintenance, testing and further development, (iii) verification of documentation by employees; (iv) promotion of quality culture and employee involvement in every step of the process. During the interview the existence of hostile employee attitude towards whole system was evident. Most of employee believe that transparency and traceability are not important for the company overall performances and that major part of documentation is not useful,

user friendly and according to their opinion it is waste of “money and time”. This indicates a low level of understanding of IQS essence and purpose. So, inefficient internal quality system, set of serious problems induced by system establishment and minimal benefits are results determinate in the company “A”, as it could be seen at table 2.

In table 2 the main problems and benefits together with its intensity (according to interviewed managers) are presented. Intensity of QM problems occurred within company “A” is higher in comparison with company “B”. In the same time intensity of experienced benefits is lower in the company “A”.

## CONCLUSION

On the basis of two companies case study results it can be concluded that whole process and its efficiency and quality is shaped by the company approach to the quality concept and quality culture. The company approach is defined by the top-management quality commitment, their understanding and knowledge about quality system benefits and also by problems which can be induced by inefficient and poorly management of IQS development process. It is important to outline that company approach to the IQS development is also shaped by the company ownership and market experience (multinational vs local) as well as by its internal human capacities. In short, if company would like to have efficient IQS and to generate added values and benefits for all, including consumers, it is important to take care about following:

- **To ensure high level of top-management commitment to the quality culture, which will be verified by its willingness to invest in whole process, especially to invest to strength internal capability and competence of Quality team to maintain system and to introduce continuous process of permanent improvement;**
- **To create internal quality system which is not an replica of generic quality management model recommended by ISO standards, but to create a system that will reflect the real needs of company and will therefore provide additional value to customers, which will in turn ensure company market success;**
- **To ensure involvement of all employees and to establish discussion and learning platform for them in order to generate joint understanding of main IQS characteristics and benefits and to give them opportunity to recognize real companies needs;**
- **To test efficiency of system and to motivate employee to make verification of whole system, especially to verify usefulness of documentation;**
- **It is recommended to invite external experts, but only as a “source of knowledge and advices”, and never as leaders and creators of the whole process and system.**

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# THE PROBLEMS OF FRESH FRUIT PRODUCTION AND MARKETING IN CANAKKALE PROVINCE AND SOLUTION SUGGESTIONS

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## ABSTRACT

Fruit production and marketing has a significant place in Turkey and especially in Canakkale province due to suitable climate and natural conditions. However, there are a number of serious problems about the marketing of the products. The objective of this study is to reveal the problems of fresh fruit production and marketing by using data which was obtained from farmer survey. This study covers apple and peach which constitute 71 % of the fruit production in Canakkale province. Questionnaires have been filled out through face to face meeting with 98 farmers which have been selected by the random sampling method.

The Five Digit Likert Scale has been employed to be able to find out production and marketing problems. Chi-square Analysis has been used for discrete variables to identify whether there are differences among groups in terms of performed applications along with the characteristics of producers. The land size of the farms, which have been analyzed, is usually small. More than half of the farmers are primary school graduates and have high occupational experiences. One of the most striking points of this study is that cooperatives are not sufficiently efficient in production and marketing despite the fact that they have quantitatively high number of members.

**Key words:** Fresh fruit, production, marketing, Canakkale.

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## INTRODUCTION

Turkey has a significant potential in terms of fruit and vegetable production due to its soil and climate characteristics (Demirbaş, 1994). Fruit production and marketing create a substantial value of agricultural economy. In this sense, fruit production value, which is 16 million \$ in 2009, constitutes 33.5 % of the total value of vegetal production (TSI, 2011).

Fruit production is a production branch in which domestic fruit demand and raw material needs of the agro-based industries is met through domestic fruit production. Likewise, inflow of foreign currency is provided as a consequence of fruit exportation. Fruit production and marketing is of high significance so that adequate and balanced nutrition need of the growing population could be secured.

Fruit products in which Turkey takes place in the first two ranks in the world are peach and apple (MFAL, 2007). Apple and peach are among the most important fruits in terms of fruit production in Canakkale province. According to the average production rates of the important fruits of Canakkale (between 2005/2007), the percentages of apple and peach productions in the fruit production value of Turkey are respectively 3.8 % and 10.4 %. In addition, apple (39.1%) and peach (32.0 %) take place in the first two ranks in the total fruit production value of Canakkale province (TSI 2005; 2006; 2007). In this sense, this study has been carried out in Canakkale province since it is an important fruit production region.

The objective of this study is to reveal some problems that are faced to fresh fruit production and marketing together with some solution suggested about these problems. Data have been collected through producer surveys in Canakkale province of Marmara Region. Product scope of this study includes apple and peach which constitute 71% of the total fresh fruit production in Canakkale province.

## MATERIALS AND METHODS

In this study, primary and secondary data have been employed. Primary data include data that have been collected in research area during the fieldwork whereas secondary data have been gathered through the scanning of the literature about this issue.

As to the research area, it includes districts in which peach and apple, which are the first two ranks of the total fruit production in Canakkale province, are mainly produced. Data about the amounts of fruit production and of its production area in the last three years have been attained through the data of Canakkale Provincial Directorate of Food, Agriculture and Livestock. According to the average fruit production rates of the districts between 2007 and 2009, Bayramiç (90.1%) takes place in the first rank in terms of apple production while peach is mainly produced in Lapseki (72.8%).

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Five villages have been chosen from two districts, and ten villages in total have been determined as research area. Stratified random sampling method has been employed since there are many large and small farms, and sample size have been identified as 98 farmers.

The Five Digit Likert Scale has been used in this study. Producers who are not the members of cooperatives have been asked about the kinds of obstacles they are faced and why they do not become a member of cooperatives along with some problems about the marketing of the products. Chi-square Analysis has been used to identify the relationship between non-numeric variables and the level of relationship. Meaningful results have been summarized in the tables.

## RESULTS

The average of agricultural land in Turkey is 5.9 ha (MFAL, 2011). The total amount of land in 69.4 % of the analyzed farms is either high or below than 5.8 ha. Only 31.6 % of these farms have land over 5.9 ha.

When cultivated land distribution of fruit production is considered, it is seen that 25 % of this land is either 1.9 ha or below 1.9 ha whereas 25 % of the land is between 2.0-2.8 ha. Besides, 23 % of the land is between 2.9 -4.4 ha while 25 % of the land is either 4.5 ha or above 4.5 ha. To elaborate, 73 % of the land is either 4.4 ha or below 4.4 ha.

It has been found that 54.1% of the producers is graduated the primary school or received less education. Besides, 17.3% of the producers is graduated at the secondary school while 28.6 % of them is high school or university or high school dropout. According to these data, it is seen that the education level of the producers is very low.

It has also been discovered that 74.5 % of the producers in the research area is a member of an agricultural cooperative whereas 25.5 % of them is not a member of any agricultural cooperatives.

It is also interesting that 32.7 % of the producers work in other working areas, as well. Some producers are working in other areas since they cannot earn enough from fruit production while some are using non-agricultural gainful activities to meet the expenses of fruit production.

In this part, some problems about fresh fruit production and its marketing have successively been focused.

In research area, the rate of producers that benefited from agricultural support is 71.4 %. Despite this, the scope and application of these agricultural supports are among the most crucial problems since there is not a special support policy or means in Turkey. Among agricultural supports from which producers mainly benefited are diesel oil and fertilizer. Some inadequacies about agricultural supports and ongoing increase in input prices prevent producers from going on production.

The rate of cooperative membership is very high, however their effect is very low; and 70.4 % of the producers are pointing out the cooperatives are not essential for production activities.

Nearly all producers are complaining on high production costs. High production cost is a serious risk in terms of the sustainability of fruit production. Small and fragmental lands along with high input prices are influential on high production costs.

Recording is of high importance since it could sustain the recording of agricultural production and conscious agricultural production (Sarıkaya, 2007). For that reason, to know whether producers keep records the cost of production. So, 70.4 % of the producers keep records their production costs while 29.6 % of them is not doing that. Recording as a farmer attitude is essentially related with experiences. In this point, the relationship between recording the cost of production and fruit growing experience was analyzed through Chi-square Analysis. According to the results of this analysis, there is a substantial difference among the groups with different experienced farmers on keeping records. The more experienced groups have more tendency on keeping records.

Table 1. The relationship between experience and recording tendency of producers

Experience (Year)	Recording Tendency		Chi-Square		
	Yes	No	Value	sd	p*
x≤15	22	8	8.64	2	0.034
16≤x≤20	17	3			
21≤x≤30	21	7			
31≥x	9	11			

\*p<0.05 (significant)

Producers in research area are running through problems which are more about fruit marketing than fruit production. Problems about marketing activities have directly negative effects on production facilities.

According to 40.81% of the producers, there are not any kinds of marketing problems. In addition, 32.66 % of the producers in the analyzed farms points out that there is constantly a marketing problem whereas 26.53 % of them asserts that there is partly a marketing problem.

The most common marketing problems that producers run through were measured by use of The Five Digit Likert Scale, and those problems were given in Table 2. These problems of the producers are that: They have to sell their products under real prices (3.79) and they have to ensure some problems about payment after sale (3.79). Nearly all of the producers are selling their products below market price to dealers. In addition, they are faced with some problems such as late payment, short payment, nonpayment and so on. Another problem is that there are a great many resellers (2.75). When marketing channels extend, producers get less money. Some obstacles like warehousing (1.74) and distance from markets (1.47) are among problems that negatively affect producers in the region.

*Table 2. Most common marketing problems*

	N=58	Never	Rarely	Sometimes	Often	Always	Average of Scale
Low Price		0	1	10	22	25	3.79
Payment Conditions		3	6	10	20	19	3.79
Excessiveness of Resellers		10	12	23	8	5	2.75
Warehousing Problem		36	9	7	4	2	1.74
Distance from Markets		9	30	8	4	7	1.47

The most important marketing problem that has been detected in research area is that 93.1% of the producers sell their product below market price in the farmyard. Producers who are producing on a large scale cannot sell their whole products in local markets. Since their warehouse are not suitable, they have to sell their products below market price during harvest time. Besides, these products cannot find a place in the big markets since their products are under quality; and cooperatives cannot take an active role in the sales and marketing of the products.

In research area, ¾ of the producers is a member of at least one cooperative, and they said that cooperatives are not active in terms of marketing. According to 61.7% of the producers, the cooperatives are not active and effective in marketing. The expectations of the producers who need support in the packing and handling of products are not met. It is of high importance to warehouse fresh fruits during harvest time so that they might be protected against price fluctuations and low prices. In addition, 50 % of the producers is claiming that they cannot get enough support from cooperatives about the warehousing of the products.

The influence of these problems was tested with the Five Digit Likert Scale. The most common displeasure of the farmers about cooperatives is that cooperatives cannot take an active role in producing activities (3.88). Second problem about cooperative membership is that cooperatives are not active in marketing (3.40). As could be seen, inadequacy of the cooperatives about production and marketing is influential upon cooperative memberships. Other important problems are that cooperatives are not active in education and extension activities (3.11) and membership fees are very expensive (2.92). Another problem is that cooperatives are far a way from where farmers are living (1.85).

*Table 3. The problems of the members on their cooperatives*

N=27	Never	Rarely	Sometimes	Often	Always	Average of Scale
Not Active in Production	1	4	3	8	11	3.88
Not Active in Marketing	3	0	11	9	4	3.40
Not active in Education and Publication Activities	0	8	10	7	2	3.11
Membership Fees	4	12	1	2	8	2.92
Distance	16	5	2	2	2	1.85

The level of education for the farmers is elementary-level. Initially, this educational level of the young ones who are living in rural areas should be increased, and a number of seminars and courses should be organized especially for those who are middle-aged and above.

The total lands and fruit lands of the farmers are usually small and fragmented. These kinds of farms are generally family enterprises. Small and fragmented lands are among the most important structural problems of Canakkale province just as in Turkey. In this point, cooperative organizations should be popularized so that structural solutions could be provided and small producers could gain some advantages; and the cooperatives should be activated. In research area, most of the farmers are a member of at least one cooperative; however cooperatives are not active enough in production and marketing activities.

Specific support policies should be identified, and these policies should be sustained through suitable means. Present support given to vegetative production is not sufficient in terms of sustainability. Enhancement of the prices of some agricultural inputs like diesel oil, fertilizer and pesticide should be prevented.

Fruits are not produced in high quality and in harmony with general standards. For that reason, products are not sufficiently demanded in domestic and international markets. Technical measurements that will enable high quality and high standard production should be ensured.

Most of the producers are running through problems about marketing rather than production. The most important marketing problem in research area is that nearly all of the producers are selling their products below market value to dealers in farmyards. Therefore, it is seen as an obligation for cooperatives to take a more active role in the marketing of the products.

## CONCLUSION

Problems that are seen in the production and marketing of Canakkale province are not different from the problems in other parts of Turkey. The activity level of the agricultural policies in Turkey affects the production and marketing structure of fruits. In this sense, it is suggested that policies concerning fruit production and marketing should selectively be determined and those policies should effectively implemented so that production and marketing problems could be solved.

Producers should be directed to actively-working cooperatives, in this way, negative impacts of the structural problems upon production and marketing could be eliminated. Cooperatives could provide some advantages like input supply and production sale in fruit production to small farmers, and then they will have the same advantages that large scale farmers have. Besides, cooperative organizations are seen as the most suitable solution ways for some investments about warehousing and preservation facilities so that small scale farmers could sell their products at a proper price. Furthermore, it is considered that an organizational structure for some services and functions such as packing and handling which create value-added could motivate producers to remain in the market.

Some socio-economic factors like continuing education of the farmers along with a number of technical and economical sides of the sustainable fruit production and marketing should be taken into consideration, and essential regulations should be carried out.

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# EVALUATION OF FRUIT-GROWERS' PRACTICES IN TERMS OF GLOBALGAP CRITERIA IN AEGEAN REGION, TURKEY\*

Gül ÖNER<sup>1</sup> Şule İŞİN<sup>2</sup>

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## ABSTRACT

In recent years, some initiatives have been taken at national and international level with the aim of ensuring food safety, protecting natural resources, making agricultural production without harming environment, human and animal health.

One of those initiatives is GLOBALGAP (EUREPGAP) protocol, prepared by European large supermarket chains in 1999, and in which minimum standards, required to be used in agricultural production were determined under the title of Good Agricultural Practices (GAP). In this study, it is aimed to determine the status of growers of cherry, table grapes and peach, exported to European Union (EU) countries in a considerable amount, in terms of implementing GLOBALGAP (EUREPGAP) criteria.

In line with this aim, the tendency of GLOBALGAP certified growers to fulfill GLOBALGAP criteria has been studied and issues, which they face while fulfilling these criteria, have been set forth. However, present status of growers without certificate has been analyzed within the scope of GLOBALGAP criteria and their deficiencies have been determined.

122 fruit-growers, analysed in the study, have been selected according to the method of stratified random sampling. 24 of 51 cherry growers, 11 of 39 grape growers and 6 of 32 peach growers are GLOBALGAP certified. Data has been received from surveys, conducted through face-to-face interviews.

At the study, firstly general features of growers have been set forth. Then opinions of growers, producing either with certificate or without certificate, have been received with regard to GLOBALGAP certificate and their compliance with these criteria has been evaluated.

