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Pest status of organic cucumber production under greenhouse conditions in İzmir (Turkey)*

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Summary

The purpose of this study was to determine possibilities of cultivating organic cucumber under greenhouse conditions. Experiments according to principles and methods for organic agriculture were conducted in Ege University (İzmir-TURKEY), Faculty of Agriculture between 2003 and 2005 in a polyethylene (PE)-covered greenhouse (12.5 x 25 m) erected with galvanized steel hoops, with side and roof ventilation and covered with insect net. Cucumber (***Cucumis sativus***) cultivar "Sardes" was used as plant material. Trials were carried on during two successive spring and autumn growing periods. Cultural methods for pest management were applied before seedling transfer. Weeds and plant remains were removed carefully during growing period regularly. Sticky yellow traps, one per 10 m^2 were hung 10 cm above the plants to monitor pests. Observations were made once a week in order to determine pests and diseases during the growing period. Plant diseases did not cause any significant problem during the growing seasons. Thrips, aphids, whiteflies, leafminers and spider mites were observed as pests. Whiteflies did not reach economic threshold. Damage due to leafminers was not important because of removal of the damaged leaves and yellow sticky traps. Aphids, thrips and spider mites caused significant injury sometimes and their injury level decreased by application of potassium soap 1-2 times a week. In addition, ***Aphidius colemani*** Viereck (Hymenoptera: Braconidae) was released to decrease aphid population. As a conclusion, yield data obtained in both growing seasons showed that spring growing season seems to be more appropriate for organic cucumber production in greenhouse conditions in İzmir.

Key words: Organic agriculture, greenhouse, pests, ***Cucumis sativus***
Anahtar sözcükler: Organik tarım, sera, zararlılar, ***Cucumis sativus***

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Introduction

In Turkey, protected cultivation area has reached to 47 773 ha in 2004 (DİE, 2004) out of which 23 549 ha are devoted to greenhouses and 17 055 ha to low tunnels. Greenhouse area has increased especially at coastal areas of Turkey where climatic conditions were suitable. Total greenhouse area is over 700 ha in the province of İzmir which is third largest city of the country. The most important crops are cucumber (149 062 t), tomato (15 222 t), lettuce (14 869 t) and strawberry (1 196 t) (Anonymous, 2005).

Synthetic agricultural chemicals namely, plant growth regulators, commercial fertilizers and pesticides are widely used to minimize crop losses in conventional greenhouses. These applications are used to obtain higher yield, damage structure of soil, cause environmental pollution, threaten human health and decrease crop quality. Organic agriculture under greenhouse conditions has gained importance because of increasing sensitivity to human and environmental health, consumer pressure on producers and demand to organically grown crops from other countries (İlter & Altındişli, 1996). However, organic agriculture under greenhouse conditions is more difficult due to lack climate control under simple structures.

Previous studies on organic greenhouse vegetable production were conducted on tomato, cucumber and lettuce crops in Tahtalı Dam area which is the preservation area of the most important drinking water source of İzmir (Tüzel et al, 2002, 2005). Satisfactory results were obtained in tomato and lettuce crops but not from cucumber due to pest problems (Madanlar et al., 2005). Therefore more studies on cucumber are needed. This study was carried out to improve organic cucumber cultivation in unheated greenhouse conditions.

Material and Methods

Experiments according to the principles and methods for organic agriculture were conducted in Ege University (İzmir-TURKEY), Faculty of Agriculture between 2003 and 2005 in a polyethylene (PE)-covered greenhouse (12.5 x 25 m) erected with galvanized steel hoops, with side and roof ventilation and covered with insect net. Cultivation was carried on as short growing cycle in two successive spring and autumn seasons. Greenhouse was only heated in order to prevent frost damage.

Cucumber (***Cucumis sativus*** cv. "Sardes") was used as plant material. Cultivar "Sardes" is appropriate for late spring, summer and autumn production periods and resistant to Powdery Mildew (PM), Cucumber Mosaic Virus (CMV), Cucumber Vine Yellow Virus (CVYV) and Zucchini Yellow Mosaic Virus (ZYMV) (Anonymous, 2001).

