Ege Üniv. Ziraat Fak. Derg., 2005, **42**(1):75-83
ISSN 1018-8851

Plant Protection Practices in Organic Vegetable Growing in Greenhouse in the Preservation Zone of Tahtalı (Menderes, İzmir, Turkey)Dam

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Özet

Tahtalı Barajı (Menderes, İzmir) Koruma Havzasında Örtüaltı Organik Sebze Yetiştiriciliğinde Bitki Koruma Uygulamaları

İçme suyu kaynağı koruma alanlarında seracılık yapılabilmesi için en akılcı tarım yöntemlerinden biri organik yetiştiriciliktir. Bu çalışmada Türkiye'de önemli bir içme suyu kaynağı olan Tahtalı Barajının (İzmir) koruma alanı içerisinde, yörenin en önemli geçim kaynaklarından biri olan seracılığın sürdürülebilmesi için örtüaltı sebzeciliğinde organik tarımın uygulanabilirliği araştırılmıştır. Çalışma 2000-2002 yılları arasında (Menderes İlçesi, Develi Köyü'nde) kurulmuş bir plastik serada yürütülmüştür. Sonbahar döneminde domates (Lycopersicon esculentum, cv. 191 F1), ilkbahar döneminde hıyar (Cucumis sativus, cv. Sardes), kış aylarında marul (Lactuca sativa, cv. Lital) yetiştirilmiştir. Haftalık gözlemlerde gerektiğinde organik tarımda kullanımına izin verilen bakır, kükürt ve bazı alternatif maddeler uygulanmıştır.

Yetiştirme dönemleri boyunca hastalıklar açısından çok önemli bir problemle karşılaşılmamıştır. Zararlılar açısından ise domates ve marul üretimlerinde önemli bir sorunla karşılaşılmazken, hıyar yetiştiriciliğinde dönem sonuna doğru özellikle kırmızıörümcek populasyonunda artış gözlenmiştir. Bu konuda araştırmaların sürdürülmesi, çiftçi eğitimine önem verilmesi gerektiği kanısına varılmıştır.

Anahtar sözcükler: Organik tarım, örtüaltı, hıyar, domates, marul

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Introduction

Increasing populations in urban areas have impact on agriculture both in terms of land-use management and in terms of pollution created. In the case of Tahtalı Dam which is the major water source providing drinking water to İzmir, the third largest city in Turkey, the problems seems to be multifaced (İlter et al., 1996). The preservation area was established around the lake in order to prevent the pollution and restrictions were brought by the state in respect to irrigation, fertilization and pesticide use.

Within the preservation area of the Tahtalı Dam, production in greenhouse is the most important agricultural activity. The production is realized under prevailing climatic conditions in very simple structures therefore, problems are more frequent and complicated and thus, synthetic chemicals are used intensively as in the other Mediterranean countries (Papasolomontos, 1997; Hanafi, 2002). The introduction of environmentally friendly systems could be a solution to sustain agricultural practices in an economically feasible way and to maintain a well balance between agricultural land and environment (Aksoy, 1995).

Organic farming is one of the several approaches to sustainable agriculture, and organic greenhouse vegetable production has potential as a niche market for out-of-season produce (Tüzel et al., 2001). It excludes the use of synthetic fertilizers, pesticides, growth regulators and transgenic seeds. Organic producers rely heavily on crop rotations, crop residues, animal manures, legumes, green manures, organic wastes, and mineral-bearing rocks to feed the soil and supply plant nutrients. Insects, weeds, and other pests are managed by mechanical cultivation, and cultural, biological and biorational controls (Greer and Diver, 2000; FAO, 2002).

The purpose of the study was to introduce organic greenhouse vegetable production as an on-farm trial in the preservation area of Tahtalı Dam and to evaluate the efficacy of applied plant protection procedures.

Material and Methods

The experiment was conducted in Menderes, within the long range protection zone of Tahtalı Dam, as an on-farm trial between 2000 and 2002 in a polyethylene (PE) covered greenhouse (12x32 m) erected with galvanized construction with side and roof ventilations and covered with insect net. The crop pattern composed of three crops, namely tomato, cucumber and lettuce.