Key Words: GLOBALGAP (EUREPGAP), cherry, grape, peach

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## INTRODUCTION

Modern-day consumers want the products they buy be healthy and safe and be produced without giving any harm to the environment and nature. Additionally, importance is also given to the work safety and satisfaction of those in charge of the processes starting from the good's production phase to consumption. In line with the demands and expectations of consumers, in the wake of efforts by retail dealers to provide healthy and safe products, a set of initiatives have been taken in the international circles.

One of these initiatives is the EUREPGAP protocol, which determines minimum standards required to be used in agricultural production, prepared by large European retailer supermarkets and defined as Good Agriculture Practices (GAP). This protocol referred to as EUREPGAP was prepared by the Euro Retailer Produce Working Group – EUREP in 1999.

Owning a EUREPGAP certificate implies the product does not contain chemical, microbiological and physical remnants harmful for human health, it is produced without polluting the environment or harming the natural balances, the welfare of people or other living creatures related to production is not negatively affected during production and that operations during its production are made in accordance with the agriculture legislation of the country where the product is grown and the agriculture legislation of the country where consumers are set (IMO, 2012).

In the course of time, as EUREPGAP has been adopted overall the world with its global trade model, its name was changed to GLOBALGAP in September 2007.

Nowadays 112 576 producers in 113 countries overall the world are producing with a GLOBALGAP certificate. When an assessment is done among world countries in accordance to certificate-owning producers, we notice Spain and Italy are ranked in the first two places. These two countries possess about 37 % of certified producers. These countries are respectively followed by Greece, Germany, the

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\* This study has been prepared by using the data of PhD thesis project supported by Ege University Scientific Research Projects Fund (No. 2008-ZRF-014).

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Netherlands, France, Belgium, India and Turkey. 67.13 % of the GLOBALGAP certified producers are found in Europe (GLOBALGAP, 2010).

As in many other countries, Turkey's export potential is expected to increase even more in the near future. Meanwhile, in the medium term, with the increase of consumer awareness in the domestic market and the realizing of GAP's importance, and as a result of efficient agriculture broadcasting and agricultural consultancy services, the number of producers and the areas of production are expected to increase further (Özçatalbaş et.al., 2010).

The production quantity of fruits reached 17.2 million tons in 2011, increasing by 3.5 % compared to the previous year in Turkey, which carries out a considerable amount of its fresh fruit exports to European countries (TUIK, 2012).

According to 2011 figures, Turkey produces 4 296 351 tons of grape in a surface of about 472 545 hectares of vineyard. About 53 % of the produced grapes are edible, 36 % are dried, 11 % are utilized as wine rack (TUIK, 2012).

According to 2010 figures, Turkey, with its 4 255 000 tons of grape production, ranks sixth in the world following China, Italy, the US, Spain and France. It ranks first in the world for the production of cherries with 417 905 tons and sixth in the world for the production of peaches following China, Italy, Spain, the US and Greece with 539 403 tons (FAO, 2012).

When all world's countries are addressed, according to 2009 data, Turkey ranks sixth in the world regarding exports of table grapes following Chile, Italy, the US, the Netherlands and South Africa, with 170 250 tons. It ranks second in the world following the US regarding exports of cherries, with 50 785 tons and ninth regarding exports of peaches following Spain, Italy, the US, Chile, Greece, France, China and the Netherlands with 32 317 tons (FAO, 2012).

Turkey is the primary choice of European countries that import fresh vegetables and fruits. For this reason, it is believed that it will be of crucial importance to try to define the applicability of GLOBALGAP protocol, being applied in Turkey since 2004, at the level of table grapes, cherries and peaches producers that own a large share in exports of fresh fruits.

This study examines the trends in carrying out GLOBALGAP criteria by GLOBALGAP certified producers. Moreover, it was also tried to identify the problems and uncertainties that producers have faced while carrying out these compliance criteria. In the meantime, it was also tried to identify the present situation and deficiencies of uncertified producers in the framework of GLOBALGAP criteria.

## **MATERIAL AND METHOD**

The material of the study consists of data acquired from face to face interviews with table grapes, cherries and peaches producers in the Aegean region in 2009. The lists of producers that deal with the production of table grapes, cherries and peaches was obtained by provincial and district agriculture directorates. Accordingly, a total of 13 villages in the provinces of Manisa and Denizli were taken under the framework of the study for table grapes, 17 villages in the provinces of Afyon, Izmir, Kütahya and Manisa for cherries and a total of 6 villages in Izmir for peaches. The method of Stratified random sampling was used to set the sample size with a total of 122 producers of whom 51 produce cherries, 39 table grapes and 32 peaches. Producers that carry a GLOBALGAP certified production are distributed as follows: 24 of 51 cherry producers, 11 of 39 table grapes producers and 6 of 32 peach producers.

For the selected producers, data concerning applicability of GLOBALGAP criteria is analyzed according to the 5 point likert scale and is then interpreted in charts.

In this study, the criteria found in the "GLOBALGAP (EUREPGAP) General Fruit Vegetables Regulation" found in the renewed Turkish version dated 02.08.2006 that are in force since 29.10.2004 and became binding as of 01.05.2005, was taken into account.

Among a total of 214 Control Points and Suitability Criteria found in the GLOBALGAP (EUREPGAP) General Fruit Vegetables Regulation dated in 2004, there are 49 major, 99 minor and 66 advisory criteria. Of the total 214 GLOBALGAP criteria, this study deals with the major and minor criteria which shall be fulfilled.

## FINDINGS

### General Features of Analyzed Producers and Farms

This section of the study addressed to certain features of the selected producers such as age, years of education, experience in agriculture and in growing fruits. The average years of education of the examined producers is 7.10 years. The average years of education of the producers that make certified production is higher than the general average. On the other hand, it was noticed the average years of education of the producers that make uncertified production is lower than the general average. In the examined farms, the average age of producers is 52.30 years. While the average age of producers that make uncertified production is higher than the general average age, it was noticed that the average age of producers making certified production is lower than the general average age. The average experience in agriculture of the examined producers is 27.32 years. While the average experience in agriculture of producers that make uncertified production is higher than the general average, it was noticed that the average experience in agriculture of producers making certified production is lower (Table 1).

Table 1. Features of examined producers (years)

	Age	Education	Experience in Agriculture	Experience in Growing Fruits
Certified (41)	49.59	8.20	24.15	21.15
Uncertified (81)	53.68	6.54	28.93	24.51
TOTAL (122)	52.30	7.10	27.32	23.38

In addition to the general features of producers, the study also addresses to certain features of farms. Accordingly, while the average size of the farm land is 41.11 decares for certified enterprises, the figure is 31.37 decares for uncertified enterprises. Generally in most of the farms, crops other than the ones treated here are also included. Moreover, some of the examined farms also deal with livestock on a small scale.

### Assessment of the Concordance Criteria of Producer's Applications in the Examined Enterprises that Do Certified and Uncertified Production

This section deals with the examination of the attitudes and current situation regarding GLOBALGAP criteria of producers that make production of fresh fruits in the Aegean region, using the 5 point likert scale under 11 titles.

A total of 5 criteria fall into the first title "product traceability, record keeping and internal self - assessment." Four of these criteria are major and one is a minor criterion. While the scale averages related to the major criteria vary between 2.22 and 3.68 for producers that make certified production, this criteria rank between 1.21 and 2.60 for producers that make uncertified production. It is noticed that the "Efficient Corrective activities according to findings from internal self-assessment," which is a subtitle of the "product traceability, record keeping and internal self-assessment," is generally carried out by producers in certified production. While the averages related to applications defined as minor criteria rank 3.39 for producers that make certified production, the figure is 2.15 for producers making uncertified production. It can be said that applications related to these topics of both producers making certified and those making uncertified production are not in adequate levels (Table 2).

Meanwhile, in the group of production area history and production area management, there are a total of 4 criteria, of which 2 are major and 2 are minor. Regarding risk assessment and availability of corrective activities according to risks, there is 1 major and 1 minor criterion. The average scale factor for major and minor criteria in this group is 0.39 for producers that make certified production and 0.15 for producers making uncertified production, which implies that none of the producers in either group has performed these applications at any time. Regarding formation and collation of a record keeping system, there is still 1 major and 1 minor criterion. While the average scale factor for the major criterion is 2.54 for



producers making certified production, this value is 1.67 for producers making uncertified production. Regarding the minor criterion, the average scale factors for producers making certified and uncertified production are 2.34 and 1.32 respectively (Table 2).

**Table 2. Producer Applications on Issues Regarding Product Traceability, Record Keeping and Internal Self-Assessment and Production Area History and Production Area Management**

Criteria	Nature of the criterion	Certified (Scale Average)	Uncertified (Scale Average)
<i>Product Traceability, Record Keeping and Internal Self-Assessment</i>			
Products, can be traced until the garden where cultivated	Major	3.56	1.86
Producers, keep updated record entries for at least a period of two years	Minor	3.39	2.15
Producers, make internal self-assessment once a year	Major	3.54	2.56
Internal self-assessment is recorded	Major	2.22	1.21
Is engaged in efficient corrective activities in accordance with findings from internal self-assessment	Major	3.68	2.60
<i>Production Area History and Production Area Management</i>			
For areas that are new/whose risks have changed; a written risk assessment taking into account the type of soil, erosion, quality and depth of underground water, water sources and effects to surrounding land is available	Major	0.39	0.15
A corrective action plan that contains strategies to minimize all risks defined in new agriculture areas is available	Minor	0.39	0.15
A record keeping system containing all yard areas where products are found and all agricultural activities occurring in these areas exists	Major	2.54	1.67
Each yard is recorded physically (using specification, map, boundary stone or code, name, number, colors)	Minor	2.34	1.32

1)Never 2)Seldom 3)Occasionally 4)Often 5)Always

There are a total of 15 criteria of which 2 major and 13 minor ones under the “fertilizer type and quantity, implementation records, implementation tools, fertilizer storage” title. Scale averages related to major criteria rank between 3.98 and 4.71 for producers making certified production, meanwhile, they rank between 3.30 and 4.30 for producers making uncertified production. Both groups of producers seem to have mostly carried out the major criteria consisting of “Human waste is in no way used in the enterprise” and “All kind of fertilizer is stored differently from products and production materials.” Naturally, this value is lower for producers making uncertified production. The averages related to applications defined as minor criteria ranked between 1.10 and 4.44 for producers making certified production and between 0.95 and 4.05 for producers making uncertified production (Table 3). These applications that are mostly carried out at a high level by producers from both groups are in general related to storage conditions of inorganic fertilizer.

In the category of basic issues in plant protection and selection of chemicals there are a total of 11 criteria. 5 of these criteria are major and 6 are minor. The scale average for applications taking part in major criteria vary between 1.10 and 4.88 for producers making certified production, while it is noticed the rank varies between 1.00 and 4.65 for producers making uncertified production. Producers of both groups use almost always licensed plant protection products, in accordance with label recommendations. Applications related to the education of producers, which are still part of major criteria, are at very low levels for both groups. Meanwhile, averages pertaining to minor criteria are defined between 1.78 and 4.76 for producers making certified production and between 1.04 and 4.27 for producers making uncertified production (Table 4).

**Table 3. Producer Applications Related Fertilizer Type and Quantity, Implementation Records, Implementation Tools and Fertilizer Storage**

Criteria	Nature of the criterion	Certified (Scale Average)	Uncertified (Scale Average)
The technical person responsible for the type and quantity of fertilizer has the adequate knowledge and education and can prove this with documents	Minor	4.15	3.35
The matter of which organic/inorganic soil or foliar fertilizer applications are used for the yard/vineyards is recorded	Minor	2.41	1.56
Application dates are recorded	Minor	2.44	1.62
Applications are recorded including the fertilizer types	Minor	2.44	1.62
Applications are recorded together with the used quantity	Minor	2.44	1.62
Applications are recorded together with the usage method	Minor	2.39	1.46
The name of the person that does the application is defined in recordings	Minor	2.00	1.30
The maintenance of the fertilizing equipment is made regularly by individuals/authorized organizations, information is recorded	Minor	3.75	2.23
The inventory of inorganic fertilizers in the farm is kept, this transaction is repeated once in three months	Minor	1.61	1.12
Inorganic fertilizers are stored in a place different from plant protection products	Minor	4.02	3.54
Inorganic fertilizers are stored in a clean, dry and closed area	Minor	4.37	4.01
Inorganic fertilizers are stored in a way that minimizes the risk of water contact	Minor	4.44	4.05
Organic/inorganic fertilizers are stored in a different place from products and production materials	Major	3.98	3.30
Human waste is in no way used in farms	Major	4.71	4.30
Before application, risk assessment is done regarding issues such as disease infection, weed seeds and composting methods, taking into account the source and structure of organic fertilizers	Minor	1.10	0.95

1)Never 2)Seldom 3)Occasionally 4)Often 5)Always

**Table 4. Producer Applications on Basic Issues in Plant Protection and Issues of Selection of Chemicals**

Criteria	Nature of the criterion	Certified (Scale Average)	Uncertified (Scale Average)
The products' struggle against weed and diseases is done by using chemicals appropriately and at lowest levels.	Minor	4.76	4.26
In case of repetition of disease, weed, there is compliance with resistance recommendations in order to increase the effectiveness of plant protection products (PPP)	Minor	4.51	3.94
The technical staff member responsible in the enterprise can certify that he/she has attended an official course on Integrated Pest Management (IPM) techniques or has taken external consultancy service on IPM	Minor	4.54	4.26
The PPP is used to address the targeted concern (disease, weed) as indicated on the label	Major	4.83	4.56
In the country where production takes place, only PPP owning a license or present in official lists are used	Major	4.88	4.65
An updated list indicating the usage of PPP on crops produced exists	Minor	1.95	1.07
This updated list includes amendments in regulation related to regional/national PPP	Minor	1.78	1.04
Chemical substances forbidden in the European Union (EU) are not used for products produced for the EU	Major	3.95	3.59
Consultants that chose disinfection products can show that they are sufficient in this area, through the special course certificate/diploma, etc. they have	Major	4.76	4.52
The producer that chose disinfection products, can show that they are sufficient in this area, through the special course certificate/diploma, etc. they have	Major	1.10	1.00
The rate of PPP is calculated, prepared and registered in accordance with information on the label	Minor	4.61	4.27

The issues of recordings of applying plant protection products and pre-harvest usage interval are examined through a total of 11 criteria, of which 6 are major and 5 minor. While the application of major criteria by producers is between 3.80 and 4.37 for producers making certified production, it is between 2.02 and 2.98 for producers making uncertified production. It is observed that producers making certified production are complying with the criteria including the recording of information such as the name and the application date of the plant protection products, their kind and content at a much higher level compared to the other group of producers. Additionally, producers making certified production generally carry out such kinds of applications. While the scale average related to applications within the scope of minor criteria rank between 3.20 and 4.37 for producers making certified production, these averages are between 1.68 and 2.96 for producers making uncertified production (Table 5).