Solarization was made between 23.07.2003 and 21.8.2003.

First year, autumn and spring productions were performed between 10.09.2003 and 24.11.2003 and between 25.02.2004 and 12.07.2004,

respectively. Second year, autumn production was started on 09.09.2004 and continued until 19.11.2004 and spring production was between 25.03.2005 and 08.07.2005. Seedlings were planted with a density of 3.125 plants per m^2.

Weeds and plant remains were removed carefully before and during growing period, regularly. Sticky yellow traps, one per 10 m^2 were hung 10 cm above the plants and moved upward during the growing period to monitor whiteflies and leafminers.

Observations were made once a week in order to determine pests and diseases during the growing period and pests were counted on 60 leaves randomly from upper, middle and lower levels.

In order to control of pests, preparations permitted in organic agriculture were used when necessary, namely Organica Neem Oil (Organica Inc., New York, USA), Herba Vetyl (Vetyl-Chemie GmbH, Illingen, Germany) (natural pyrethrum extract) and potassium soap. They were applied as 2.0; 0.1 and 3.0 %, respectively as recommended. Biological control agents could not use due to limited availability of biological control agents against pests in greenhouses in Turkey. However, ***Aphidius colemani*** Viereck (Hymenoptera: Braconidae), namely Aphipar (Koppert Bio. Sys., Rodenrus, Holland) was supplied and used only in spring production periods.

Harvested fruits were weighed at each harvest from each treatment. Misshaped and damaged fruits were classfied as non-marketable. Average cumulative yield of four fertilizer treatments is given as total yield in this paper. Marketable yield was determined by subtracting the weight of non-marketable yield from total.

Inside temperature of greenhouse was monitored with data logger, HOBO (Onset Computer Corp., Massachusetts, USA).

Results

Aphis gossypii Glover (Homoptera: Aphididae) as aphid, ***Frankliniella occidentalis*** (Pergande) and ***Thrips tabaci*** Lind. (Thysanoptera: Thripidae) as thrips and ***Tetranychus cinnabarinus*** (Boisd.) (Acarina: Tetranychidae) as spider mite were determined as important pests during trials.

Populations of whiteflies (Homoptera: Aleyrodidae) were not high enough to damage plants. Applications of potassium soap against aphids and also removing of lower leaves from plants were effective to reduce these pests' populations as same as leafminers (Diptera: Agromyzidae).

Autumn Production Periods

Aphids were seen in 23.09.2003 in autumn production period of first year. Potassium soap was used twice a week, totally 10 times after 28.10.2003, Herba Vetyl at 20.10.2003 and Organica Neem Oil at 12.11.2003 against aphids. However the increase of aphid population could not be prevented (Figure 1).

Yield data obtained in autumn production period of 2003 was extremely low because of the increase of aphid population. Total yield was determined as 5.33 kg/m^2 and marketable yield was 5.11 kg/m^2. Aphids were seen two weeks after from planting and damaged plant rate was reached 100 % at 27 October. Aphids caused a significant decrease in yield. Net profit was negative. Organic cucumber production was not found economic in this cycle.

Thrips and spider mites were not enough to damage plants in this production period (Figure 1).

In second year autumn production period, aphids were also the main problem. Seven times of potassium soap application after 05.10.2004 was not found effective to reduce aphids' population and the highest total aphid number were determined as 105.91 per leaf at 09.11.2004 (Figure 1). Intensive typical damage was observed on plants.

Thrips and spider mites did not cause any problem at this production period (Figure 4). Seven application of potassium soap reduced these pests' population. The highest population density of both thrips and spider mites were determined at 19 October 2004. These values for thrips and spider mites were 4.05 and 1.06 individuals per leaf, respectively.