Soil solarization was applied for four weeks each year between 17 July – 17 August 2000 and 13 August – 10 September 2001 in order to eliminate soil borne pathogens.

Tomato (Lycopersicon esculentum Mill.) was grown for autumn season production. The seedlings were transferred into the greenhouse on 13 September 2000 with a plant density of 1.85 plant/m2 (1.2x0.6x0.6 m). The cultivar used, 191 F1, is resistant to tobacco mosaic virus (TMV), Fusarium 1-2 and Cladosporium 5. Bumble bees were used for pollination.

Cucumber (Cucumis sativus L.) was planted on 29th of March, 2001 as spring season production. The cultivar was Sardes which is resistant to powdery mildew (PM), cucumber mosaic virus (CMV), cucumber vein yellowing virus (CVYV) and zucchini yellow mosaic virus (ZYMV). The plant density was as in tomato growing.

Lettuce (Lactuca sativa L.) was grown during the winter months. Seedlings of cv. Lithal which is resistant to mildew 1-4 were planted on 28 November 2001 at a plant density of 11.1 plant/m2 (0.3x0.3 m).

Experiments were conducted according to the randomised parcels with two replicates. During the growing periods, observation and sampling were made twice and once a week respectively in order to determine pest and diseases. Foliage pests were monitored by counting 80 leaves. Sticky yellow traps, one per 15 m2, were hang 10 cm above the plants to monitor the pests and changed two weeks intervals. In terms of nematodes, soil samples were taken before and after the solarization and four times during the growing period totalling to six samples and determinations were made according to Flegg and Hooper (1970). Additionally, roots of 50 plants were checked at the termination of the vegetation period to determine any nematode damage (Zeck, 1971).

During the control of pests and diseases, preparations permitted in organic agriculture were used when necessary, namely copper, sulphur, Organica neem oil, NeemAzal T/S (neem extracts), Herba Vetyl (natural pyrethrum extract), potassium soap. Copper (50 % CuO) and sulphur (80 % wettable) were applied as 0.4 % and the rates of Organica neem oil, NeemAzal T/S, Herba vetyl and potassium soap used were 2.0, 0.5, 0.1 and 3.0 %, respectively as recommended.

Results

Tomato

In terms of diseases, powdery mildew was observed at the lower leaves of tomato plants during the 5th week (12 October 2000) of the growing period. Copper and sulphur were applied on 15th and 19th of October, respectively against powdery mildew. Since powdery mildew continued until the 7th week at the lower leaves, sulphur was applied twice only to the lower leaves on 28 October and 3 November 2000. Powdery mildew was controlled after the 9th week. After then no disesase problem appeared during the growing period. Tomato bacterial spot Xanthomonas campestris pv. vesicatoria was determined only in one plant, and the plant was removed urgently to prevent its spreading. During the later observations, X. campestris pv. vesicatoria was not determined again.

In terms of pests, whiteflies, Trialeurodes vaporariorum West. and Bemisia tabaci Genn. (Homoptera, Aleyrodidae) were determined for the first time on the 22nd of September. The number of whitefly adults per plant peaked on 6 October 2000 and reached to 0.63. After the 5th week, its number decreased gradually and reached to zero. It was most probably due to the side effect of copper and in particular the effect of sulphur on whiteflies.

T. vaporariorum nymphes were determined for the first time on 17th week (4 January 2001) of the growing season as 0.11 per plant. The population was reduced since the leaves were removed just after the frost damage on 25 December 2000. There was no need for further treatments.

Spider mites, aphids and nematodes were not determined during the growing season.

Cucumber

Regarding the diseases, only powdery mildew (Erysiphe cichoracearum) was determined. Due to the sulphur treatments for spider mites on 26 April, 22 May and 5 July 2001 and removal of the lower leaves, the damage was reduced.

T. vaporariorum and B. tabaci were determined first on 2 April 2001 on sticky yellow traps. Starting with the second week, adults were observed even if the numbers were few. Nymphs started to appear after the 10th week (Table 1). Due to the sticky yellow traps and applied preparations, its population remained below the economic threshold.