*Table 5. Producer Applications on Recordings of Applying Plant Protection Products and Pre-harvest Usage Interval*

Criteria	Nature of the criterion	Certified (Scale Average)	Uncertified (Scale Average)
The plant protection products (PPP) applications are recorded together with the name and kind of products they are applied on	Major	4.32	2.88
The reference number of the yard or vineyard where the PPP is used is specified	Major	3.80	2.02
The date of the application of the PPP is recorded (in the form of day/month/year)	Major	4.37	2.98
The trade name and active agent of the PPP is recorded	Major	4.37	2.95
The name of the person doing the application is recorded	Minor	3.20	1.68
The aims of the PPP usage are recorded	Minor	4.37	2.96
The name of the person who recommends the PPP is recorded	Minor	4.15	2.32
The PPP applications are recorded together with the equipment they are used with	Minor	4.20	2.54
The application quantity is specified by weight/volume, g/l, dosage or internationally recognized measurement units	Minor	4.34	2.94
The pre-harvest period of the PPP applications is recorded as a date	Major	4.29	2.75
The pre-harvest usage intervals of the used PPP are considered and dates are recorded	Major	4.32	2.73

1)Never 2)Seldom 3)Occasionally 4)Often 5)Always

The title of application equipment and the disposal of plant protection products remained from the mixture includes a total of 4 minor criteria. The scale averages related to these minor criteria are between 2.71 and 4.10 for producers making certified production, while they vary between 1.90 and 4.02 for producers making uncertified production. There are total of 5 criteria of which 4 major and 1 minor related to the analysis of the plant protection products residuals. Because these criteria are generally applied by the exporting firms, neither producers making certified production nor those making uncertified production make residual analysis (Table 6).

There are total of 16 minor criteria under the title of the storage and usage of plant protection products. The average scale of minor criteria is between 1.68 and 4.56 for producers making certified production, while they rank among values between 1.26 and 4.28 for producers making uncertified production. It is observed that producers from both groups fit to a large extent to the storage in original package of the plant protection products. Meanwhile, the preparation of inventory of plant protection products once in three months is the application which is least carried out by producers (Table 7).

**Table 6. Producer Practices on Application Equipment and the Disposal of Plant Protection Products Remained from the Mixture and on Analyses of Plant Protection Products Residuals**

Criteria	Nature of criterion	Certified (Scale Average)	Uncertified (Scale Average)
<b>Application Equipment and the Disposal of Plant Protection Products remained from the Mixture</b>			
Maintenance of plant protection equipment is made regularly and information related to maintenance is regularly recorded	Minor	3.39	2.78
The plant protection product application machinery is maintained yearly by a person who is sufficient regarding maintenance and records regarding maintenance are kept	Minor	3.32	2.72
The owned equipment and measuring tools are sufficient for mixing the chemicals in a proper manner	Minor	4.10	4.02
The water remaining from pesticide mixtures or from the washing water of pesticide tanks disposed of according to local or national regulation.	Minor	2.71	1.90
<b>Analyses of Plant Protection Products Residuals</b>			
Yearly analyses of residuals are done. The analyses conclusions are kept track of for each production unit	Major	0.10	0.00
The Maximum Residue Limits (MRL) of countries where products will be sold are kept track of	Major	0.10	0.00
For products subject to exporting, limits of that country are considered	Major	0.10	0.00
In the course of analyses made, if the MRL are exceeded, there is a written action plan where what should be done is explained	Major	0.07	0.00
The residuals analyses are made in a laboratory accredited with ISO 17025 or according to another equivalent standard	Minor	0.12	0.00

1)Never 2)Seldom 3)Occasionally 4)Often 5)Always

**Table 7. Producer Applications on Storage and Usage of Plant Protection Products**

Criteria	Nature of criterion	Certified (Scale Average)	Uncertified (Scale Average)
Storage places of plant protection products (PPP) are organized in accordance with local/national regulation	Minor	3.71	2.81
The storage place is steady as a structure and safe, it is kept locked	Minor	3.76	2.83
The storage is built with special materials in a special place in order for PPP not to be affected by changes in temperature	Minor	3.88	2.98
The storage is built with fire resistant materials	Minor	3.83	3.02
The storage has a mechanism that ventilates sufficiently and regularly	Minor	4.12	3.48
There is sufficient light/illumination in the storage to read the label information	Minor	4.34	3.62
The storage floor has absorbing/precipitating characteristics in case PPP are poured on the floor	Minor	3.49	2.80
PPP is stored at sufficient distance from other materials	Minor	4.24	3.48
There is suitable equipment for the measurement of PPP and the producer carries out its yearly maintenance	Minor	3.73	3.19
The necessary tool equipment for the mixture of PPP is found in the storage	Minor	4.20	3.91
In case of leakage of any pesticide, a container of sand, pesticide precipitating material, a broom, dustpan, plastic bags, etc. are found in the storage	Minor	2.71	1.95
Entry-exit and locking transactions in the storage are limited to trained workers	Minor	2.41	1.73
An inventory of PPP in the storage is made each every three months	Minor	1.68	1.26
All PPP are stored in their original packages	Minor	4.56	4.28
PPP used for cultivated products and PPP to be used for the product in rotation are stored in different places	Minor	3.51	2.47
Liquid pesticides are not stored on pesticides of a dust/granule nature	Minor	4.34	3.38

1)Never 2)Seldom 3)Occasionally 4)Often 5)Always

There are total of 10 minor criteria analyzed under the title related to applications on the empty containers of plant protection products. The scale average regarding applications within the scope of minor criteria vary between 1.22 and 4.88 for producers making certified production, while it is between 1.09 and 4.81 for producers making uncertified production. Producers of both groups in no way use empty containers of plant protection products. The applications related to the washing and rinsing of empty containers and the return of water from rinsing to the application equipment tank, which still take place in minor criteria, are generally carried out by producers of both groups. Nonetheless, disposal or collection of empty containers of plant protection products are not documented officially by either producers making certified production or those making uncertified production (Table 8).

*Table 8. Producer Practices on Applications Related to Empty Containers of Plant Protection Products*

Criteria	Nature of criterion	Certified (Scale Average)	Uncertified (Scale Average)
Empty containers are in no way used	Minor	4.88	4.81
Empty containers are stored in a safe area where contact with people is not possible	Minor	3.56	2.79
The system used to dispose of empty plant protection product (PPP) containers is made in a way as to minimize the risk of spreading to the surroundings, water sources, flora and fauna	Minor	2.98	2.52
Producers document the disposal of empty containers using official collection and disposal systems	Minor	1.22	1.09
Empty containers are collected, labeled and transported in a way suitable to dispose in an official way	Minor	2.68	2.11
The washing of empty containers is done by using a pressured rinsing tool integrated to the application equipment or by being rinsed at least three times with water	Minor	4.02	3.90
The rinsing water coming from empty boxes is turned back to the application equipment tank in order to be used during mixture	Minor	4.07	3.83
Empty boxes are stored in a safe way until they get destroyed	Minor	3.34	2.67
The local, regional and national regulation and laws are taken into account for the demolition of empty containers	Minor	2.80	2.35
The PPP whose usage date has expired are defined and stored in a safe manner or are disposed through authorized channels	Minor	2.59	2.07

1)Never 2)Seldom 3)Occasionally 4)Often 5)Always

There are 7 criteria under the title of hygiene applications during harvest. 6 of these criteria are considered as major while 1 of them is minor criteria. While the scale average for major criteria for producers making certified production is between 0.88 and 3.20, the figure is between 0.94 and 2.27 for producers making uncertified production. It has been noticed that, both certified and uncertified producers do not fulfill the need of preparing a risk analysis for one of the major criteria, which is, transportation process between the harvest and the farm gate. As for the scale average for the minor criteria, the average for producers making certified production is 3.20, while it is 2.23 for producers making uncertified production (Table 9).

There are 3 criteria for the title of environmental matters and complaints as 2 of the criteria are major while one of them is minor. Scale average for the minor criteria of preserving the wild life has been 1.00 for producers making certified and uncertified production. Average values for 2 major criteria under the complaints subtitle have been 1.10 for producers making certified production, while the figure is 1.00 for producers making uncertified production. According to the scale averages obtained, both certified and uncertified producers do not fulfill the criteria concerning developing an administrative plan about preserving wild life, having complaint forms ready in case of a complaint concerning the matters that has been studied within the scope of the criteria and following those complaints (Table 10).

**Table 9. Producer Applications Concerning Hygiene Applications during Harvest**

Criteria	Nature of the Criteria	Certified (Scale Average)	Uncertified (Scale Average)
A risk analysis is prepared for hygiene conditions during the transportation process between the harvest and the farm gate	Major	0.88	0.94
A hygiene procedure is applied during the harvest	Major	2.56	2.10
The hygiene procedure includes containers, crates and hand tools	Major	2.61	2.14
Hygiene procedure of harvesting includes the actions have to be taken in the matters of transportation of products, direct contact with the products, packaging in the garden and storage at the exporter firm.	Major	2.61	2.14
This procedure includes, maintenance of tools being used to transport goods within the enterprise	Major	2.63	2.14
There are moving/stationary and hygienic washstands for workers within the range of 500 m. where they can wash their hands.	Major	3.20	2.27
There are moving/stationary and clean toilets for workers and they are within the range of 500 m.	Minor	3.20	2.23

1)Never 2)Seldom 3)Occasionally 4)Often 5)Always

**Table 10. Producer Applications on Environmental Matters and Complaints**

Criteria	Nature of the Criteria	Certified (Scale Average)	Uncertified (Scale Average)
An administrative plan is developed concerning the preservation of wild life and it is transformed into a document	Minor	1.00	1.00
Complaint forms are readily present at the farms that can identify the complaints related to the above mentioned subjects	Major	1.10	1.00
The complaint procedure can show that complaints are being recorded, studied, followed and new measures are being taken to improve the situation	Major	1.10	1.00

1)Never 2)Seldom 3)Occasionally 4)Often 5)Always

## CONCLUSION AND SUGGESTIONS

According to research conducted to this point, both producers making certified and uncertified production are very limited when it comes to meet some of the GLOBALGAP criteria. Especially, applications in areas such as; risk audit, analysis and evaluation, orderly stock inventory records for inorganic fertilizers and plant protection products, up-to-date records for plant protection products, education for the usage of these products, residual analysis, formal collection of empty chemical packages and keeping the records of their disposals and developing a plan to enhance the preservation of wild life, having forms and records for complaints; are either never in place or they are met by producers rarely. While it is considered most of these shortcomings in such applications are related to the education of producer, the lack of coordination among the exporters, certification bodies and legal authorities also may plays a role. These institutions can play a crucial role in educating, raising the awareness of and even encouraging the producers for such applications. Also, some of the above mentioned shortcomings in applications may be hard to fulfill for the producers by themselves. Therefore, development of an appropriate infrastructure is necessary.

The criteria that both groups of producers are having problems to fulfill are addressed above. However, there is a significant differentiation between producers making certified and uncertified production when it comes to major and minor criteria under the title of keeping the records for the applications of plant protection products and pre-harvest usage rates. It is expected that producers making certified production are more careful in this field, even if it is not fully satisfactory, due to agreements they make with exporter firms. If not, cancellation of the agreement can harm both the producer making certified production and the exporter firm.

**It is considered that, in order to enhance the crop yield and quality, it is necessary that technical support from exporter firms given to the producer under contract should increase while producers who are not under a contract should take support from an authorized person or institution.**

**Lack of attention from certification institutions during their inspection of producers and exporter firms leads to; disorderly records, not to perform maintenance of tools-equipment timely and sufficiently, deficiencies and problems in product hygiene and quality, workers health and security. If the certification bodies show the necessary attention, it will especially allow the exporter firms and producers to correct their deficiencies.**

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# MARKETING ORIENTATION OF CROATIAN FOOD INDUSTRY

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## ABSTRACT

The research of 60 companies in Croatian food industry has indicated the insufficient marketing orientation of the industry neither in terms of marketing philosophy of the companies, nor in terms of marketing behavior. Although marketing resources are generally recognized, inadequate marketing knowledge and existence and role of marketing department make this industry predominantly sales oriented. Such orientation is not corresponding to contemporary market situation in domestic and international market and creates serious constraints to the industry growth and development.

**Key Words:** Food industry, marketing orientation, Croatia

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## INTRODUCTION

Marketing orientation is a widely researched topic since the early 1990ies. Its basic assumption is that a company, in order to achieve superior market performance, needs to be focused on its customers and their needs and wants. Dynamic market changes due to the processes of globalization and market liberalization in the past few decades have additionally emphasized the need for such approach.

Although market economy is relatively new in Croatia as well as in the other transitional countries of Central and Eastern Europe and despite the fact that food industry is usually perceived as a rather traditional one, concentrated on fulfillment of basic human needs, new circumstances brought by the above mentioned processes imply the need of adoption of marketing orientation in Croatian food industry.

Therefore the aim of this paper is to analyze the contemporary features of the Croatian food industry and test the level of marketing orientation within the sector.

Marketing theory states that marketing oriented company is the one that has adopted the marketing concept and the corresponding customer focus. According to Kotler (1988), the four basic components of the marketing concept are customer orientation, customer satisfaction, coordinated or integrated marketing, and focus on profitability.

Contemporary research distinguishes between two approaches to marketing orientation: it can be defined as a specific company philosophy that is illustrated by the following priorities: (Avolonitis, 1999)

- a priority in customers when evaluating the company and its products and the extent to which both of them satisfy specific customer needs,
- a priority in elevating marketing as the prevailing culture of the company so that the entire organization will mobilize towards satisfying customer needs; and
- a priority in adjusting products according to the market needs and wants.

This approach was developed by Slater and Narver (1995) as a one-dimensional construct with most important underlying components: customers, competition and interfunctional coordination.

On the other hand, marketing orientation defined as a specific company behavior means designing of strategies that aim at achieving customer satisfaction, with the following priorities (Kohli and Jaworski, 1990):

- a priority in marketing intelligence collection in order to understand the market.
- a priority in intelligence dissemination throughout the company in order to familiarize it with the market.
- a priority in responsiveness to this intelligence through the strategies and plans that the company designs and implements.

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## MATERIALS AND METHODS

Croatian food industry has a long and rich tradition. In terms of its volume, employability and intensity it is one of the most important in Croatian economy. It is represented by about 2800 companies, 47000 employees (20% of the total), and the highest total income. It makes 13% of total Croatian exports and imports. Most of the companies are locally owned. The major trend in Croatian food industry during past two decades is polarization of the industry: 85% of the industry are small companies. Mid-size companies make 9% and large companies only 7% of the sector. Financial parameters show opposite results: large companies create about 80% of the total industry income (Ekonomski institut, 2012). Those large companies are organized by marketing principles, are active not only in local but also international market and often involve in exports, licensing, acquisitions and direct foreign investments. They are in all aspects of doing business comparable to any large food sector company in the world. On the other hand, small companies are rather traditional, concentrating on traditional products, based on labor and natural resource intensity. Although Croatia has ample resources that would enable it to supply the market with domestic products, the comparatively high cost of food production combined with steep tax rates make it cheaper to bring in food products from abroad. According to Croatian Chamber of Commerce data the Croatian food industry balance is steadily negative. On the other hand, the food industry throughout the past few years of recession and economic crisis has proved to be one of the most stable Croatian industry sectors.

SWOT analysis is performed in order to identify Croatian food industry basic strengths, weaknesses, opportunities and threats (Mesić and Markovina, 2009). It is shown in Table 1.

