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in

Choukr-Allah R. (ed.).
Protected cultivation in the Mediterranean region

Paris : CIHEAM / IAV Hassan II
Cahiers Options Méditerranéennes; n. 31

1999
pages 425-434

BIOLOGICAL CONTROL PRACTICES AGAINST PESTS IN VEGETABLE GREENHOUSES IN IZMIR (TURKEY)

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Abstract: Results of different studies conducted between 1992 and 1996 in Izmir on greenhouse tomato, cucumber and eggplant growing are presented in this paper. Native strain of the parasitoid *Encarsia formosa* (Gahan), Hohenheim strain of predator *Phytoseiulus persimilis* A-H. and native strain of predator *Chrysoperla carnea* (Steph.) were released against whiteflies, spider mites and aphids, respectively. *E. formosa* and *P. persimilis* were found to be effective in a release ratio of 1/5 parasitoid / whitefly and 1/20-40 predator / red spidermite, respectively, on tomatoes and cucumbers, but ineffective on eggplants. *C. carnea* was not able to control aphids.

Introduction

Greenhouse production has great importance in Turkey, and vegetables cover 94.4 % of the total greenhouse area (11771 ha) (Anonymous, 1993). In protected cultivation conditions, which promote growth of the crop also promote the growth of pathogens and pests. Greenhouse environment, on the other hand, allows natural enemies of pests to be used as effective means of control and thus in many countries biological control is now being applied in protected cultivation commercially (Markkula & Tiittanen, 1980; Freuler, 1987; van Lenteren & Woets, 1988; Maisonneuve, 1989; van Roermund & van Lenteren, 1992 and Sunderland et al., 1992). Although researches on biological control against greenhouse pests started in 1986 in Turkey and in 1992 in Izmir (Kýlýnçer & Bulut, 1986; Öncüer et al., 1994), chemical control methods are the most common practice of growers. These trials aiming to investigate possibilities of biological control of major pests in poorly climatized greenhouses in the Mediterranean Basin were made on tomato, cucumber and eggplant which are the main greenhouse crops in Turkey and cultivated in nearly 51, 20 and 9 % of the total area, respectively.

MATERIALS AND METHODS

Mass production of natural enemies

Natural enemies were reproduced under controlled conditions in climate rooms (25± 1°C temperature, 60 ± 5% relative humidity and 16 hour light + 8 hour dark). Native strains of *Encarsia formosa* (Gahan) (Hym., Aphelinidae) and *Chrysoperla carnea* (Neur., Chrysopidae), and Hohenheim strain of *Phytoseiulus persimilis* A.-H. (Acarina, Phytoseiidae) were used as stock material. Nymphs of *Trialeurodes vaporariorum* (Westwood)(Hom., Aleyrodidae) propagated on tomato plants, individuals of *Tetranychus cinnabarinus* (Boisduval) (Acarina, Tetranychidae) at different growing stages reproduced on phaseolus plants and eggs of *Ephestia kuehniella* Zell. (Lep., Pyralidae) were used to produce *E. formosa, P. persimilis* and *C. carnea*, respectively.

Plant production

Trials were performed in a greenhouse having compartments (3x3 or 3x4 m) between 1992 and 1996. Experiments were performed on tomatoes and cucumbers during 2 spring and 2 autumn seasons and on eggplant in 1995 spring. Details of plant production are given Table1.

Table 1. Details of plant production

Plant species	Growing season	Cultivar	Sowing	Date of Planting	End of prod.
Tomato	Autumn 1992	Galit	3 August	1 September	19 February
	Autumn 1993	Galit	2 August	26 August	27 January
	Spring 1993	Galit	11 January	5 March	29 June
	Spring 1996	Elif	28 December	14 February	8 July
Cucumber	Autumn 1992	Alara	18 August	8 September	21 December
	Autumn 1993	Alara	16 August	27 August	10 January
	Spring 1993	Sahara	22 January	15 March	30 June
	Spring 1996	Afrodit	4 January	14 February	12 July
Eggplant	Spring 1995	Bonica	7 November	13 January	28 June

Release of natural enemies

Population of pests infested naturally was monitored once a week. Application thresholds and release ratios are given in table 2.