The damage of leafminer (Liriomyiza huidobrensis (Blanchard) (Diptera, Agromyzidae)) was determined during the

seedling stage as intensive signs of ovipositing by females. Neem-Azal T/S was applied on 16 April because of the high number of individuals on sticky yellow traps. Galleries were observed after the third week (April 17) (Table 1). The removal of the damaged leaves and neem treatment were effective and thus, leafminer was not observed again after the 7th week (15 May).

Thrips, Frankliniella occidentalis (Pergande), Thrips tabaci Lind. and Aelothrips sp. (Thysanoptera, Thripidae) were determined at the 2nd week. The highest intensity was at the 11th week as 3.98 per leaf (Table 1). Potassium soap applications on 4, 12 and 18 June 2001 against spider mites (Table 2) affected thrips and killed most of the individuals.

First spider mites (Tetranychus cinnabarinus (Boisd.) (Acarina, Tetranychidae)) were determined on plants close to the entrance of the greenhouse. Sulphur was applied locally on 1 and 7 May 2001 in order to prevent the spread of the pest (Table 2). However, pest population increased after the 12th week (18 June) and spread to all plants after the 14th week (Table 1). Permitted preparations were applied each week could control spider mites in April, May and June.

Table 1. Population densities of pests in cucumber production (Individual/leaf)
(A: Adult, N: Nymph, M: Motile, Q: Quiescent, E: Egg)

Date	Whitefly		Thrips	Spider mite		Aphid	Leafminer
	A	N	N+A	M	Q+E	N+A	Gallery/Leaf
02.4.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.4.01	0.01	0.00	0.01	0.05	0.51	0.00	0.00
17.4.01	0.13	0.00	0.15	0.15	0.30	0.00	0.24
24.4.01	0.01	0.00	0.18	0.29	0.13	0.00	0.18
01.5.01	0.04	0.00	0.09	0.15	0.33	0.00	0.18
07.5.01	0.04	0.00	0.13	0.25	0.00	0.00	0.24
15.5.01	0.00	0.00	0.59	0.13	0.51	0.00	0.00
22.5.01	0.00	0.00	1.23	0.77	3.76	0.00	0.00
29.5.01	0.03	0.00	1.69	2.48	5.18	0.00	0.00
04.6.01	0.03	0.11	2.69	3.00	5.28	0.00	0.00
12.6.01	0.09	0.05	3.98	2.56	1.75	0.00	0.00
18.6.01	0.20	0.10	1.46	5.92	5.55	0.01	0.00
25.6.01	0.01	0.04	0.78	6.49	5.80	0.38	0.00
02.7.01	0.13	0.06	0.19	20.08	11.48	1.58	0.00
09.7.01	0.04	0.34	0.34	33.29	-	4.94	0.00
16.7.01	-	-	-	37.31	-	4.26	0.00

Table 2. Preparations applied against pests and diseases in cucumber production

Date	Application	Pest	Dose (%)
16.04.2001	NeemAzal T/S	Leafminer	0.5
26.04.2001	Sulphur	Powdery mildew	0.4
01.05.2001	Sulphur *	Spider mite	0.4
07.05.2001	Sulphur *	Spide rmite	0.4
22.05.2001	Sulphur	Spide rmite	0.4
29.05.2001	Herba vetyl	Spider mite	0.1
04.06.2001	Potassium soap	Spider mite	3.0
12.06.2001	Potassium soap	Spider mite	3.0
18.06.2001	Potassium soap	Spider mite	3.0
25.06.2001	NeemAzal T/S	Spide mite	0.5
02.07.2001	NeemAzal T/S	Spider mite	0.5
05.07.2001	Sulphur	Powdery mildew	0.4
09.07.2001	Sulphur	Spider mite	0.3
12.07.2001	Organica neem oil	Spider mite	2.0

* Local application on plants close to the entrance of the greenhouse

Aphis gossypii Glover (Homoptera, Aphididiae) was determined after the 12th week. The highest number of individuals was 4.94 at the 15th week due to the treatments against spider mites (Table 1).

Nematodes were not determined neither in the soil samples nor on the plant roots.