Total and marketable yield were determined as 4.60 kg/m^2 and 4.36 kg/m^2, respectively in this production period which was low and not economic. Production was ended due to high levels and intensive damage of aphid population within two months.

Spring Production Periods

In the first year, ***A. colemani*** was released against aphids on 08.04.2004. Aphid population was not high in comparison with autumn productions. Maximum aphid per leaf was found as 31.88 and parasitization rate was reached to 100 % (Figure 2).

Potassium soap was not used because of side-effects to ***A. colemani*** until 31 May 2004 when high thrips (10.68 individual per leaf) and spider mite population was determined. Potassium soap was found efficient against thrips and from this application population decreased considerably (Figure 2).

Spider mites was seen at the beginning of May (Figure 2). Six application of potassium soap starting on 31 May 2004 and also removing of lower leaves were effective to reduce population. However population did not decrease below economic threshold level during June and July.

Total yield was determined as 16.46 kg/m^2 and marketable yield was 14.61 kg/m^2 in this production period.

A. colemani was also released against aphids in the second spring production period on 29.04.2005. Aphid population was not high as in the previous spring cycle. Maximum aphid per leaf was found as 11.95 and parasitization rate was reached to 100 % (Figure 2).

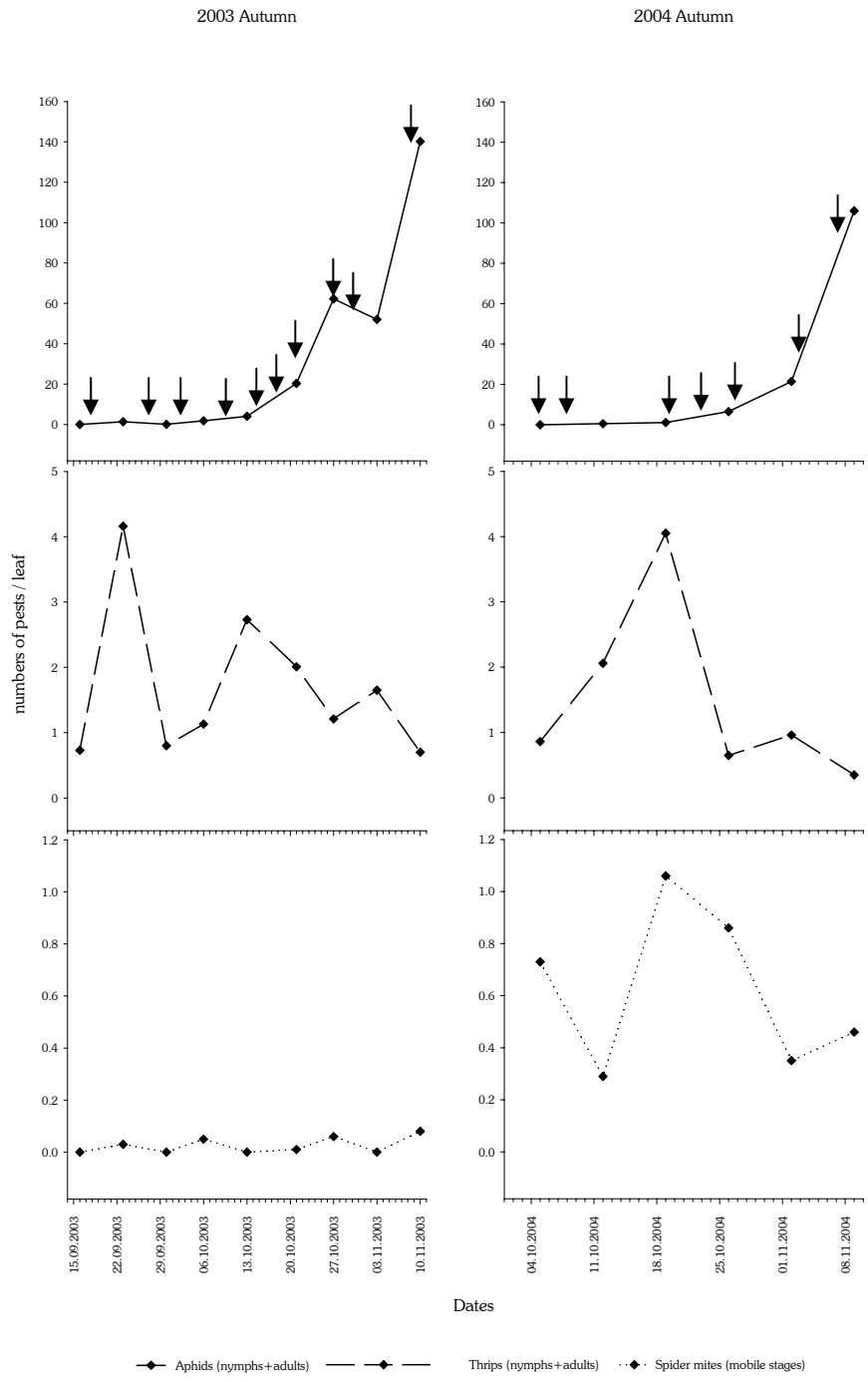

Figure 1. The population density of aphids, thrips and spider mites at autumn production periods in 2003 and 2004 (↓: application of potassium soap).