Table 2. Application thresholds and release ratios

Natural enemies	Application threshold (pest/leaf)	Release ratio (parasite/host) (predator/prey)
Encarsia formosa	5	1/5
Phytoseiulus persimilis	5	1/20, 1/40
Crysoperla carnea	5	1/20

RESULTS

Tomato

As species of whiteflies, *T. vaporariorum* and *Bemisia tabaci* (Genn.) (Hom. Aleyrodidae) were determined in spring and autumn, respectively. Three species of mites; *Aculops lycopersici* (Massee) (Acarina, Eriophyidae), *Tetranychus urticae* Koch and *T. cinnabarinus*; and two species of aphids; *Macrosiphum euphorbiae* (Thomas) and *Myzus persicae* (Sulzer) (Hom., Aphididae); were determined in both seasons.

As shown in figure 1, whitefly population reached to the application threshold in the first autumn and spring. During the autumn, 14 releases were made, 3 of them were made to reserve the parasitoid population. After the releases, the whitefly population was controlled successfully with 80.02 % parasitization rate, and never reached more than 11.16 nymphs per leaf. *E. formosa* also controlled *T. vaporariorum* population effectively during the spring production. The population of *T. vaporariorum* which reached to a maximum of 27.4 individuals per leaf decreased to almost zero after *E. formosa* releases. Parasitization rate was nearly 100 %.