Lettuce

Downy mildew (Bremia lactuca) was determined on the outer leaves when the plants had 4-5 leaves. Copper was applied on 15 February 2002 at a lower dose (0.3 %) in order not to cause phytotoxicity. Damaged leaves were removed at the later stage. Despite the intensive damage of the disease, plants were not sprayed close to the harvest date.

Lettuce mosaic virus also caused problems. Elisa and mechanical inoculation tests gave positive results. Positive results obtained by the analysis of the seeds showed that the virus came through the infected seeds.

In terms of pests, only leafminer was determined during the 6th and 8th weeks (3-21 January 2002), however, the removal of the lower leaves and yellow sticky traps were found effective to control that pest. As in the other crops, nematodes were not determined neither in the soil samples nor on roots.

Discussion

In organic vegetable production, the average total yields were 7, 13 and 12 kg/m^2 for tomato, cucumber and lettuce (data not shown). In general, the yields vary according to variety, climatic conditions, growing season, etc. The yield values of organically grown tomatoes, cucumber and lettuce obtained in the experimental greenhouse seem quite reasonable especially in tomato and lettuce (FAO, 1990; Greer and Diver, 2000; Sevgican 2002; Tüzel et al., 2002). In cucumber production, in a trial conducted as closed soilless system under similar environmental conditions, yield varied between 27.7-31.6 kg/m^2 with 2.66 plant per m^2 (Gül et al., 2002). The reduction in yield in this experiment can be attributed to the lower number of plants per m^2 and pest problems particularly spidermites at the later stage of plant growth. Even if the total yield in cucumber seems to be comperatively lower, the reduced production cost and price premium for organic products should be taken into consideration.

The disease incidence was low since the microclimatic conditions within the greenhouse such as aeration did not favour fungal growth. Powdery mildew that developed during the growing periods could be easily controlled through removal of the leaves and the use of sulphur.

Pests did not cause significant problems in tomato and lettuce production. In cucumber production pest problems mainly appeared on plants that were close to the entrance, thus signifying the effect of sanitary measures.

The overall evaluation of the results proved that the pest and disease management in organic production of vegetables can be successfully performed with the allowed preparations (Başpınar et al., 2000; Madanlar et al., 2000; 2002), however, close monitoring and quick response seem to be the key factors in achieving success. Biological control has also an important role in organic agriculture particularly in the greenhouses. Further studies may be required to optimise the organic production as new solutions appear or as the changes appear in the related regulations. The most important step in the transition to organically grown greenhouse vegetables lies on farmers' willingness to accept and thus on training.

Summary

Organic farming seems to be solution in environmentally sensitive zones. Menderes Township is an important district in this respect since it is in the protection zone of Tahtalı Dam, supplying fresh water to Izmir, the third largest metropolitan city in Turkey. Because of the high risk of pollution originating from agricultural activities, the authorities have already discouraged the use of chemicals within the collection basin by issuing a regulation. Since organic agriculture is one of the possibilities in order to continue agricultural activities in environmentally sensitive protected regions, a successful project implemented in the dam region would be a model for similar areas facing the same sort of ecological problems in Turkey.

The project was conducted during the years between 2000 and 2002 at the preservation area of Tahtalı Dam, as an on-farm trial. Tomato (***Lycopersicon esculentum*** cv. 191 F_1), cucumber (***Cucumis sativus*** cv. Sardes) and lettuce (***Lactuca sativa*** cv. Lital) were grown during autumn, spring and winter seasons, respectively. Pests and diseases were monitored weekly. Preparations allowed in organic agriculture were used when necessary.

Plant diseases did not create any significant problem during the three growing seasons. Also, there were no problems in terms of pests in tomato and lettuce production, but pest population in particularly spider mites increased during cucumber production.

Results regarding the yield seem to be at a quite acceptable level excluding cucumber, however, there is still a need to continue researchwork and farmers' training activities on organic agriculture.

Key words: Organic farming, greenhouse, cucumber, tomato, lettuce

Acknowledgement

This research has been supported by TUBITAK (Turkish Scientific and Technical Research Council), IZSU (Municipality of the city of Izmir) and EBILTEM (Ege University Science and Technology Center).

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