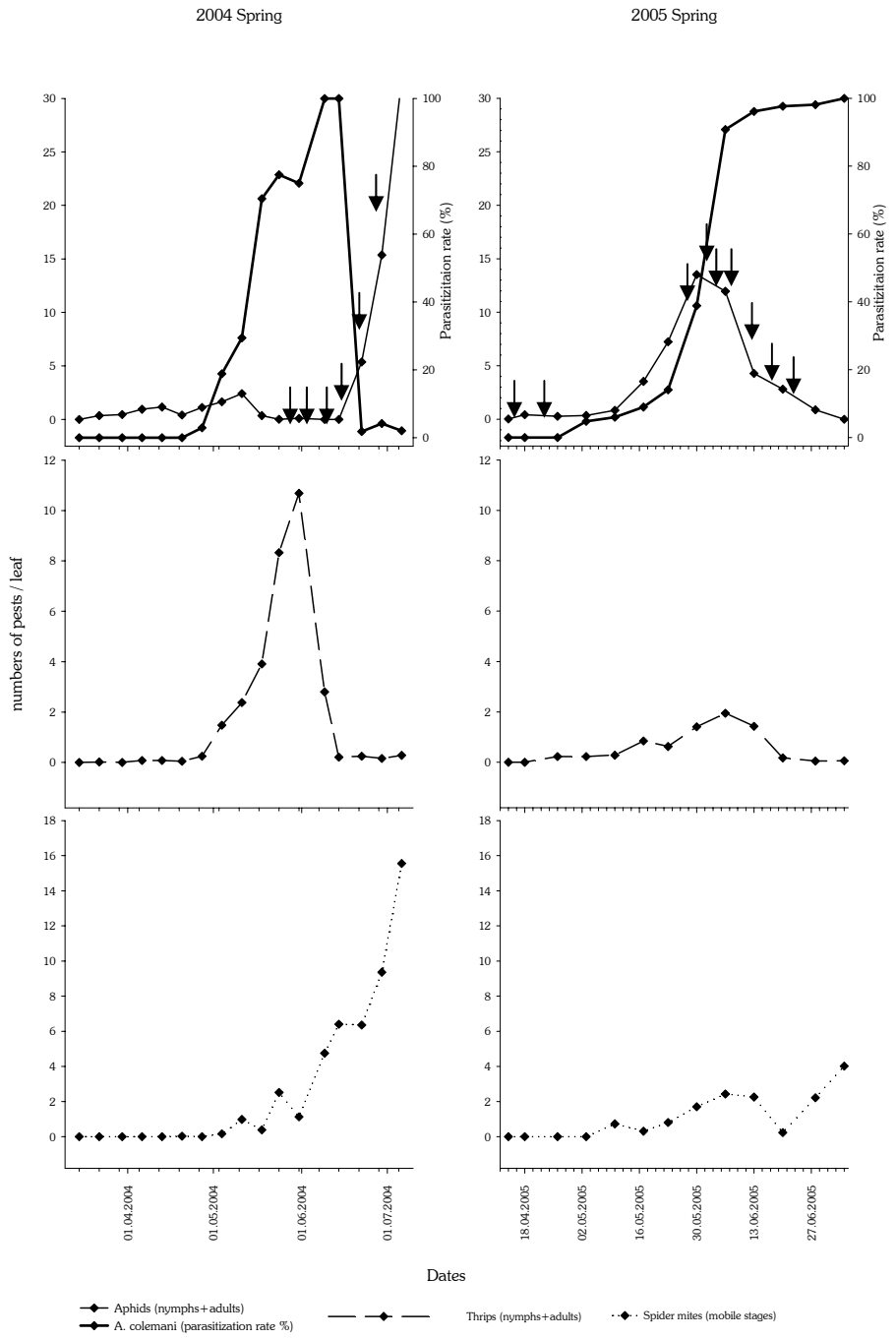

Figure 2. The population density of aphids, thrips and spider mites and parasitization rate of ***Aphidius colemani*** Viereck on aphids at spring production periods in 2004 and 2005 (↓: application of potassium soap).

Nine potassium soap application reduced both thrips and spidermites population. The highest population density of thrips that determined on 06.06.2005 was 1.95 individual per leaf whereas the highest spider mite population density determined on 05.07.2005 was 4.01 individuals per leaf (Figure 2).

Total yield was determined as 16.89 kg/m^2 and marketable yield was 14.76 kg/m^2 in second year which was similar to the previous spring season.

Discussion

Yield data of vegetable production under greenhouse conditions depends on factors such as variety, growing period, climatic conditions, method of growing and density of plant per unit. Average yield of cucumber production could be increase up to 20-25 kg/m^2 in unheated greenhouse conditions (Sevgican, 1999). Aybak & Kaygısız, (2004) stated that cucumber yield of in unheated greenhouses is 8-10 kg/m^2 and 11-20 kg/m^2 in autumn and spring production periods, respectively. In this study, yield data obtained in autumn production periods were low because of especially intensive damage of aphids resulting in negative net profit. Aphid population increased rapidly at the beginning of both autumn production periods. However, the first mummies of ***A. colemani*** can be observed in the crop approximately 2 weeks after the first