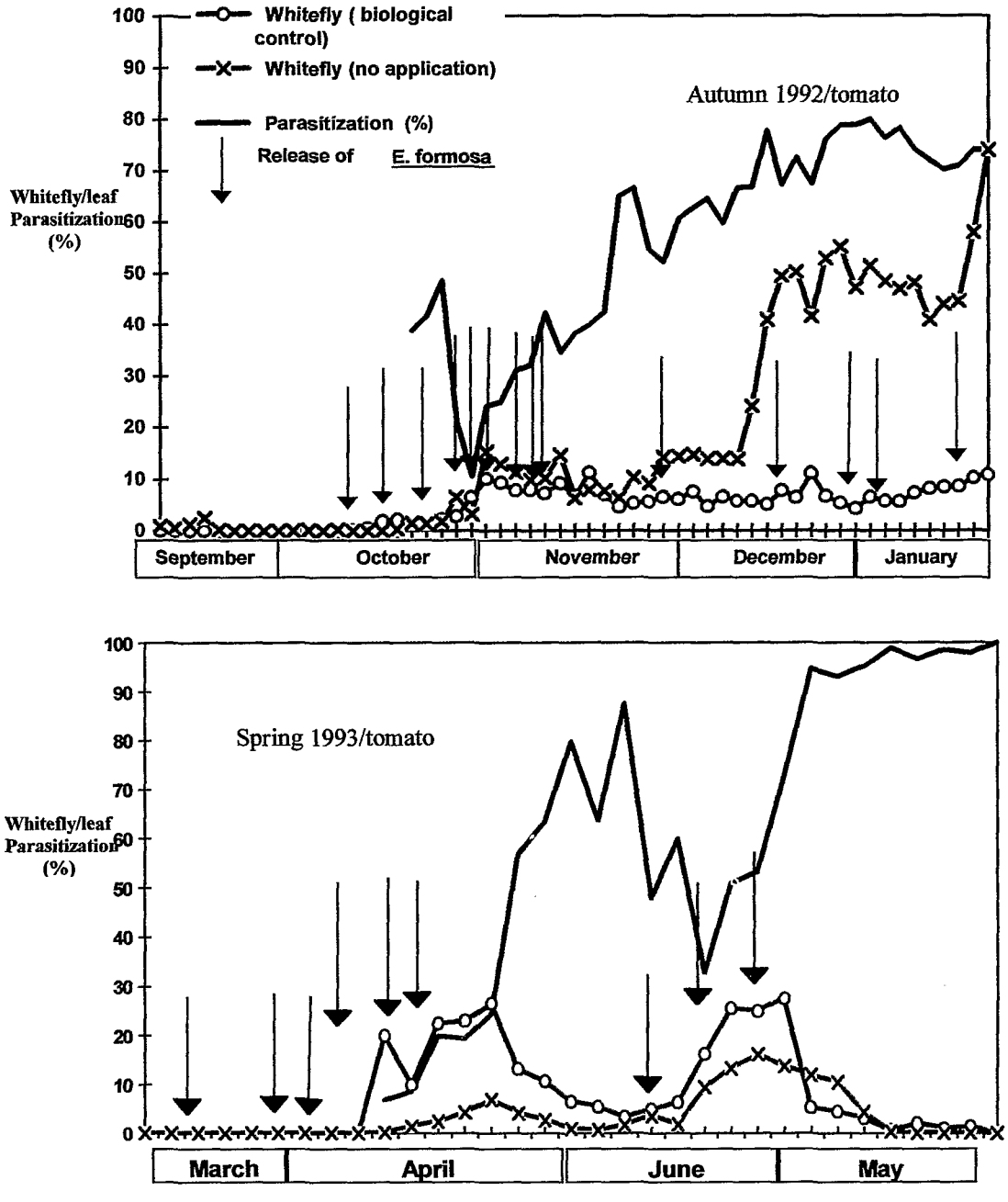


Figure 1. Nymph density and parasitization rate of whiteflies on tomato plants in treated and control parcels

Four successive *P. persimilis* releases with a rate of 1/20 showed an effective control against red spider mites during both autumn and spring. But it was necessary to spray chemicals in June during the spring production (figure 2). In the second autumn and spring periods, no release of predatory mites was made, because acaricide applications that were necessary to control *A. lycopersici* provided complete control over *Tetranychus* spp. During the trials, aphid population on tomato did not reach to the application threshold.

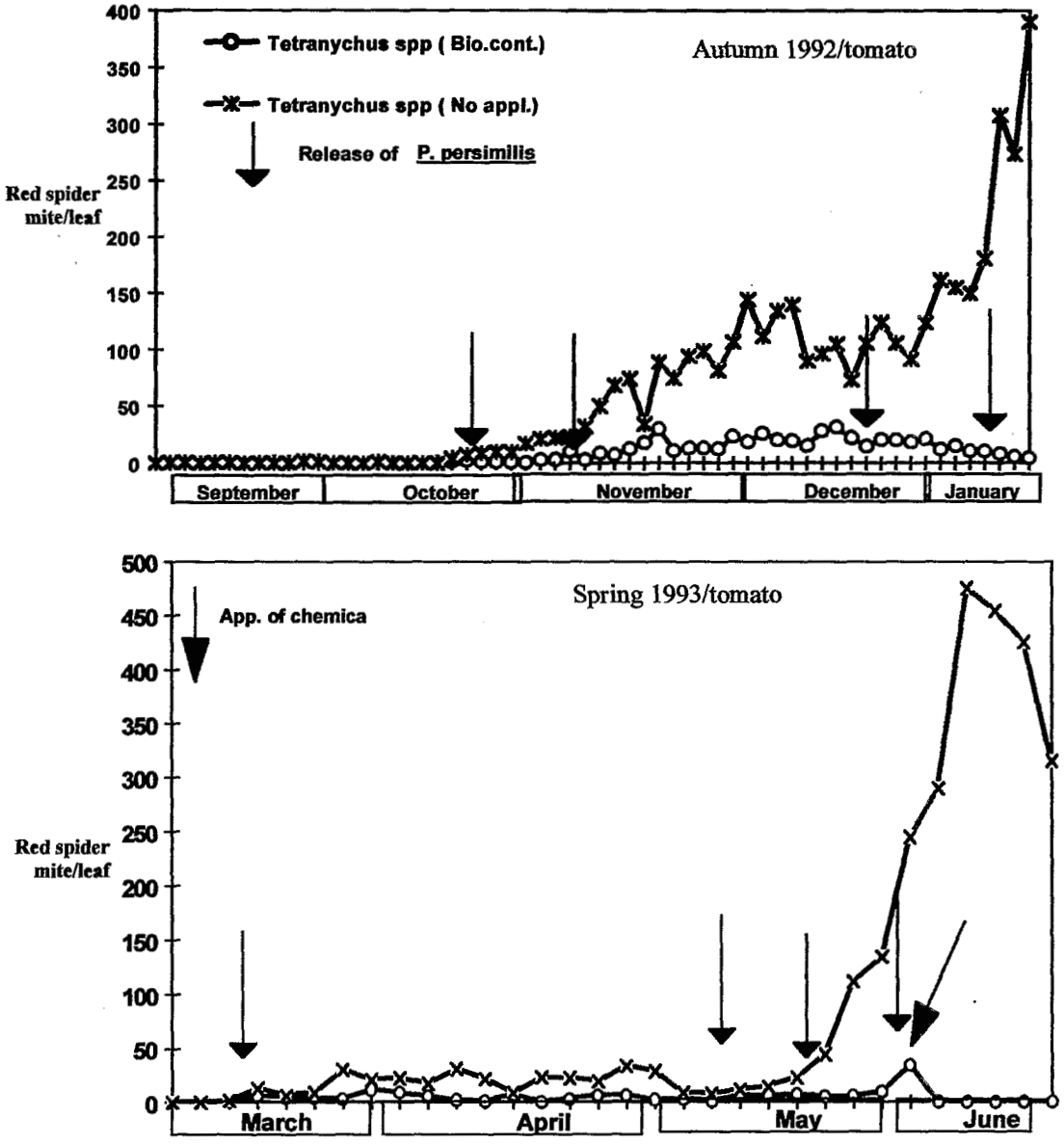
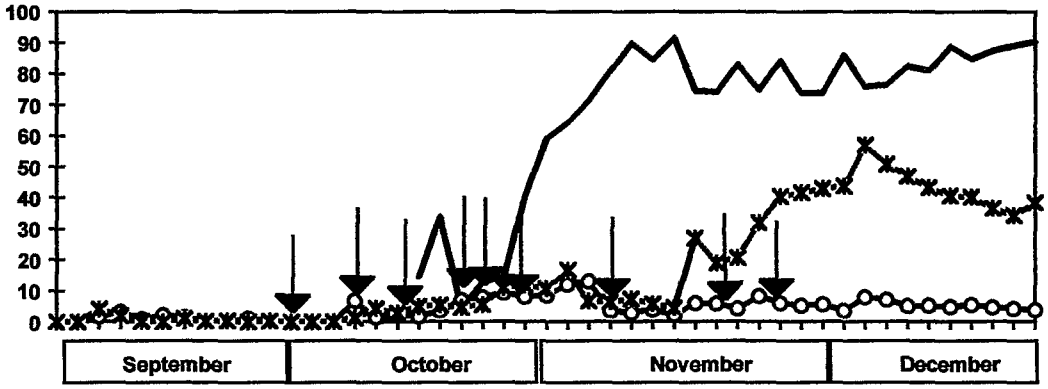