Table 1. SWOT analysis of the Croatian food industry

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Successfully following industry trends	Non-competitive input base (inefficient system of agricultural subsidies, small production units, low productivity, underdeveloped infrastructure,	Accession to EU – new markets	Accession to EU – loss of the market position within CEFTA countries (estimation cca. 100 mil. Euros)
Globally recognized certificates	Constant growth of input costs	Cluster development programs	
International awards and acknowledgments	Difficulties with production financing	Recognition of food industry as one of the most stable and „healthy“ in the current crisis	
	Insufficient production volumes		

Source: adapted according to Mesić and Markovina (2009)

The previous research on the marketing environment of the Croatian food industry (Leko Šimić et al. 2011) has indicated that food sector considers the marketing environment to be rather hostile, mainly due to the current economic crisis. Industry managers are focused on increasing their competitiveness both on local and international market by implementing more innovative approach and techniques in their companies. In this sense, most effort is given in new technologies (new products and processes) in large companies. The prevailing SMEs stress more new business models, especially in the distribution segment.

The highly structured questionnaire was sent out to 280 companies operating in food sector (10% of the total population) and 60 usable questionnaires were returned, which makes acceptable response rate of 21.4%. The questionnaire consisted of three parts: the first one was on the existing level of marketing knowledge and existence and position and organization of marketing sector in the company, the second one questioned marketing resources, capabilities, orientation and financial and marketing performance in the company, and the last one included company data (size, ownership structure, type of business and net income). Descriptive statistics was used to determine the major characteristics of marketing implementation in food sector companies in Croatia. In order to find significant differences between different performance results and position of marketing in the company ANOVA was used.

Sample consisted of 60 companies. Their major characteristics are shown in Table 2.

Table.2. Sample characteristics

		N	%
Type of business	Family business	12	20
	Limited liability company	33	55
	Cooperative	2	3,3
	Joint stock company	5	8,3
	Other	5	8,3
Number of employees	Micro (up to 10 employees)	27	45
	Small (11-50 employees)	15	25
	Middle (51-250 employees)	12	20
	Large (over 250 employees)	5	8,3
Net income	0 - 2.500,00 Euro	28	46,7
	2.500,00 – 10.000,00 Euro	5	8,3
	Over 10.000,00 Euro	7	11,7
Ownership structure	State	3	4,8
	Employees	7	11,1
	Local private	46	73
	Foreign	7	11,1

## RESULTS

Within the given sample our results first show inadequacy of existing marketing knowledge within companies: Over half of the companies in the sample (51.7%) do not employ any person with formal marketing knowledge, which is shown in Figure 1. only 11 (18.3%) companies employ one or more persons with higher education degree in marketing.

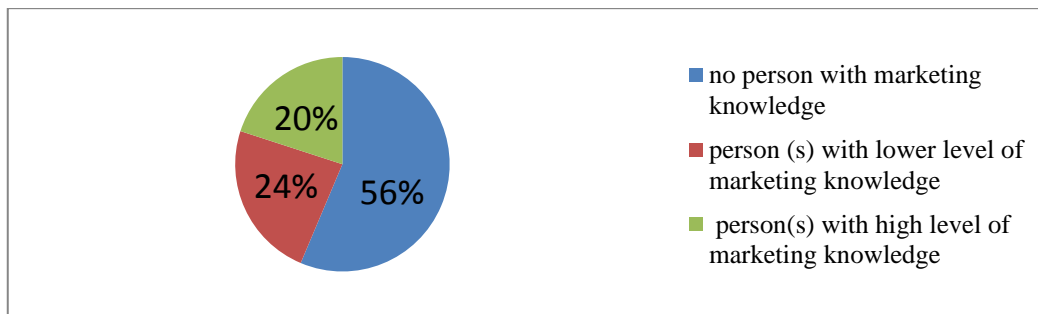


Figure 1. Marketing knowledge in Croatian food production

In accordance with this is the existence of a person responsible for marketing activities, as it is shown in Figure 2.

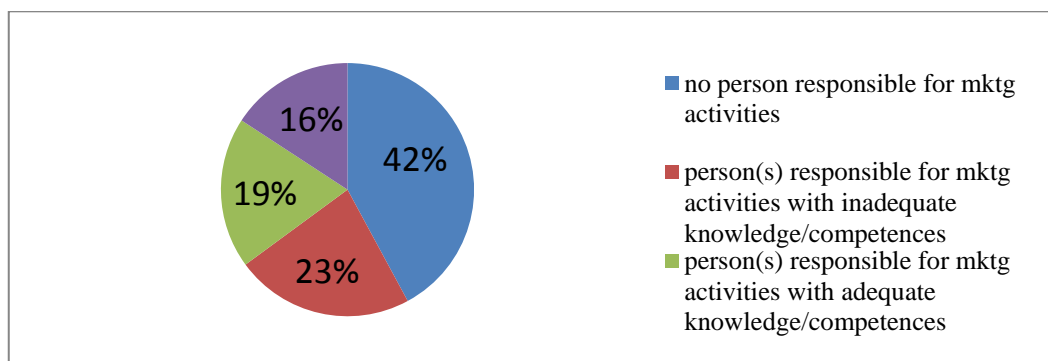


Figure 2. Responsibility for marketing activities in Croatian food production

The majority of marketing knowledge in the companies comes from experience while in only 9 cases the source of marketing knowledge is formal education. The structure of marketing knowledge sources are shown in Figure 3.

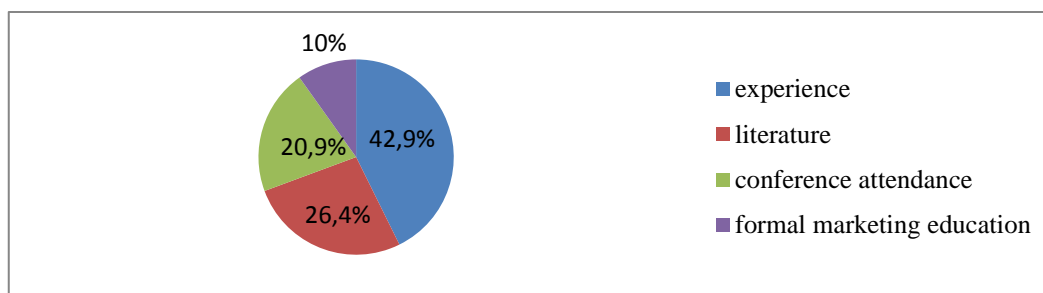


Figure 3. The structure of marketing knowledge sources in Croatian food production

Altogether 43 companies in the sample (71.7%) do not have a formal marketing department. In 23 companies (38.3%) marketing activities are performed within the sales department, and in only 9 companies (15%) sales is part of the marketing department. In 26 companies marketing activities are under direct supervision of general management. The internal organization of marketing in majority of companies (27, i.e. 45%) is based on geographic criteria, and in 22 (36.7%) on products/brands.

The evaluation of different aspects of marketing orientation by responding managers on 5-point Likert scale is shown in Figure 4.

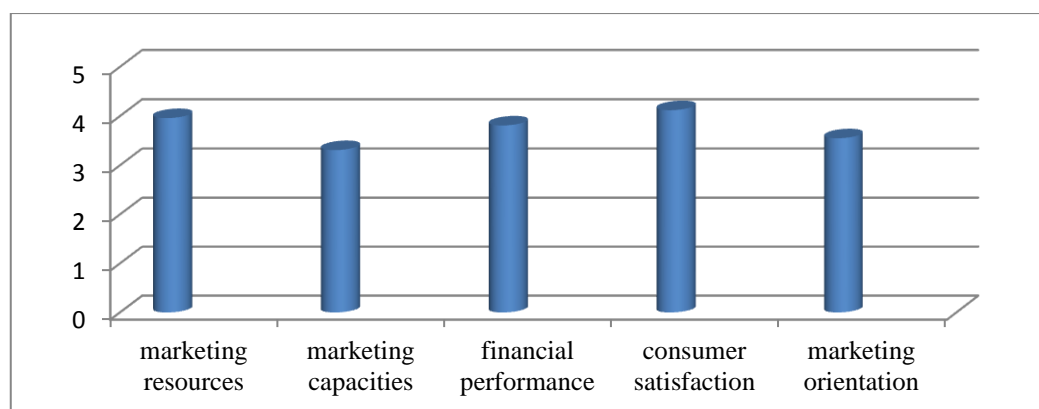


Figure 4. Evaluation of different aspects of marketing orientation in Croatian food industry

Within the complex variable of marketing resources, the most important items are quality relationship with key customers (average score 3.90), quality relationship with suppliers (3.59), high quality service (3.37), market stability and consumer loyalty (3.35) and cost effective production (3.31). The marketing resources which company managers consider most insufficient are marketing information system (2.59), and collaboration with partners in the food marketing system – in terms of financing activities (2.67), technology (2.73) and markets (2.79).

Within the complex variable of marketing capabilities the most important items are: supplier relationship management (3.70), procurement and distribution management (3.60) and customer relationship management (3.59). The weakest marketing capabilities are financial management (2.58), marketing management (2.75), human resource management (3.0) and new product management (3.06).

Evaluation of different aspects of marketing orientation shows that companies are best at solving customer complaints (4.29), quick response to consumer dissatisfaction (4.20) and changes in products or processes due to changes in consumer needs and wants (4.07). On the other hand, they are worst at sharing of their research results with decision-makers (2.93), reporting to customers/consumers (2.96), internal marketing (2.98) and usage of marketing segmentation as marketing strategy (3.06).

The highest overall score was acquired in complex variable of perceived consumer satisfaction where the strongest item is consumer loyalty (4.50), and the weakest is attraction of new consumers/customers (3.57). In general, the vast majority of responding managers consider their companies to have superior image on the market than the competition, lower work force fluctuation and superior product quality. The perceived general problems are lower than average profit margin, and return on assets as well as sales growth.

In ANOVA all the variables were checked against sample socio-economic characteristics. The statistically significant differences were found in existence of person responsible for marketing and number of employees ( $F=6.431$ ;  $p=.014$ : the more employees, the more probability that the company will have a marketing person employed and in existence of marketing department and number of employees ( $F=17.198$ ;  $p=.000$ ). Also, in smaller companies marketing departments would more often be part of the sales department ( $F=4.544$ ;  $p=.038$ ). Other significant differences were found between net income and existence of marketing department ( $F=3.508$ ;  $p=.022$ ) and inclusion of marketing activities in sales department ( $F=3.570$ ;  $p=.021$ ). Significantly higher net income is evident in companies that have a marketing department that is independent and not integrated in sales.

## DISCUSSION

Obtained research results show that the polarization of the Croatian food industry is not only in terms of its size and income distribution, but also in terms of existence and relative importance of marketing sector/department and marketing orientation. In general, we might conclude that Croatian food industry is more sales than marketing oriented. Although products are of high quality and have earned consumers' trust and loyalty, companies seem to be more oriented to reactive actions to recognized problems, than to proactive marketing intelligence collection and dissemination which is a basis of marketing orientation in terms of behavior, as defined by Kohli and Jaworski (1990). In the liberalized market in such circumstances it is very difficult to earn new customers and grow. Companies perceived the marketing environment as rather hostile and hesitate to work on turning competition into cooperation, which might gain them more competitive strength. Most of the marketing activities that are performed are on operational and not strategic level, which is illustrated by position and role of the marketing department and marketing knowledge in companies: in smaller companies marketing department usually doesn't exist and in larger it is often subordinated to sales. In such circumstances it cannot develop marketing philosophy on strategic level for the whole company, which is a basis of marketing orientation as defined by Slater and Narver (1995).

## CONCLUSION

This research has identified the position and role of marketing in Croatian food sector, as well as the most important elements that create marketing orientation of a company. Croatian food industry is not sufficiently marketing oriented, neither in terms of marketing philosophy implementation, nor in terms of marketing behavior. If Croatian food sector wants to keep its current local market position and grow in international market in new circumstances of EU accession, it has to turn its sales orientation to the marketing one.

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# A STUDY ON MEASURING CONSUMER PREFERENCES FOR FOOD PRODUCTION SYSTEMS AND ATTRIBUTES

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## ABSTRACT

This study provides insight into understanding consumer food purchasing behaviors with the intention of putting forward some policy interventions and programs to improve healthy eating habits. First, we investigated consumer attitudes toward the following food production systems-conventional, sustainable, and organic along five criteria-environmental concerns, food safety, food quality, wellness and community development concerns. Data were collected from a random sample of 252 respondents in three Southeastern states of the U.S.: Georgia, North Carolina and South Carolina. Analytic Hierarchy Process was employed to derive a measure of an individual consumer's preference for production systems in term of the selected criteria. Consumers prefer an organic production system over sustainable and conventional systems. Second, we assessed consumer attitudes towards fresh fruit and vegetables along five attributes: nutrition value, hygiene, taste, affordable price and freshness. Data were collected from a random sample of 412 consumers in the same states. Fuzzy Pair-wise Comparison was used to designate the degree of an individual consumer's preferences for fresh fruit and vegetable attributes. The results show that consumers prefer food attributes in the following order; freshness, taste, hygiene, nutritional value and affordable price.

**Key Words:** Consumer Preferences, food production systems, food attributes, analytic hierarchy process, fuzzy pair-wise comparison

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## INTRODUCTION

The emergence of food stores specializing in the sale of organic produce and products and the allocation self-space to organic produce and products in traditional supermarkets attest to the increasing demand for food and food products produced under alternative production systems. The growing popularity of alternative food production systems and the discussion in the popular media (print and electronic) concerning the health, environmental and social benefits they offer *visa-a-vis* conventional production systems may have, at the very least, make consumers aware of the opportunities that exist for making food purchasing decisions based on the type of production systems and their perceived benefits. Additionally, the promotion of healthy eating habits and the need for increased consumption of fruits and vegetables (FAO 2003; Stewart and Harris 2004; USDA-FNS 2008) plus the well-publicized need for environmental conservation (WCED, 1987) amplifies the salience and relevance of differences between food production systems in terms of their health, environmental and socio-economic benefit. For the purpose of this study conventional agriculture is operationalized as emphasizing the intensive use of land, water, synthetic fertilizers and inorganic chemical insecticides. The general consensus is that conventional agriculture, as currently practiced, is unsustainable. In general, sustainable systems use conventional practices more judiciously and integrate such practices with natural systems. In this study, a sustainable agricultural production system is operationalized as employing good agricultural practices (judicious use of synthetic fertilizers and pesticides), integrated pest management and emphasizing the use of natural cultural practices and fertilizers and insecticides from natural sources (WCED, 1987; Ikerd 1993). Even though sustainable agricultural systems are more in sync with nature and promote social equity, the popular belief is that true sustainability is captured best by organic production systems, which rely completely on natural systems and products to produce food and fiber. Based on this perspective, organic agriculture is operationalized as using only natural fertilizers and insecticides and emphasizes the use of natural cultural practices.