introduction. It is usual for the mummy to exist for 5 to 6 days (Copping, 2004). Therefore the efficacy of parasitoid could be lower. Then, only potassium soap was applied to obtain quick response in autumn production periods. But populations of aphids could not be decreased. Thrips and spider mites were not problem in autumn production periods.

Total and marketable yield data of spring periods are acceptable when the average local yield data is taken into consideration. Application of both potassium soap and inoculative releases of ***A. colemani*** decreased aphid population in spring production periods. Potassium soap have some side-effects to ***A. colemani*** (Bostanian & Akalach, 2004; Bostanian et al., 2005). However, once the residues have dissipated they are less harmful (Cloyd, 2005). Therefore, application of potassium soap had been cancelled until higher parazitism rates were obtained. Goh et al. (2001), noted that ***A. colemani*** is a good candidate for biological control of ***A. gossypii*** at spring production periods. Madanlar et al. (2005), found that ***A. gossypii*** were not problem in spring period on organic greenhouse cucumber production in Tahtalı Dam area, similarly. Population of spider mites increased severe levels in both spring production periods, but not decreased yield of cucumber when it is compared with aphid population. On the contrary, Madanlar et al. (2005), remarked spider mite is the most important pest of organic greenhouse cucumber production in Tahtalı Dam area in spring period.