Figure 2. Effect of *P. persimilis* release on the control against red spider mites on tomato plants

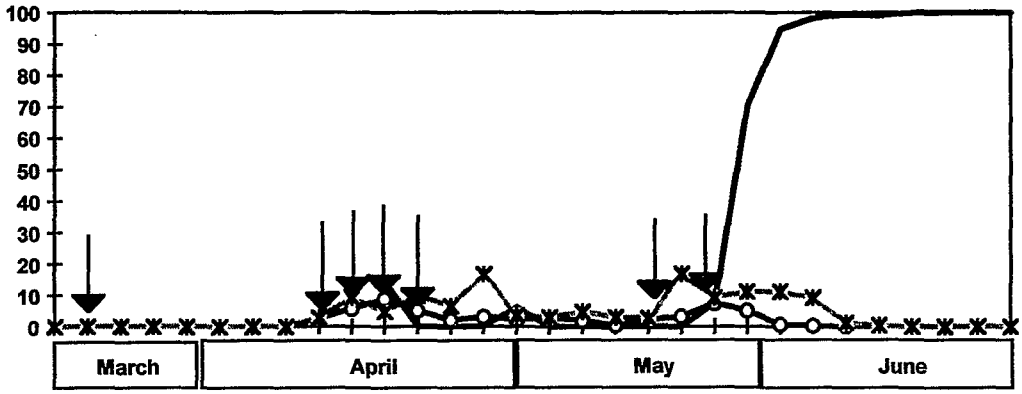
Cucumber

T.vaporariorum and *B. tabaci* were the major whitefly species in spring and autumn, respectively, on cucumber similar to tomato. *Tetranychus* spp. and *Aphis gossypii* Glov. (Hom., Aphididae) were determined as serious pests, as well. During the trial, whitefly population reached to the application threshold in both autumns and one of the spring periods. In the last spring production, *E. formosa* was not released because of low whitefly population (1.16 nymph/leaf). *E. formosa* was also found to be effective to control white flies on cucumber. In autumn periods, the maximum pest population was 13.08 and 18.50 nymphs per leaf on biologically controlled plants with 91.47 and 92.2 % parasitization rates, whereas 56.84 and 102.3 nymphs per leaf were determined in untreated control plots. During the spring period, maximum whitefly population was 8.8 nymphs/leaf, and the parasitization rate was 100 % (figure 3).