Additionally, measuring consumers' preferences for the attributes of food produced via these systems will generate information that is indispensable in designing an education programs to promote an increase in the consumption of fresh fruits and vegetables. The United States Department of Agriculture (USDA)-Nutrition Assistance Programs and Produce for Better Health Foundation (PBH) have encouraged Americans to consume fruit and vegetables to reduce diet-related health problems such as stroke, cancer and diabetes (USDA-FNS, 2008). These reports indicate t that the dietary recommendations for fruit and

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vegetable are taken into consideration by 23% and 38% of all individuals, respectively (Stewart and Harris, 2004). In 2009, per capita consumption of fresh fruits and vegetables was 101.3 and 209.1 lb., whereas processed fruits and vegetables was 163.7 and 201.2 lb., respectively (USDA-ERS, 2011). The increased consumption of fresh fruits and vegetables (Moser et al., 2011) provides opportunities for farmers, and the growing number of urban community gardens to meet this increased demand and improve access to fresh fruits and vegetables in urban food deserts. Success in meeting this increased demand will depend on the ability of farmers to produce and market fresh fruits and vegetables that match consumers' preferences.

Consequently, the objectives of this study were: (1) To measure consumer preferences for food produced under the following food production systems—conventional agriculture, sustainable alternatives and organic along five criteria—contribution to environmental conservation, food safety, food quality, contribution to wellness and contribution to community economic development by using Analytic Hierarchy Process (AHP). (2) To measure consumer preferences for fresh fruit and vegetables along five attributes: nutrition value, hygiene, taste, affordable price and freshness by using Fuzzy Pair-wise Comparison (FPC).

## MATERIALS AND METHODS

### *Measuring preferences for food production systems*

The sample was designed following the protocol described by Dillman et al. (2009). It was drawn proportionate to population size by county in Georgia, North Carolina and South Carolina. Data were collected from a random sample of 252 respondents via a telephone survey. Enumerators were trained to use the instrument prior to calling the study sample. This ensured that enumerators developed the desired level of comfort and competence in using the instrument to collect the data. Enumerators asked consumers to compare three food production systems, conventional, sustainable and organic, in terms of which consumers would prefer farmers to use in producing the fresh fruits and vegetables that they purchase or consume; taking into consideration the following criteria: environmental, food safety, food quality, wellness, and community development issues. , The AHP model, illustrated in Figure 1, was employed to derive a measure of an individual consumer's preferences for production systems given the selected criteria.

### *Measuring preferences for food attributes*

The sample was designed using the same protocol (Dillman et al., 2009) described in the objective 1. It was drawn proportionate to population size by county in the same states. Data were collected from a random sample of 412 respondents. For achieving the objective 2, FPC was used to derive a measure of an individual consumer's preferences for fresh fruit and vegetable attributes in the second stage of the study. Researchers designed and formatted a FPC questionnaire to be compatible with the data collection protocol of Survey Monkey. In the questions, enumerators asked consumers to make pair-wise comparisons of five food attributes: nutritional value, hygiene, taste, affordable price and freshness, in order to determine their preference for one attribute over the other. The results obtained from FPC were evaluated using the Friedman and Kendall's W tests to establish the relative importance of attributes and the extent of agreement among consumers with respect to two or more rankings.

## RESULTS AND DISCUSSION

In the AHP Model, consumers were asked to assess conventional, sustainable and organic production systems, taking into account the ability of each to generate benefits related to environmental conservation, food safety, food quality, wellness and community economic development. The AHP model for measuring the preference for production systems in terms of these criteria is defined in Figure 1. The goal is to determine consumers' preferences for food produced under three production systems using the following criteria: environmental conservation, food safety, food quality, wellness and community economic development. These criteria are the perceived benefits generated by each system. In the AHP model illustrated below, consumers are being asked to choose their preferred food production system from among the alternatives, conventional, sustainable and organic production systems, based on environmental conservation, food safety, food quality, wellness and community economic development criteria.

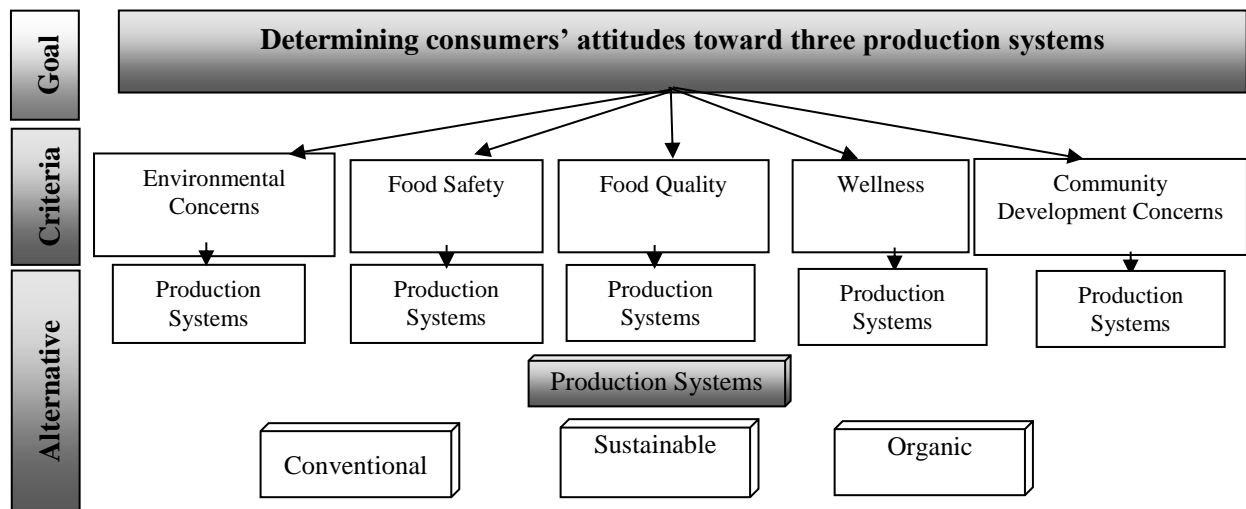


Figure 1: AHP model for consumer attitudes toward food production systems

Table 1 shows the results obtained by applying the AHP model. The last column in Table 1 indicates the consumers' average priority ratings for each criterion. The results indicate that consumers accorded priority in the following order to food safety (0.281) followed by wellness (0.275), food quality (0.209), environmental concerns (0.144) and community development concerns (0.091). Consumers considered food safety and wellness to be more important attributes or features of a food production system than the other attributes such as food quality and the capacity of the food system to contribute to community development or environmental quality. In each row of Table 1, the preference scores for each type of production systems are presented. The third column of Table 1 shows that organic agriculture is preferred based on its perceived capacity to generate benefits associated with wellness, food quality and safety, environmental and community development with the highest ratings of 0.575, 0.533, 0.530, 0.515 and 0.514 respectively. The average preference degree of 0.544 shown in the last row of Table 1 denotes that consumers preferred the organic production system over sustainable and conventional alternatives, which were assigned preference ratings of 0.274 and 0.182 respectively.

Table 1: Consumers' attitudes toward food production systems by the criteria

Criteria	Conventional	Sustainable	Organic	Preference
Environmental Concerns	0.203	0.282	0.515	0.144
Food Safety	0.186	0.284	0.530	0.281
Food Quality	0.195	0.272	0.533	0.209
Wellness	0.162	0.262	0.575	0.275
Community Development Concerns	0.209	0.278	0.514	0.091
Final Decision	0.182	0.274	0.544	

<sup>1</sup> Consumer preference scores are ranged between 0 and 1. The sum of each row, excluding the preference in the last column, is equal to 1.00.

Descriptive statistics for consumers' pair-wise comparisons of the attributes of fresh fruit and vegetables generated by the FPC model are presented in Table 2. The fresh fruit and vegetable attributes are ranked from most to least preferable using the reported degree of the consumer preferences. The results show that the fresh fruit and vegetable attribute most preferred by consumers is freshness with a preference rating of 0.579. Consumers prefer the other food attributes in the following order: Taste (0.452), hygiene (0.449), nutritional value (0.428) and affordable price (0.411). In this sample, consumers seem to value freshness, taste and hygiene over price and nutritional value. The Friedman test was used to see if there was a difference in the rankings of the fresh fruit and vegetable attributes. The Friedman test, which is significant ( $\chi^2= 177.71$ ;  $p<0.01$ ), confirms that some attributes are preferable to the others. Kendall's W test was used to measure the degree of agreement among consumers. The value of Kendall's W is 0.11, which indicates that the level of agreement among consumers in ranking the attributes is very low. A low level of agreement among consumers is an indication of the heterogeneity of consumers' preferences for the attributes of fresh fruits and vegetables.



**Table 2: Descriptive statistics of consumer preferences towards fresh fruits and vegetable attributes**

Attributes	Mean	Standard deviation	Minimum	Maximum
Nutrition Value	0.428	0.122	0.024	0.929
Hygiene	0.449	0.142	0.049	1.000
Taste	0.452	0.128	0.049	0.868
Affordable Price	0.411	0.154	0.000	0.735
Freshness	0.579	0.159	0.150	1.000

*Significant by Friedman test for  $p < 0.01$ ; Kendall's  $W = 0.11$*

## CONCLUSION

Organic production received the highest preference score rating, followed by sustainable and conventional production systems respectively. Furthermore, in according a higher priority to food safety and wellness, consumers appear to be more concerned with criteria that have consequences for their personal and immediate well-being. Emerging research has indicated that sustainable and organic agriculture can have positive impact on rural economic development (Ikerd, 2008). Since our findings indicate that consumers don't associate organic food production with benefits for environmental and community development, there is a need to design education programs that will convince consumers that there are socioeconomic and environmental benefits to be derived from organic production.

Consumers in making purchasing decisions pay more attention to freshness, taste and hygiene attributes of fresh fruits and vegetables than they do price and nutritional value, when these attributes are considered separately. These results indicate the need to (1) educate consumers on the connection among the food attributes and their relevance to healthy eating habits and a healthier lifestyle; and (2) the need to develop a holistic education program, that teaches consumers to use information available on all the attributes: price, taste, hygiene and nutritional value in making purchasing decisions.

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# THE DEVELOPMENTS OF MILK PRICES IN TURKEY AND SEASONALITY INDEX

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## ABSTRACT

At the beginning of the most important problems in the dairy sector in Turkey is the instability and uncertainty of raw milk price. The main purpose of this study is to determine the developments and the seasonal fluctuations in milk prices for the period of 2000-2010 in Turkey. In this regard, current and real prices of raw milk and their developments for the mentioned period were revealed. Moving Average Method was used to calculate Seasonal Index. Moreover, to make meaningful comparisons in the study; raw milk price, price parity of dairy products and raw milk feed price were calculated, the developments and support policies in dairy sector for this period were examined in general. Particularly, comparisons with EU were made. In this study, inadequate organization of producers is pointed to the main reason of the instability of milk prices in Turkey. Additionally, improving efficiency of Turkish Milk Board at politics, gaining functionality of farm accountancy data network and the importance of determining the policy priorities were emphasized. Determining the effect of market regulation by Ministry of Food, Agriculture and Livestock with establishment of Meat and Dairy Institute was pointed out.

Key Words: Milk prices, seasonality index, Turkey

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## INTRODUCTION

The share of livestock in the value of agricultural production is 27%, milk production in animal production is 42% in Turkey. The share of cow milk in the value of milk production is 89%. Moreover, the production of livestock comprises 69% of cattle. This case points out the importance of cow milk while assessing livestock sector in Turkey. Nevertheless, serious problems related to milk prices received by farmers in Turkey are experienced. Milk price in the free market in Turkey is consists of accordance with supply and demand. However, a fact also known dairy industry plays an active role to milk price. The beef cattle and dairy cattle husbandry in Turkey is of usually used combined in the races, is the reason of interdependent of beef cattle and dairy cattle. The main objective of this study is to reveal annual current and real developments (fluctuations) of milk prices received by farmers in Turkey, additionally, to determine of monthly fluctuations in the last ten year period. For this purpose, Seasonal Index (SI) was calculated to identify the fluctuations of the milk prices. Moving Average Method was used to calculate Seasonal Index. To make the study more meaningful, developments of the milk and concentrate feed prices and the subsidies applied for milk production in EU was particularly examined by comparing with Turkey. As a result of this study, the policies should be applied to ensure the stability at milk prices in Turkey and regarding the increase in income of the producers were given.

## MATERIALS AND METHODS

In this study, some difficulties were encountered while obtaining and evaluating the macro level data. Particularly, differences in milk prices received by the farmers at different institutions, establishments and associations caused problems during the evaluation. Some analysis results of EU and OECD data were used for international comparisons. Current and real prices received by farmers for cow milk in Turkey were given. Wholesale Price Index (TEFE) of Turkish Statistical Institute (TurkStat) was used while converting the current prices to the real prices (TurkStat has used the index of price received by farmers since 2003). Seasonal Index (SI') for milk price received by farmers and dairy products was calculated to determine the seasonal fluctuations. Moving Average Method was used to calculate Seasonal Index. In this method, trend value with duodecimal averages was found because of being 12 months of the size of seasonal fluctuations, which changes of the real values by the effect of season were found with the formula of  $\left[\frac{Y_{month}}{\bar{Y}_{month}}\right] \cdot 100$ . Arithmetic means of the same months belongs to different years were calculated. Because of the total for monthly seasonal index is  $\sum SI' \neq 1200$ , adjustment of SI' which gives seasonal index value was made by using adjustment factor (Durmuş, 2009). Some methods are used by OECD to measure the effects of agricultural support policies and to make international

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comparisons. With the inefficiency of these methods is stated during gathering the data or calculating, the database and comparisons of OECD was found suitable to take place in this study for using these methods in international comparisons and evaluating Turkey's position in this regard. In this context, producer support estimation, nominal protection coefficient for milk and transfer of a single product were evaluated.

## RESULTS

While the formation of price received by the farmers is searched, determination of the price is observed by four-way according to the market information given by the cooperatives and the companies. These are; the price formed through tender, out of tender regions, at the big companies and the collectors (contractor) (Uzmay, 2009). Effectiveness of the western regions for determination of the milk prices in Turkey might significantly be indicated (Uzmay, 2006). Thus, while the regional distribution of milk processing facilities where dairy cattle husbandry farms that taking advantage of milk incentive premium delivering the milk, it is pointed out that 56% of the milk processing facilities (with the milk incentive code number) are gathered in Aegean and Marmara Region. The share of milk processing facilities of these regions in total is 58% (TKB, 2009). Average and monthly current milk prices received by farmers in Turkey are given in Table 1. As analyzing the table 1, while the raw milk price is 0.199TL/kg in 2001, increase with 279% to 0.754/kg is observed in 2010. In the same period, the real prices simply increased with 36% and raised from 0.422 TL/kg to 0.422 TL/kg (Table 2).

Table 1. Milk prices received by farmers (TL/kg)

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUGS	SEP	OCT	NOV	DEC	AVERAGE
2001	0.175	0.175	0.175	0.178	0.178	0.178	0.200	0.200	0.200	0.243	0.243	0.243	0.199
2002	0.266	0.266	0.266	0.320	0.320	0.320	0.320	0.320	0.320	0.380	0.380	0.380	0.321
2003	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.401	0.425	0.425	0.425	0.407
2004	0.470	0.470	0.470	0.450	0.450	0.450	0.455	0.455	0.455	0.518	0.518	0.518	0.473
2005	0.500	0.500	0.500	0.430	0.430	0.430	0.432	0.432	0.432	0.442	0.442	0.442	0.451
2006	0.443	0.443	0.443	0.432	0.432	0.432	0.440	0.440	0.440	0.465	0.465	0.465	0.445
2007	0.487	0.487	0.487	0.487	0.487	0.487	0.540	0.540	0.540	0.660	0.660	0.660	0.544
2008	0.640	0.620	0.620	0.530	0.530	0.570	0.600	0.600	0.600	0.600	0.540	0.510	0.580

Source: TSÜMB (Milk Producers' Central Union of Turkey), USK (Turkish Milk Board), Records of monthly milk prices received by farmers, 2012.