Biological control and the use of natural product for pest management have become important in organic agriculture (Lampkin, 1990; van Lenteren, 2000; Onoğur & Çetinkaya, 1999; Yoldaş, 1998; Zender et. al., 2007). Although successful researches on biological control in greenhouse have been carried on since 1990s (Öncüer et al., 1994; Yoldaş et al., 1996; Kısmalı et al., 1997; Madanlar, 1999; Yoldaş et al., 1999), it is not applied in small-scale commercial greenhouses. For this reason researches on alternative pesticides in greenhouses for both integrated pest management and organic agriculture were carried out and promising results were obtained (Başpınar et al., 2000; Madanlar et al., 2000; 2002). It is certain that organic vegetable production could be successful when alternative pesticides and also commercially biological control agents were used.

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 optimize the organic production in particular controlled environment.

Demand of organically grown agricultural commodities from both interior and exterior markets is an advantage for producers. However, it is known that sustaining organic agriculture under greenhouse conditions is very difficult. Limited climate control can affect plants negatively. For this reason required attention should be given to production. The most important step in the transition to organically grown greenhouse vegetables lies on farmers' willingness to accept and thus on training for increasing sensitivity to human and environment health.

Özet

İzmir (Türkiye)'de örtüaltı organik hıyar yetiştiriciliğinde zararlıların durumu

Bu çalışmada, İzmir ilinin önemli sera sebze türü olan hıyarın, organik olarak yetiştirilebilme olanaklarının araştırılması amaçlanmıştır. Çalışmalar organik tarım ilke ve yöntemlerine göre 2003-2005 yılları arasında E.Ü. Ziraat Fakültesi (İzmir-Türkiye)'ne ait PE örtülü (12.5 x 25 m) bir serada yürütülmüştür. Seranın yan ve çatı havalandırmaları böcek neti ile kapatılmış ve sadece bitkileri dondan korumaya yönelik olarak ısıtılmıştır. Bitkisel materyal olarak organik tarım kurallarına uygun olarak yetiştirilen Sardes çeşidi hıyar fideleri kullanılmıştır. İki sonbahar ve iki ilkbahar üretim döneminde çalışılmıştır. Serada zararlı yönetimi amacıyla, kültürel önlemlerin uygulanmasına bitkiler dikilmeden önce başlanmıştır. Solarizasyon uygulanmış, yabancı otlar ve bitkisel artıklar üretim dönemlerinde seradan dikkatlice uzaklaştırılmıştır. Bitkilerin dikilmesinden hemen sonra 10 m^2'ye bir adet ve

bitkilerin 10 cm üzerinde olacak şekilde sarı yapışkan tuzaklar asılmıştır. Tüm üretim dönemleri boyunca hastalık ve zararlılarla ilgili haftalık gözlemler yapılmış ve zararlıların yoğunluğu kaydedilmiştir. Tüm dönemlerde hastalıklar açısından çok önemli bir problemle karşılaşılmamıştır. Zararlı olarak thripsler, kırmızıörümcekler, yaprakbitleri, beyazsinekler ve yaprak galerisinekleri görülmüştür. Beyazsinekler sorun olmamıştır. Yaprak galerisinekleri galerili yaprakların elle toplanarak seradan uzaklaştırılması ve sarı yapışkan tuzaklar sayesinde yoğunluklarını arttıramamışlardır. Yaprakbitleri, kırmızıörümcekler ve thripsler zaman zaman önemli zarara neden olmuş ve bunlara karşı haftada 1-2 kez yapılan arapsabunu uygulamalarıyla baskı altına alınmalarına çalışılmıştır. Ayrıca yaprakbitlerine karşı salınan parazitoit ***Aphidius colemani*** Viereck (Hymenoptera: Braconidae) bu zararlının yoğunluğunu azaltmada etkili olmuştur. Sonuç olarak her iki yetiştirme döneminde elde edilen verim değerleri dikkate alındığında, bölgemiz için ilkbahar döneminin serada organik hıyar yetiştiriciliği açısından daha uygun olduğu kanısına varılmıştır.

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