Autumn 1992



Spring 1993



Autumn 1993

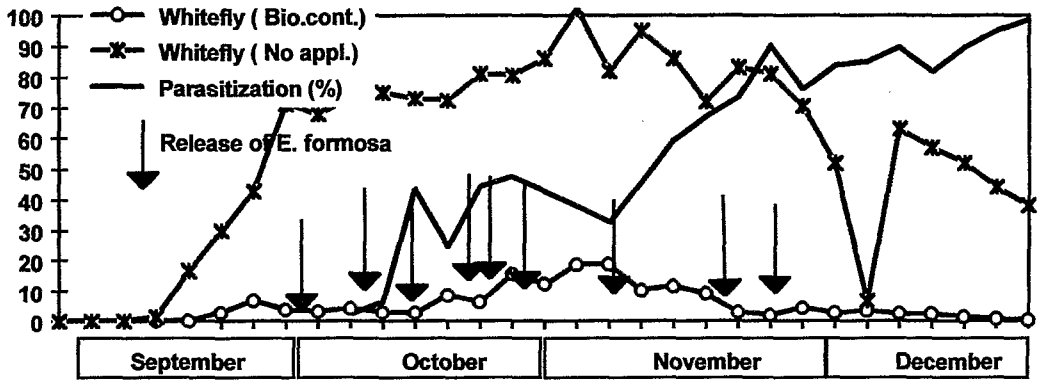


Figure 3. Nymph density and parasitization rate of white fly on cucumber plants

Red spider mites could be reduced by releasing *P. persimilis* in all the seasons. Because of the high pest population on un-treated control plants, plant deaths were observed. During the second

spring production different release ratios were compared, and it was determined that there was no difference between 1/20 and 1/40 release ratios in terms of pest population (figure 4)

In contrast to tomato, high aphid population necessitated the release of *C. carnea* on cucumber. *C. carnea* was released both at the egg and larvae stages. Since it was not effective, a specific aphicide was sprayed.