As the decrease in current prices in 2005, 2006 and 2009 is observed, it decreased in 2005, 2006 and 2008, 2009 by 1% and 11% while the real price is based on 2001.

Table 2. Real prices received by farmers\*

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUGS	SEP	OCT	NOV	DEC	AVERAGE
2001	0.493	0.489	0.453	0.414	0.389	0.374	0.401	0.391	0.378	0.443	0.428	0.412	0.422
2002	0.390	0.387	0.387	0.471	0.469	0.458	0.440	0.434	0.429	0.509	0.505	0.493	0.448
2003	0.444	0.438	0.433	0.437	0.439	0.443	0.439	0.443	0.451	0.491	0.486	0.484	0.452
2004	0.470	0.470	0.470	0.450	0.450	0.450	0.455	0.455	0.455	0.518	0.518	0.518	0.473
2005	0.455	0.462	0.462	0.400	0.401	0.396	0.392	0.389	0.389	0.409	0.421	0.423	0.417
2006	0.375	0.380	0.387	0.380	0.370	0.351	0.350	0.355	0.362	0.394	0.398	0.399	0.375
2007	0.377	0.379	0.383	0.390	0.389	0.385	0.420	0.420	0.423	0.535	0.534	0.534	0.431
2008	0.465	0.446	0.442	0.371	0.363	0.385	0.394	0.407	0.418	0.429	0.389	0.382	0.408
2009	0.348	0.344	0.350	0.355	0.376	0.374	0.436	0.442	0.446	0.510	0.507	0.524	0.418
2010	0.629	0.620	0.566	0.528	0.549	0.575	0.581	0.570	0.566	0.562	0.564	0.556	0.572

While analyzing raw milk price and retail milk price parity from Table 3 in the period of 2000-2010 in Turkey, it is observed that the parity is changed between 3 and 4 and is decreased to 2.64 in 2010. As examining raw milk prices and feta cheese price parity, it is shown that the parity is between 9 and 20 and is in increase from 11.64 to 17.77 in ten years. When analyzing raw milk prices, cheddar cheese and butter price parity, it is pointed out that the parity is in fluctuation and decreasing to 9% and 30% respectively with respect to 2000. While butter/raw milk price parity in Germany and USA is 11, it is 8 in France (CLAL, 2012). As gaudo/raw milk price parity in Germany is 11, cheddar/raw milk price parity in USA is 11. These data shows that there is significant difference between processed dairy products' price and raw milk price in Turkey.

Table 3. Dairy products prices in Turkey /raw milk price ratio (2000-2010)

	Retail price	Index	Feta cheese	Index	Cheddar cheese	Index	Butter	Index
2000	4.09	100	11.64	100	26.11	100	33.50	100
2001	3.99	97.55	11.26	96.68	25.8	98.84	32.82	97.98
2002	3.60	87.96	9.77	83.87	22.55	86.36	25.96	77.50
2003	3.38	82.68	9.70	83.30	22.93	87.81	22.58	67.40
2004	3.24	79.20	9.11	78.21	22.80	87.33	21.42	63.95
2005	3.43	83.92	10.76	92.39	27.33	104.67	25.21	75.27
2006	3.35	82.03	11.19	96.08	27.85	106.67	25.29	75.49
2007	3.15	76.95	17.41	149.52	25.12	96.20	23.42	69.92
2008	3.14	76.77	18.88	162.17	26.33	100.84	25.89	77.28
2009	3.28	80.21	20.13	172.9	28.05	107.43	28.36	84.67
2010	2.62	64.01	17.77	152.57	23.66	90.60	23.41	69.89

Source: Turkish Milk Board Records. Prepared with using TUIK database.

One of the issues discussed in Turkey is the occurring fluctuations of raw milk prices. While the seasonal fluctuations in Table 4 is analyzing, it is pointed out that the seasonality price index is in change approximately between 95 and 106. The index is above 100 in the period of January-March yet it is in decrease between 4.08-0.14%, moreover, it is observed that in the period of April-September is below 100 and in change between 4.88%-2.47%. To make meaningful comparison in this regard, the same assessments of the same period for retail milk price and processed dairy products' price are needed (Table 4). In this regard, as evaluating the processed dairy products it is pointed out that the seasonality index is; above 100 in the period of January-April and below 100 in the period of June- October. While examining cheddar cheese; it is shown that the monthly index in the seasons of autumn and winter is in change between 0.74% and 1.59%, in contrast, the index in the seasons of summer and autumn (May-October) is observed as in change between 1.57% and 0.20%. Except the increase of 3.21% in January, the index is in low fluctuation for also butter, as it was for cheddar cheese. The index for feta cheese changed between 1.06%-2.60% in the period of June-November, and increased between 1.76%- 4.27% for the period of January-April. Retail milk price index decreased between 1-3.95% in the period of May-October and changed between 2%-3.71% in the other months.

Table 4. Seasonality index (2000-2010)\*

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUGS	SEP	OCT	NOV	DEC
Raw milk	104.80	102.11	100.14	96.62	95.76	95.12	97.98	96.93	97.53	105.96	104.14	102.93
Retail milk price	103.33	103.24	102.73	100.81	99.05	96.98	96.29	96.05	96.60	99.06	102.16	103.71
Cheddar cheese	101.42	101.59	101.28	100.76	99.68	98.58	98.50	98.44	98.43	99.80	100.78	100.74
Feta cheese	104.27	103.51	102.42	101.76	100.55	98.94	98.06	97.53	97.40	98.22	98.84	98.51
Butter	103.21	101.32	100.78	100.23	99.59	98.48	98.27	98.16	98.55	99.60	100.08	101.73

\*Because of the total of monthly seasonal index in calculations is  $\sum S' \neq 1200$ , adjustment of S' which gives seasonal index value was made by using adjustment factor.  
Source: Prepared with using Table 1.

Monthly seasonality index trend in the period of 2000-2010 is followed more clearly by Figure 1. The index for raw milk in the period of January-April decreased approximately by 9%. The decrease is observed for the processed dairy products of the same periods by approximately 4%. While the period of July-September is particularly stable, raw milk prices increased approximately 8% in October comparing to the previous month. The increase for processed dairy products is changed between 1% and 2% for the same period. While significant change for raw milk price is observed (3%) from October to the end of the year, approximately 5% of increase for retail milk price, 2% for butter, 1% for cheddar cheese is pointed out. As can be seen, the fluctuations in processed dairy products are not as clear as in raw milk prices. The producers are affected negatively from the fluctuations in raw milk prices and uncertainty of the prices.

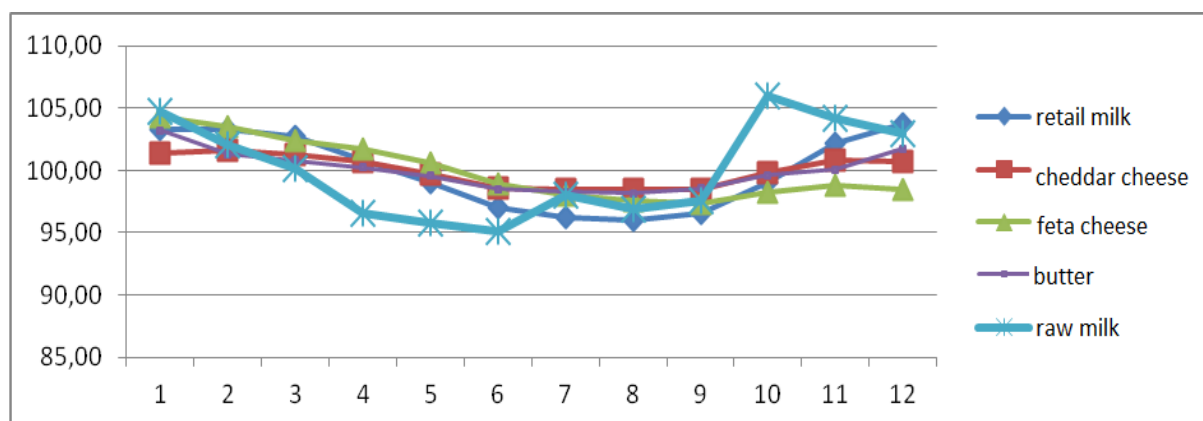


Figure 1: Seasonality index (Monthly) of milk and dairy products in the period of 2000-2010 in Turkey. Source: Prepared with using Table 4.

One of the other important problems in Turkey is the decrease of feed parity which is available to be purchased with 1 kg of raw milk. While analyzing raw milk and milk feed price parity by Table 5, it is highlighted that the parity is in decrease with 1.45 in 2001, 1.61 in 2003 with the highest level of ten years, 1.17 in 2008, and 1.25 in 2009. The inability of producers to compete with the high prices of inputs is the reason of taking significant number of dairy cattle (250 000 units) for cutting in this period (TZOB. 2011). The beef and dairy cattle husbandry in Turkey is of usually used combined in the races, is the reason of interdependent of beef cattle and dairy cattle. These problems faced with dairy cattle husbandry also affected the meat sector negatively, and had been the main reason for the start of meat and live animal imports in 2010

Table 5. Raw milk price (TL/Kg)/concentrate feed parity (TL/kg) (2000-2009)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Raw milk price	0.14	0.20	0.32	0.41	0.47	0.45	0.45	0.54	0.58	0.56
Concentrate feed price	0.97	0.14	0.20	0.25	0.33	0.31	0.33	0.41	0.50	0.45
parity	0.14	1.45	1.57	1.61	1.41	1.44	1.37	1.32	1.17	1.25

Source: Prepared with using Table 1 and Fodder Manufacturers' Association, 2012.

Milk prices received by farmers in Turkey and EU and price parity of concentrate feed raw plants for cereals are given in Table 6. As it is shown in the table, raw milk price/price parity of concentrate feed raw plants for cereals in Turkey is lower than EU. While the parity of wheat, corn and barley in EU was in change between 3 and 1.64 until 2009, for wheat and corn in Turkey was below 1.5 in general. Table 6. Milk Prices Received by Farmers in Turkey and EU and Price Parity of Concentrate Feed Raw Plants (Corn, Barley, Wheat) for Cereals (TL/kg and EU/kg)

**Table 6. Milk prices received by farmers in Turkey and EU and price parity of concentrate feed raw plants (corn, barley, wheat) for cereals (TL/kg and EU/kg)**

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Milk price/corn price parity TURKEY	1.50	1.42	1.51	1.33	1.48	1.86	1.27	1.36	1.42	1.29	1.56
Milk price /corn price parity EU	2.47	2.67	2.54	2.13	2.43	2.65	2.15	1.64	2.11	2.19	1.53
Milk price /barley price TURKEY	1.66	1.54	2.13	1.76	1.81	1.81	1.72	1.70	1.48	1.38	1.81
Milk price /barley price EU	2.73	2.94	3.01	2.78	2.74	2.97	2.56	1.87	2.08	2.60	1.87
Milk price /wheat price parity TURKEY	1.39	1.27	1.40	1.15	1.35	1.36	1.27	1.28	1.25	1.21	1.49
Milk price /wheat price parity EU	2.67	2.79	2.92	2.57	2.61	2.99	2.37	1.73	1.96	2.34	1.70

Source: Prepared with using Turkish Milk Board records and OECD databases, 2010.

Another policy tool should be analyzed in addition to the developments of milk prices is the support policy. The implemented policies for dairy cattle husbandry in Turkey are payments within animal husbandry support, credit support with low-interest rate, agricultural insurance support, support for the assessment of raw milk, Eastern Anatolia Project, South Eastern Anatolia Project, İPARD support and foreign trade precautions. Lately, support project for school milk has been implemented in 2012 for the first time. The share of animal husbandry in total supports is 20.08% in 2010; the share of dairy premium support in animal husbandry supports is 28%. When the support tools in EU are analyzed, the share of single farm payment is 66%, payments depending on area is 10.13%, sugar payments is 0.64%, fruit and vegetable payments is 0.03%, other direct payments are 13.2% pointed out. Target price of dairy products in EU will be removed till 2012. However, reference price implementation for butter and skimmed milk powder which intervention purchases are applied for is continued. Intervention price for butter has been made 90% of reference price since 2007 and equalized to the reference price for skimmed milk powder. Customs duty and export returns are implemented in foreign trade. Therefore, EU markets are being tried to prevented from negative effects of world markets' fluctuations. Further, school milk support project still continues (EU, 2010). While the transfer of a single product which is implemented for milk in EU and Turkey is examined (Table 7), the share of product specific supports is 70% in EU and 55% in Turkey in 1986; and approximately 3% in Turkey and 0.3% in EU in 2007. Taking important place of market price support in product specific supports, implementing the support tool which is called as the single payment system with the new reform by EU and reaching the supports related to milk in general support items to the producers indirectly might be explained as the reasons of the decrease in product specific supports in 2007.

**Table 7. Transfers of single products for cow milk (%)**

	1986	1987	2000	2001	2002	2003	2004	2005	2006	2007
EU	70.39	75.87	36.75	27.34	49.42	45.01	35.66	23.42	19.72	0.27
TUR	55.21	39.93	40.47	0.33	37.85	36.40	31.67	27.97	26.71	2.64

Source: OECD; 2010.

## CONCLUSION

As a result, current raw milk prices in Turkey significantly increased (279%) in the period of 2000-2010 while the real prices increased in the extremely low level (36%). There is a significant difference between raw milk prices and price of processed dairy products. While examining the monthly price fluctuations of raw milk prices and dairy products' prices, the fluctuations of dairy products' prices is observed as more stable. As raw milk price and feed price parity are analyzed, the parity is highlighted as below 1.5 and lowers in general. The main reason of the problems for milk prices is the inability of the producer

organizations in marketing of milk. Only 3% of the marketed milk is processed by cooperatives (TKB 2008). This condition inhibits producers' competitiveness in the market and causes to be the main actors of modern factories to determine the prices. The share of animal husbandry in agricultural supports in Turkey begun to carry an importance after a year of 2000, even to increase 26% of the supports for animal husbandry is planned by the year 2012 this ratio remained low. Establishing Turkish Milk Board is one of the positive developments lately in Turkey. But, it have not provide the efficiency in the polices yet. Even the intervention to the raw milk prices by Meat and Dairy Institute which is planning to establish is announced by Ministry of Food, Agriculture and Livestock, in which methods to interfere or the timing is not certain. Even working on to set farm accounting network in Turkey is still in continue, it have not been finalized yet. Within establishing the farm accounting network the current economic situation will be determined and effective policy measures will be implemented. This condition is acceptable for dairy cattle husbandry and also for milk prices.