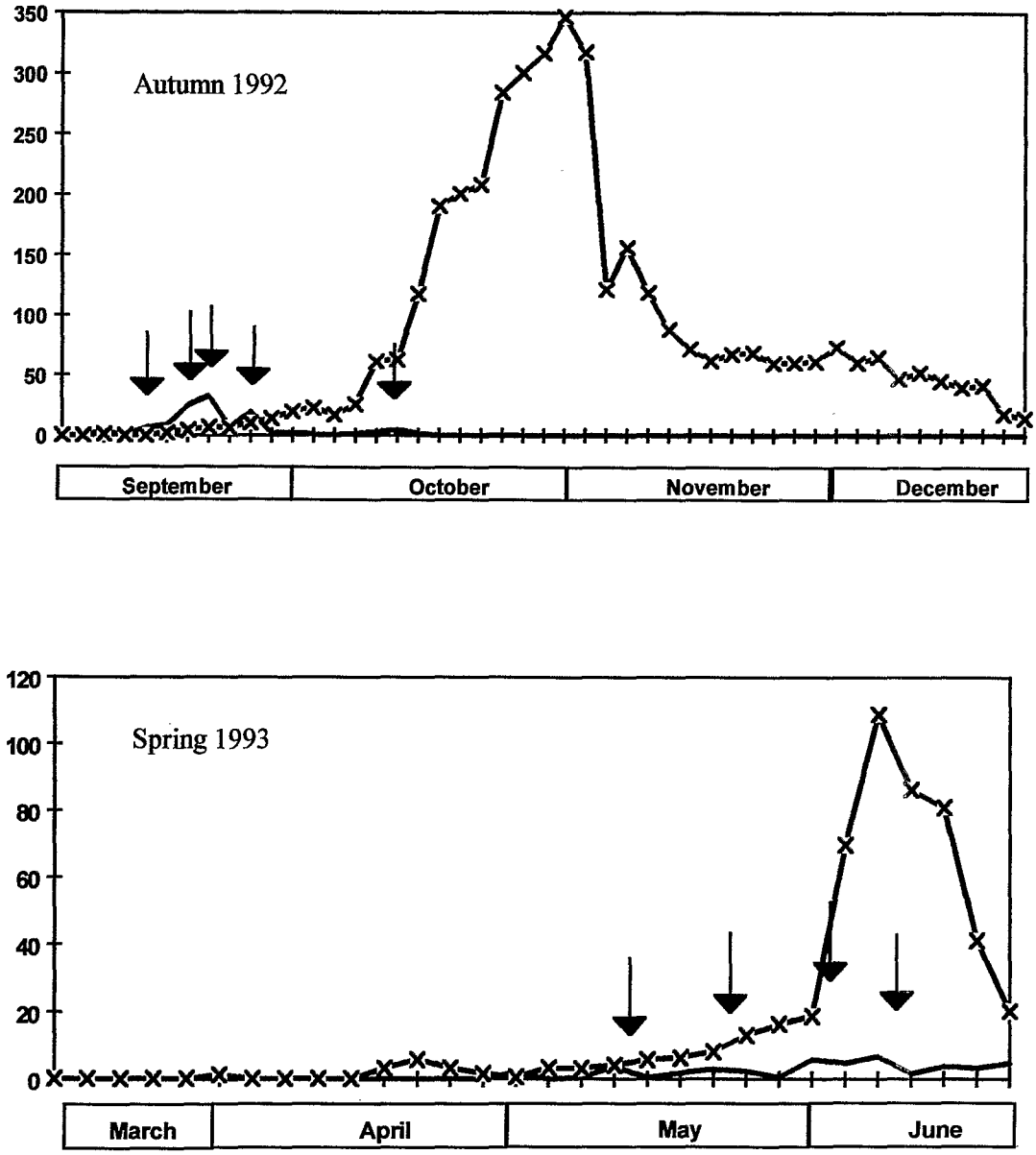


Figure 4a. Population density of red spider mite on cucumber plants (Autumn 1992, Spring 1993)

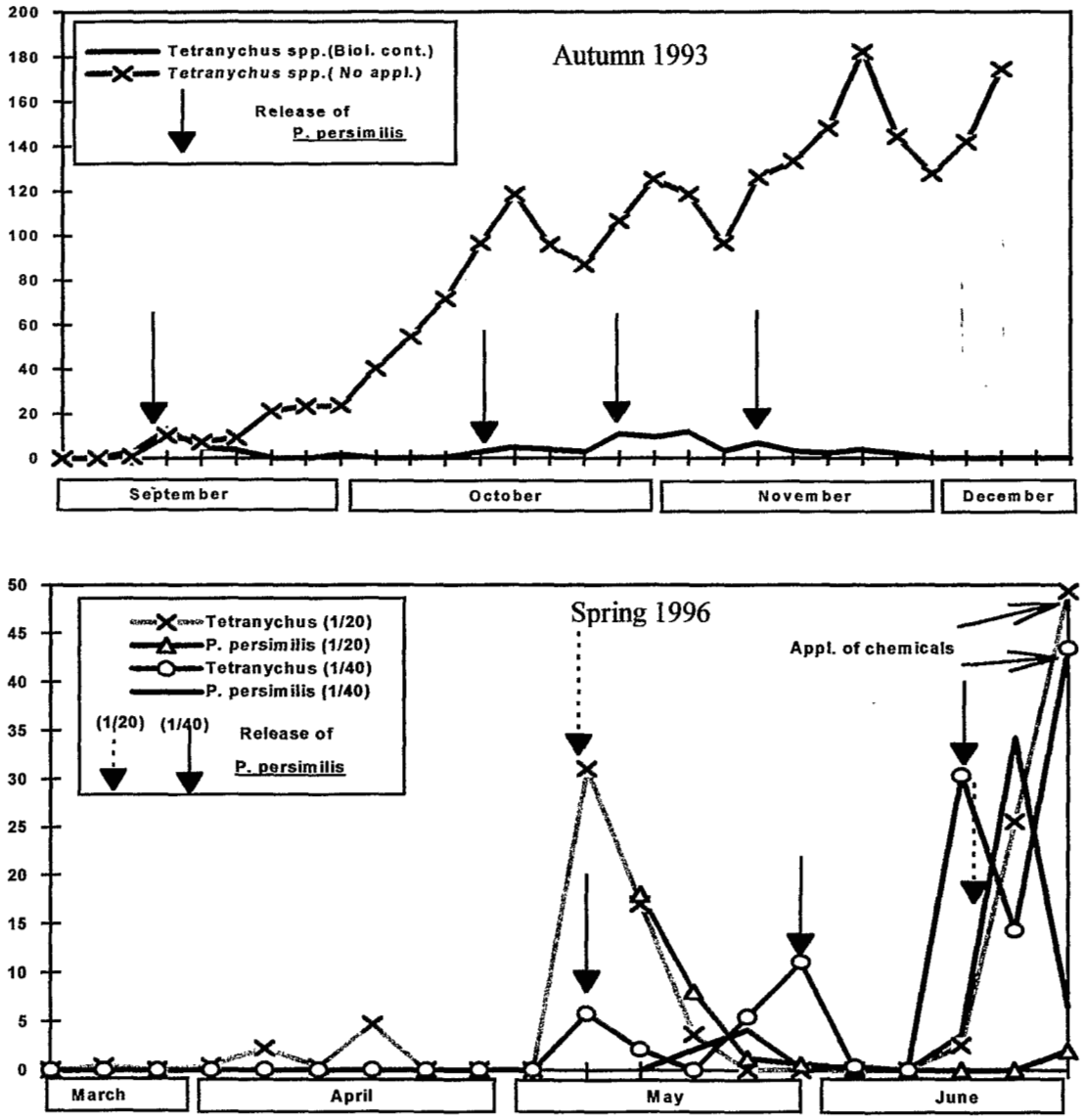


Figure 4b. Population density of red spider mite on cucumber plants (Autumn 1993, Spring 1996)

Eggplant

During the trial, serious pests of eggplant were *T. vaporariorum, T. urticae* and *M. persicae*, but thrips were also observed at a lesser extent.

Although *E. formosa* supplied high parasitization with a rate of 79.82 %, it was not able to reduce whitefly population (figure 5). As it is shown in (figure 6), many releases of *P. persimilis* were made, but red spider mite population could not be suppressed. It was observed that predatory mites did not settle on eggplants. There are no results related to the biological control of aphids on eggplant, because satisfactory results could not be obtained by releasing *C. carnea* on tomato and cucumber plants and thus specific aphicide was sprayed.