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# THE AFFECTING FACTORS AND ACTORS ON ADOPTION OF SUSTAINABLE APPLICATIONS IN MENEMEN COUNTY

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## ABSTRACT

In this study, the effective components on adoption of sustainable farming applications have been investigated by interviewing with 67 farmers in Menemen County (in Izmir, Turkey). AHP analysis was employed in order to determine the affecting factors and actors on adoption process. According to the analysis results, economic factors are the most important criteria, the research organizations are defined as the most important actor on acceptance of sustainable practices. The farmers have different expectations from different actors. Although, the farmers with economic priority have more expectations from input sellers but, research organizations are mentioned as the most effective actor on technical and environmental factors of sustainable farming in the region. Especially, the farmers are willing to cooperate with the research organizations for sustainable farming. The research and extension organizations have to undertake the considerable roles for creating sustainable technology and information on the other hand the policy makers have to increase their efforts on supporting the environmental sound agricultural applications.

**Key words:** Sustainable farming, agricultural extension, AHP analysis, diffusion of farming practices

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## INTRODUCTION

Intensive usage of synthetic inputs in conventional agriculture caused to environmental and health problems in the world. Raising problems have encouraged the sustainable applications such as organic farming, integrated pest management, precision agriculture, good agricultural practices. All sustainable definitions mainly base upon the holistic and dynamic approach with ecologic, economic, social and technical dimensions of agriculture (Lefroy et al., 2000; Zhen and Routay, 2003).

Ecologic and social-economic dimensions intensively appeared with sustainable farming applications. While ecologic dimension covers natural resources protection, economic and social aspects intensify on yield, profit and living standards. (Carlos and Javier, 2006; Zahm et al., 2008; Ochola et al., 2006). The agricultural policies and extension systems in between 1950s to 1980s mainly based on the conventional approaches by supporting chemical usages for encouraging the yield and production increases, commercial conventional farmers, and profit maximization with the limited consideration on the environmental, social and health costs (Axinn, 1988). Following 1980's farming systems and governmental policies started to become more sensitive to environmental issues (Aksoy and Altindisli, 1999).

Agriculture takes a considerable part in Turkish economy with a 9% share in GNP (Gross National Product), 29.5% share in employment, and 4.25% share in the export value. Izmir Province has 7.6% of share in Turkish GDP (Gross Domestic Product). While the province has 1.41% of the total agricultural land in Turkey, Menemen County covers 6.7 % of total agricultural lands of Izmir. Almost all agricultural lands are irrigated in Menemen. The distribution of arable lands (totally 23455 hectares) among the crops can be listed as field crops (52%), vegetables (17%), grapes (15%), olives (9%), fruits (4%), and others (3%) in the county. Cotton, seedless grape and olive oil are the staple income sources in Menemen (TUIK, 2010; TKB, 2007).

Conventional production has become dominant in Turkish agriculture since 1950s. Irrigation, chemical usages, hybrid seeds and other inputs of the conventional farming were supported by governmental policies and services for meeting the domestic consumption, industrial requirements and exporting. In the middle of 1980s, first attempts of organic farming in Turkey were seen in Izmir Province for exporting the staple crops. There are also some experiences on integrated pest management applications. According to the figures, only 0.3% (8654) of the existing 3.100.000 farms is producing organic crops in Turkey. Although these efforts, acceptance of sustainable farming related applications were not reached at intended level in Turkey.

This research has examined the effective factors and actors expected on sustainable agriculture in Menemen County in Izmir Province. In the study by evaluating farmers' thoughts the suggestions were made for spreading the sustainable farming applications.

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## MATERIAL AND METHODS

The main materials of the study were collected from farmers through the survey in 2009. Four villages (Seyrek, Musabey, Tuzculu, Kesik) were selected by interviewing with County Extension Organization and The Chamber of Agriculture in Menemen. There are 3334 farmers registered to the chamber of agriculture in the county and 557 of them are cultivating in these four villages. Totally 67 farmers were calculated as the sample size (90% confidence interval and 10% margin of error) in the study. AHP was employed in order to determine the effective factors and actors on adoption of sustainable agriculture. Technical, environmental, social and economic dimensions and actors were also tested according to the significance (Friedman test) and harmony levels (Kendall's W value) in the study.

The AHP, proposed by Thomas L. Saaty, is one of the most commonly applied multicriteria decision making techniques. It is a powerful and comprehensive methodology designed to facilitate sound decision making by using both empirical data as well as subjective judgments of the decision maker. It combines tangible and intangible aspects in order to derive a ratio scale, the abstract scale of priorities, which is valid to make complex decisions (Saaty et al., 2003; Gunden et al., 2010). In this study; income, marketing, input costs, product quality, factor effectiveness were investigated under the economic factors. While technical factors were including all farming applications, environmental factors were accepted as soil erosion, protection of bio-diversity, soil, water, and air pollution. Social factors have covered the usage of resources by considering the future generations, employment, food safety, and public health during cultivation (Carlos and Javier, 2006; Zahm, 2008; Ochola et al., 2006; Van der Werf and Petit, 2002). Furthermore, the decision alternatives were formed by the friends and relatives, research organizations, buyers, NGOs and input sellers (Carlos and Javier, 2006) (Figure 1).

## RESEARCH FINDINGS

### Some Characteristics of Farmers

Age, educational level, farming experience, and farm size are important components on diffusion of innovations in rural areas (Rogers 1983). For instance; in a research on organic farming, the elder farmers were found more sensitive to environmental issues than younger (Karaturhan and Boyaci, 2007). According to the findings; the average age of farmers is 50.5; education duration is meanly seven years and farming experience was 28 years in the research area. The small sizes and fragmented structures of farms in the county reflect the typical Mediterranean situation (Rodriguez, 1996). Most of the interviewing farmers are cultivating on less than 10 hectares lands. Up to 80% of the farmers are also farming by renting or tenanting lands. Cotton is cultivated on 62% of the lands of the interviewing farmers. About 42% of the farmers are engaging with animal husbandry beside, plant production.

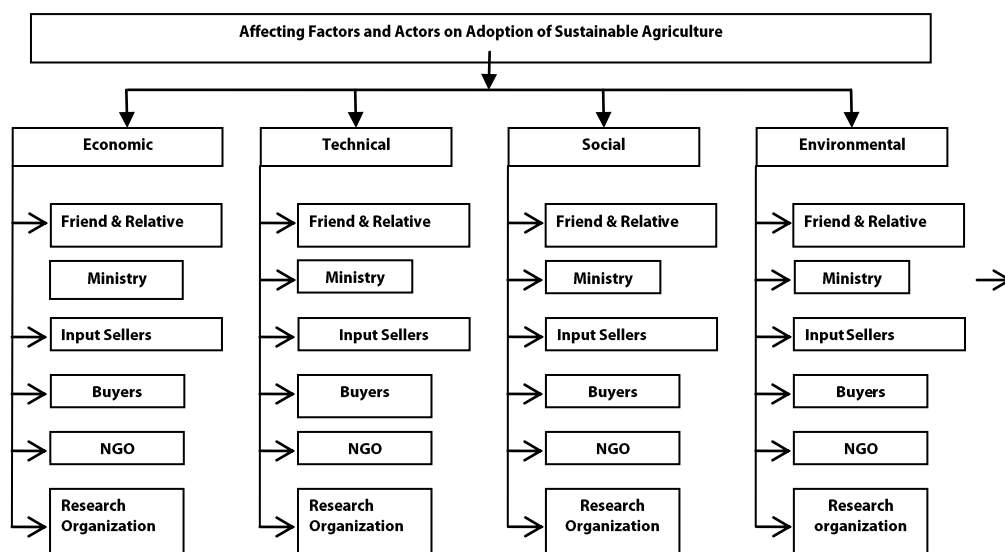


Figure 1: The Hierarchy Process

## AHP Analysis Results

The farmers have mentioned the input sellers as the most impressive actor on economic factor (0.211). The input sellers generally dwell in the villages, so they know rural needs and conditions in the region (Boyaci, 1998). Research organizations (0.207), NGO's (0.199), Ministry of Agriculture (0.161), friends and relatives (0.160) follow the input sellers. The crop buyers were seen as the least effective actors (0.063) (Table 1).

Table 1: Dimensions of sustainable farming and actors expected to be effective (AHP)

Actors	Economic	Technical	Social	Environmental
Friends & Relatives	0.160	0.089	0.132	0.091
Research Organizations	0.207	0.272	0.205	0.268
Ministry of Agriculture	0.161	0.232	0.142	0.243
Buyers	0.063	0.050	0.050	0.046
NGOs	0.199	0.215	0.231	0.235
Input Sellers	0.211	0.142	0.240	0.117

The research organizations (0.272) were seen as the most effective actor in terms of technical factors. The Ministry (0.232), NGO's (0.215), input sellers (0.142), friends and relatives (0.089) and buyers (0.050) follow the research organizations. While input sellers (0.240), NGO's (0.231), research organizations (0.205), the ministry (0.142), friends (0.132) and buyers (0.050) were ranked by farmers as affecting actors on social factors, the research organizations (0.268), the ministry (0.243) and NGO's (0.235) were seen as the important actors in terms of the environmental factors for adoption of sustainable applications (Table 1).

Effective criteria can be counted as economic (0.308), environmental (0.260), technical (0.227) and social factors (0.204) on acceptance of sustainable applications (Table 2). The farmers need more information on technical topics, but they are also willing to learn the environmental issues. Especially, the farmer experiences on pollution of Gediz River and recently droughts in the region create a demand for information about environment.

There are three research institutes (Aegean Agricultural Research Institute, Land and Water Resources Research Institute, Agricultural Hydrology Research Institute) in Menemen. The geographical closeness to research organizations has increased the farmers' expectations from research (0.236) on adoption of sustainable agriculture. The ranking among actors was found significant according to the Friedman Test (Table 3). According to AHP analysis, economic factors are the most important criteria, and research institutes are the most important alternative for adoption of sustainable applications. The farmer who gives the priority to economic factors, have more expectations from input sellers (Table 2 and 3).

Table 2: Evaluating the criteria

Criteria	Mean
Economic factors	0.308
Environmental factors	0.260
Technical factors	0.227
Social factors	0.204

Friedman Test is significant  $p < 0.05$

Table 3: Assessment the efficient actors on adoption of sustainable applications

Actors	Mean
Research organizations	0.236
NGOs	0.223
Ministry of Agriculture	0.182
Input seller firms	0.178
Friends and relatives	0.124
Buyers	0.055

Friedman Test is significant for  $p < 0.01$ .

The differences between farmer groups on actor affecting for adoption of sustainable farming was tested by employing Kruskal Wallis Test. Efficiency of NGOs is statistically important for the elder farmers, according to the farmers in Musabey and Kesik Villages the priorities of input sellers are higher on sustainable farming (Table 4; 5).

Table 4: Efficient actors on adoption of sustainable applications according to age groups

	Age Groups	Number	Mean Rank	P Value
NGOs	< 30	6	35.33	0.024**
	31 - 60	51	30.86	
	61 >	10	49.20	

\*\*  $\alpha < 0.05$  significant

Table 5: Efficient actors on adoption of sustainable applications according to villages

Actor	Villages	Number	Mean Rank	P Value
Input Seller Firms	Seyrek	23	36.61	0.058*
	Tuzculu	17	22.94	
	Kesik	8	38.25	
	Musabey	19	38.95	

\*\*  $\alpha < 0.10$  significant

The factor priorities have varied according to the villages. For instance, technical ones are the most important factor in Musabey farmers who are also the lowest educational level in the county. On the other hand; environmental factors have great importance among the Seyrek farmers whose educational levels are highest in the county (Table 6).

Table 6: Effective criteria on adoption of sustainable applications according to the villages

Criteria	Villages	Number	Mean Rank	P Value
Economic	Seyrek	23	34.67	0.117
	Tuzculu	17	37.74	
	Kesik	8	43.50	
	Musabey	19	25.84	
Social	Seyrek	23	33.87	0.866
	Tuzculu	17	30.91	
	Kesik	8	36.31	
	Musabey	19	35.95	
Technique	Seyrek	23	30.59	0.003**
	Tuzculu	17	23.38	
	Kesik	8	36.50	
	Musabey	19	46.58	
Environmental	Seyrek	23	41.70	0.012*
	Tuzculu	17	37.32	
	Kesik	8	18.19	
	Musabey	19	28.37	

\*\*  $\alpha < 0.05$  significant

\*  $\alpha < 0.10$  significant

## CONCLUSIONS

The relevance and acceptance of sustainable applications depend on perceptions and expectations of the actors. In this respect, proposing sustainable practice is required to consider the differences on local conditions (Ochola et al., 2006). In the region, the priority ranking among the factors was statistically significant. While the economical factors are accepted the most important criteria, environmental, technical and social factors follow it. Among the technical issues such as plant protection, fertilization and mechanization are seen as important components for diffusion of sustainable agriculture. Economically and technically validity of advices will encourage the acceptance of sustainable practices in the region. At this stage research and extension organizations have to undertake the roles for creating

**locally adoptable technologies and information. Ministry of Agriculture and governmental policy makers have to increase their efforts for disseminating the environmental sound agriculture.**

**According to the observations, the agricultural structure of the region is proper for sustainable farming. The small farm sizes are seen as an advantage for sustainable applications which need intensive knowledge and labour. Affecting criteria on adoption sustainable agriculture were classified as economical, technical, social and environmental dimensions by the hierarchy process in the study. The effective actors in the region were grouped as friends and relatives, research, Ministry, buyers, NGOs and input sellers.**

**Farmers have the different expectations from different actors. While farmers expect the contributions of input sellers on economic and social dimensions, the same farmers are willing to cooperate with the research organizations on technical and environmental dimensions of sustainable farming.**

**Farmers have also compared the significances of criteria on adoption process the priority is given to the economical dimensions of sustainable applications. Furthermore, the most reliable actor for sustainable applications is the research organization and it is followed by NGOs and Ministry of Agriculture and Rural Affairs but, the commercial actors such as input sellers and crop buyers are less effective on adoption of sustainable farming practices.**

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# NUTRITION PREFERENCE OF THE STUDENTS IN EGE UNIVERSITY: AN APPLICATION OF AHP

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## ABSTRACT

All living things need to feed in order to survive in every period of life. Being physically and mentally healthy in each stage of life is possible with an adequate and balanced nutrition. The problems caused from nutritional preferences affect human beings' physically and mentally. Particularly wrong nutritional habits may give rise to failures in education. University students are in the critical period setting up the eating habits. Irregular eating and unbalanced nutrition bring together unexpected failures. To examine all these issues, students of Ege University will be considered as a case study for nutrition preferences.

The original-quality data collected from the students from the faculties of Ege University campus. The study sample size was determined as 190 with proportional sampling, 90% confidence interval and 10% error margin.

The aim of this study is to carry out the nutrition preferences of university students. The method called Analytic Hierarchy Process developed by Saaty in 1977 is used in order to determine nutrition preferences of the students. The Kruskal Wallis test was used for comparing the means of the priorities of criteria and preferences. Although the nutrition preferences of students are close to each other, healthy nutrition (0.5283) was more preferred than overcoming hunger (0.4717).

**Key Words:** University students, nutrition preference, analytic hierarchy process

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## INTRODUCTION

Besides being one of the basic needs of human being, nutrition is also one of the main factor affecting human health. Adequate and balanced nutrition is also defined as; receiving the variety of foods with the most economical way and using them in the body that necessary for human being's growth and development, maintaining their existence and being able to do their activities in the best way, with the most appropriate amounts, without losing their nutritional value, without letting it disrupt the health. In every stage of life, being healthy in both physical and mental aspects is possible with the adequate and balanced diet (Bozkurt and Nizamlioglu, 2005).

The importance of the adequate and balanced nutrition especially gains value on the period of youth. In this period, inadequate and unbalanced nutrition of young people may cause obesity, cardiovascular diseases, anemia, vitamin and mineral deficiencies and growth and development deficiencies. Teenagers' being obsessive about their experiences, for example particularly teenage girls wrong perception about being beautiful (means being thin according to them), come up with the unconscious nutrition and improper diets that lead nutrition habit disorders. Many researches made about this issue exhibits that university students don't have a balanced nutrition habit (Akcam Oluk at al., 2011).

Although nutrition is important for every phase of society, in terms of university students, it has a different significance. Most of the students studying at university have to live separately from their family for the first time in their lives with the start of their Bachelor's Degree Training. While students' nutrition habit were keeping on how family requires, the changing life style with the university can also change the nutrition habits of the students. The changing nutrition habit can affect the school performances of the students as well as it bears on the mental and the physical conditions of them. For these reasons, it is highly important that the knowledge about the nutrition and the eating habits that university students have, are to be stated and the appropriate suggestions are to be improved (Yilmaz and Ozkan, 2007).

In Turkey, it is seen on the researches about the nutrition habits of the young people that in this period there are serious problems with nutrition. It is detected; that students generally do not pay attention to the repasts, that they only have a repast, that they eat mostly sandwiches and bagels and this kind of foods, that economical problems have impacts on inadequate and unbalanced nutrition that

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students living in dormitories do not have a good diet because of poor conditions, so they only satisfy their hunger (Yilmaz and Ozkan, 2007).

Although there are numerous studies on university students about their nutrition preferences ( Khattak at al., 2012), (Akcem Oluk at al., 2011), ( Martins Bion at al., 2008), (Yilmaz and Ozkan, 2007), (Sanlier and Unusan, 2007), (Wyka and Zechalko-Czajkowska, 2006), (Bozkurt and Nizamlioglu, 2005), especially in Turkey, there is no study using AHP technique. This increases the importance of this research. A limited number of studies on the AHP technique which ara made in Turkey, are: consumer preferences for purchasing place of fresh fruit and vegetable considered food safety, quality and price (Gunden et al., 2008), analysis of farmers' fundamental farm management decisions (Gunden and Miran, 2008), multi-criteria supplier selection (Dagdeviren and Eren, 2001; Kahraman, Cebeci and Ulukan, 2003), comparison of quality consultants (Cebeci and Ruan, 2007), comparison of catering service companies (Kahraman, Cebeci and Ruan, 2004), students at Anadolu University who need nutrition and shelter will be identified through analytic hierarchy (Hacikoylu, 2006).

This research has been done with the aim of identifying the nutrition habits of the students and supplying further suggestions for adequate nutrition.

## MATERIAL AND METHODS

The main material of this study is consist of the data obtained from the students registered at the faculties of Ege University in the 2010-2011 academic year. The data is obtained by face to face interviews with students using a questionnaire designed for the purpose of the study. Secondary data of the study is provided from the Department of Students Affairs of the Ege University and Student Affairs Services of the Faculties.

The number of the students interviewed with in this study is determined with the Proportional Sampling Method. For a finite population, the sample volume of the people carry out with certain features according to the known or estimated rate, is as follows. As can be obtained from the prior studies, P value can also be predicted intuitively. To achieve the maximum sample volume p should be taken as p=0.5. Considering the p value higher or less than 0.5 reduce the sample volume of it. Therefore, working with the maximum sample volume could detract from the possible errors when P is not known, P should be taken as P=0.5 (Miran, 2003).

$$n = \frac{Np(1-p)}{(N-1)\sigma_{px}^2 + p(1-p)}$$

n: sample volume

N: The number of students in the population

p: rate of the number of students in the population (to access a maximum volume of sample 0.50 was taken)

opx: Variance

Proportional sampling method with the 90% confidence interval and 10% margin of error, the number of the students interviewed with is determined as 190. 190 questionnaires were distributed by calculated the share in student total number of faculties.

When analyzing the data, the faculties on the campus of Ege University are combined into three groups. Accordingly; Bachelor of Arts, Faculty of Education, Faculty of Economics and Administrative Sciences, and Faculty of Communication are the group of social sciences, Engineering Faculty, Faculty of Science, Faculty of Fisheries, Faculty of Agriculture are the group of science and engineering, Faculty of Medicine, Faculty of Dentistry and Faculty of Pharmacy are the group of health sciences. Analysis and the evaluation of the data were made according to these three group and the public (11 faculties).

### *Analytic Hierarchy Process*

The AHP, which was developed by Thomas L. Saaty (1977), is one of the most commonly applied multi-criteria decision making techniques. The AHP is a decision-support tool to cope with complex multi-criteria problems. The method helps to structure and analyze decision problems by breaking down the

complex problem in a hierarchic order and by employing pair-wise comparisons of its elements to determine the preferences among the set of alternatives. The first stage of AHP is problem structuring. The AHP decision problem is structured hierarchically at different levels, each level consisting of a finite number of decision elements. A basic hierarchical model consists of a goal, criteria and alternatives. The top level of the hierarchy represents the overall goal, while the lowest level is composed of criteria and all possible alternatives (Figure 1). The second stage is assessment of local priorities. The relative importance of the decision elements is assessed indirectly from comparison judgments during the second step of the decision process. The third stage is calculation of global priorities. The last step of the AHP aggregates all local priorities from the decision table by a simple weighted sum.

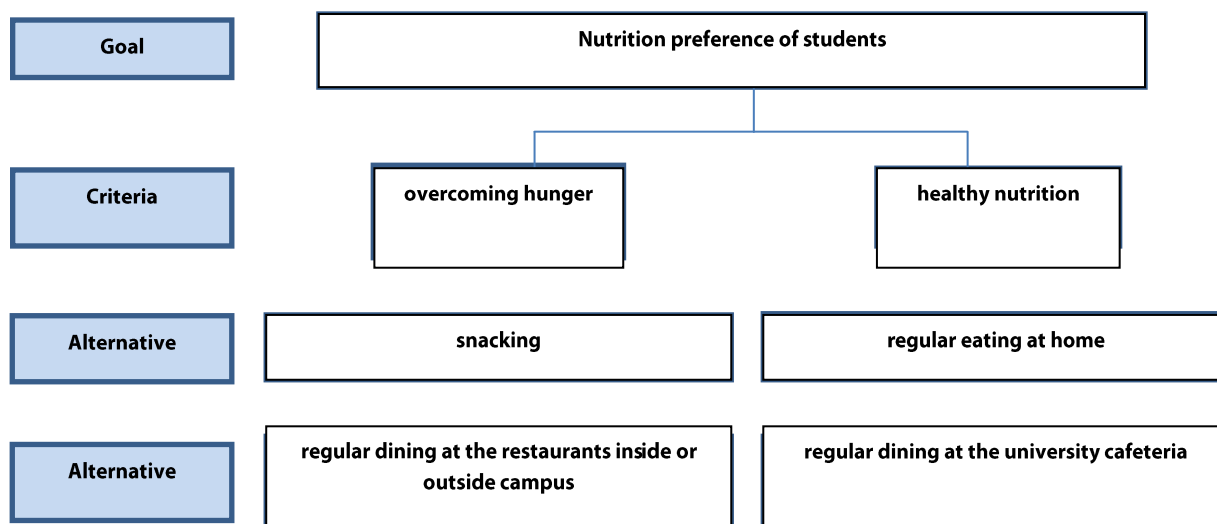


Figure 1: Problem Definition of AHP Model

AHP scales of pair wise comparisons are as follows (Table 1) Reciprocals are used for inverse comparisons (Saaty, 1977).

Table 1: The Fundamental Scale for the Comparative Judgments

Values	Definition
1	Equal importance
3	Moderate importance of one over another
5	Strong or essential importance
7	Very strong or demonstrated importance
9	Extreme importance
2,4,6,8	Intermediate values

## RESULTS

### General Characteristics of Students

Table 2: The distributions of the students to the faculty groups according to their age and gender

Faculty groups	18-20				21-23				24 +			
	Male		Female		Male		Female		Male		Female	
	n	%	n	%	n	%	n	%	n	%	n	%
Social science	6	3.2	9	4.7	20	10.5	26	13.7	7	3.7	0	0.0
Science and engineering	13	6.8	7	3.7	35	18.4	11	5.8	14	7.4	5	2.6
Health science	5	2.6	5	2.6	17	8.9	5	2.6	4	2.1	1	0.5
Total	24	12.6	21	11.0	72	37.8	42	22.1	25	13.2	6	3.1



When Table 2 is analyzed the rates are as followed; students in the age group 18-20 12.6% (of it) male and 11.0% (of it) female, students in the age group 21-23, 37.9% male, 22.1% female, students in the age group 24 and more 13.2% male and 3.1% female (Table 2).

Table 3: Distribution of students from different study areas at university and locations they completed high schools

Faculty groups	District		Urban		Metropole	
	n	%	n	%	n	%
Social science	15	7.9	28	14.7	25	13.2
Science and engineering	31	16.3	23	12.1	31	16.3
Health science	8	4.2	15	7.9	14	7.4
Total	54	28.4	66	34.7	70	36.9

When the table is examined it is seen that in general students participated in the survey completed their secondary education; 28.4% in the district, 34.7% in the urban, 36.9% in the metropole (Table 3).

Table 4: Distribution of students according to their accommodation

Faculty groups	Dormitory (public)		Dormitory (private)		With save family		Student house		Another	
	n	%	n	%	n	%	n	%	n	%
Social science	15	7.9	6	3.2	12	6.3	34	17.9	1	0.5
Science and engineering	14	7.4	5	2.6	28	14.7	36	18.9	2	1.1
Health science	3	1.6	2	1.1	3	1.6	26	13.7	3	1.6
Total	32	16.9	13	6.9	43	22.6	96	50.5	6	3.2

When the distribution of students according to their accommodation is analyzed; while 22.6% of the students participated in the survey live with their family, with a noteworthy rate 50.5% of them live in student house (Table 4). Students of Gazi University Physical Education and Sports College participated a scientific study, which ended with this results ; 27% of male students remain with their family, 64% stay at student house (53.6% of female students stay at student house and 24.4% stay with their own family) (Filiz and Demir, 2004). Students of Ege University made the same scientific study and it resulted as ; 37.2% of the participants stay with their family, 44.8% live at student homes and 18 % live at public dormitory (Akcem Oluk at al., 2011). Studies mentioned above have same findings as our study which is the fact that students mostly prefer student houses.

Table 5: Students' monthly total average expenses of food-nutrition (TL)

Faculty groups	Food and nutrition expenses	Total average expenses
Social science	149.56	677.81
Science and engineering	137.06	632.95
Health science	177.65	881.86
Total	149.44	697.48

When the monthly expenses of the students participated in the survey are examined, while the food-nutrition expenses is 149.44 TL per month, the monthly total average expense of them is 697.48 TL. It is noteworthy that the food and nutrition cost of the students in the health science group is higher than the other groups with 881.86 TL (Table 5) since they probably less prefer fast food than that of other groups (Table 6). In a study with the Balikesir University, it came out that, students spend 125 TL on nutrition every month, total money given out: 520 TL/month (Kasli and Serel 2008). Gazi University Sports College students participated the same study, their results are ; male students spend 127 TL on nutrition every month, female students spend 116 TL (Filiz and Demir, 2004). The results of this research are seen as compatible with the study.

**Table 6: Feeding habits of students from different groups**

Faculty groups	Snacking (Mean)*	Eating at university cafeteria or regular meals at restaurants/home (Mean)*	Dining options inside or outside the campus (Mean)*	Regular meals at home (Mean)*
Social science	4.26	2.56	3.51	4.00
Science and engineering	3.98	2.71	2.80	3.98
Health science	3.73	3.41	3.08	2.73
Total	4.03	2.79	3.11	3.74

\* 1) never 2) a few times in a year 3) a few times in a month 4) a few times in a week 5) almost every day

### Analytic Hierarchy Process (AHP) Results

In this study, the students of Ege University were examined by the AHP; their sensitivity to hunger, the preference of healthy eating or fast food, eating at university cafeteria or regular meals at restaurants/home, dining options inside or outside the campus. Research of the Ege University students showed that, while the diet preference between the students are close to each other, their preferred diet is a healthy diet (Table 7).

**Table 7. Descriptive statistics of AHP criteria for nutrition preferences**

Criteria	Mean	Minimum	Maximum	Std. Dev.
Overcoming hunger	0.4717	0.1000	0.9000	0.3096
Healthy nutrition	0.5283	0.1000	0.9000	0.3096

Kruskal-Wallis Test for criteria

Chisquare(0.05,1)= 3.84146

H =3.91197352\*\* (Alternatives are different at 0.05)

An evaluation of different alternatives in terms of accurate nutrition shape is made; Ege University students top alternatives to very clearly is regular meals at home (Table 8).

In turn, the university dining hall or dormitory cafeteria regular meals, regular meals and fast food restaurants within or outside the campus snack comes after this alternative. It is well known that a healthy diet is one of the most important issues discussed by experts in the home-cooked meal skipping meals nutrition. Analysis of AHP supports this results.

**Table 8. Descriptive statistics of AHP alternatives for nutrition preferences**

Alternatives	Mean	Minimum	Maximum	Std. Dev.
Snacking	0.1552	0.0339	0.5666	0.1355
Eating at university cafeteria or regular meals at restaurants/home	0.1917	0.0367	0.7287	0.1307
Dining options inside or outside the campus	0.1764	0.0396	0.4865	0.0806
Regular meals at home	0.4767	0.0379	0.7500	0.1871

Kruskal-Wallis Test for alternatives

Chisquare(0.05,3)= 7.81473

H =278.94622\*\*\* (Alternatives are different at 0.01)

Ege University students prefer fast food snack, university refectory or dormitory cafeteria regular meals, regular meals at restaurants and at home, on campus or outside of regular meals and overcoming hunger alternatives in terms of healthy nutrition and regular dinner at home (Table 9).

**Table 9. Average priorities of AHP alternatives by criteria for nutrition preferences**

Criteria	Alternatives			
	Fast food	Eating at university cafeteria or regular meals at restaurants/home	Dining options inside or outside the campus	Regular meals at home
Overcoming hunger	0.18985	0.18969	0.17264	0.44782
Healthy nutrition	0.09872	0.19796	0.18182	0.52150

Kruskal-Wallis Test for criteria

Chisquare(0.05,1)= 3.84146

H =3.91197352\*\* (Alternatives are different at 0.05)

## CONCLUSION

**In this study, students' choice of nutrition was determined using the method of Analytic Hierarchy Process. Although the nutrition preferences of students are close to each other, healthy nutrition (0.5283) was more preferred than overcoming hunger (0.4717).**

**The reason, why most of the students chose healthy diet is that, 73.1% of them live with their family or friend at home and they don't neglect any mealtime (breakfast and dinner). So, they have a regular habit of eating.**

**The average monthly food expenditure of students of health sciences was found more than the other groups because of the high sensitivity in relation to healthy nutrition.**

**It should be carry out more scientific studies on nutrition preferences in order to give the general opinion.**

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