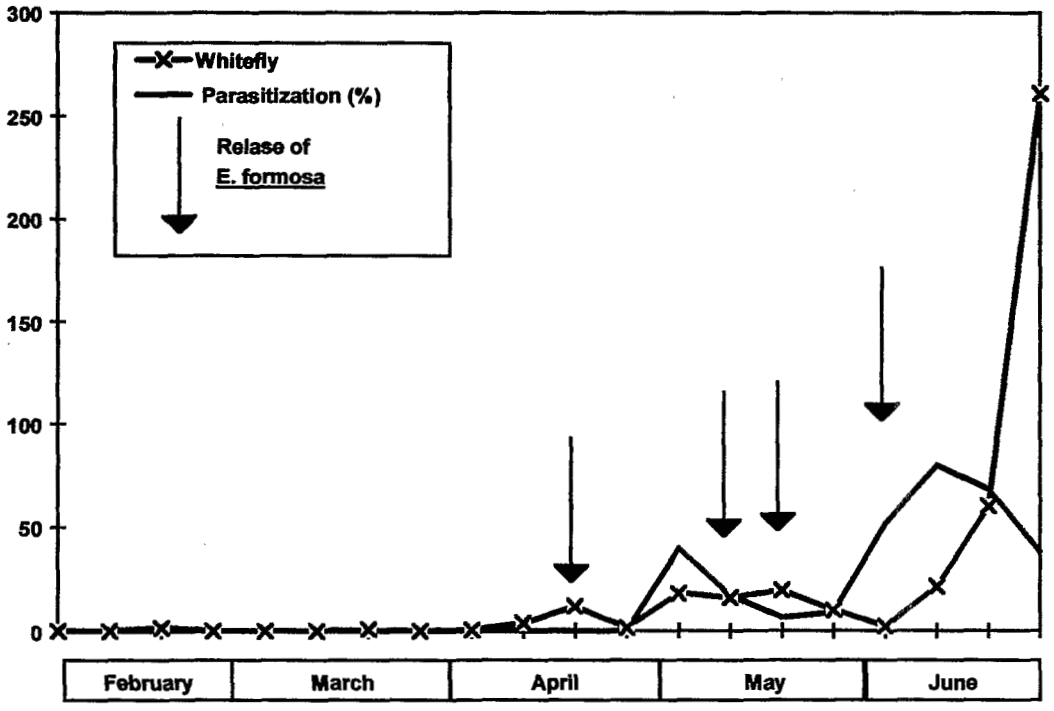


Figure 5. Whitefly population on eggplant

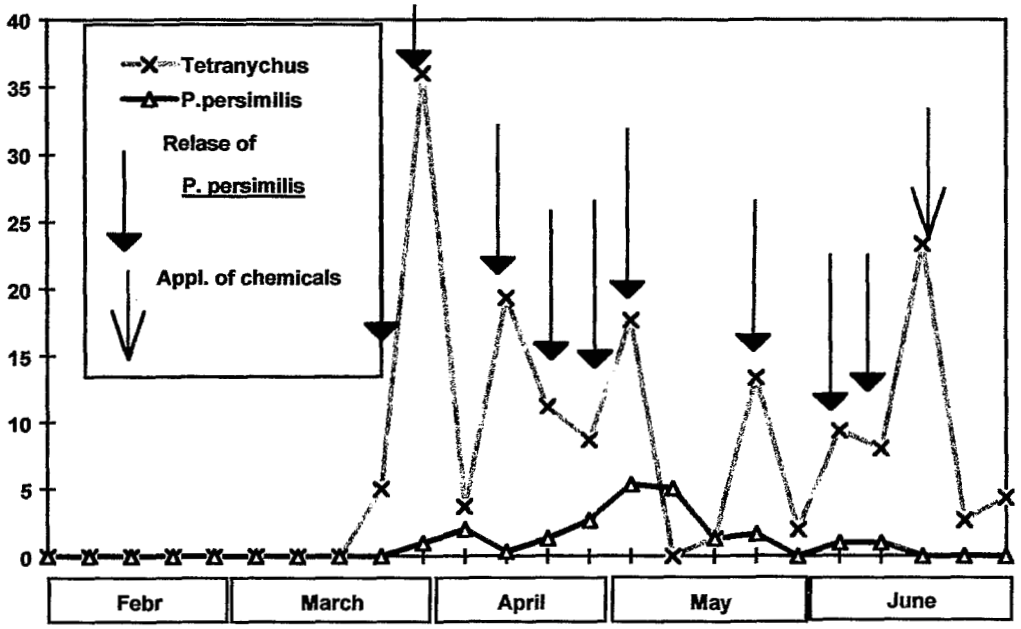


Figure 6. Population density of red spider mite on eggplant plants

DISCUSSION

Results show that *E. formosa* was able to control *T. vaporariorum* and *B. tabaci* on tomato and cucumber plants confirming the results of earlier studies (van Lenteren & Woets, 1988; Koch, 1989; van Roermund & van Lenteren, 1992; Yoldaþ, 1995). Because it was not able to suppress

whitefly population on eggplants, using an entomopathogen fungus preparate can be recommended.

A satisfactory control of *Tetranychus* spp. was achieved with *P. persimilis* on tomato and cucumber. Predatory mite release ratio of 1/40 (predator/red spider mite) was found to be sufficient to reduce red spider mite population on cucumber plants. In tomato production, it was determined that chemicals sprayed against *A. lycopersici* which is a serious pest of tomato plants grown in both greenhouses (Madanlar & Öncüer, 1994) and open field (Madanlar & Karsavuran, 1995) in the recent years in Turkey. *P. persimilis* did not give satisfactory results on eggplants. Therefore, a specific acaricide or sulphure may be used for controlling spider mites. It was determined that a lot of predatory mites died owing to increasing temperatures during the last days of June. Sunderland et al. (1992) also report that *P. persimilis* was not effective at the temperatures above 30 °C, and success might be possible by using native strains or strains tolerant to high temperatures.

In the trial, *C. carnea* was not able to suppress aphids, therefore, native strains of *Aphidius* sp. (Hym., Aphidiidae) and *Aphidoletes aphidimyza* (Rond.) (Dip., Cecidomyiidae) are taken into consideration for the forthcoming trials. In the light of the results obtained, *E. formosa* and *P. persimilis* can be recommended for the control of whiteflies and red spider mites, respectively, in the commercial tomato and cucumber greenhouses in Turkey. It is suggested that researches related to integrated pest management programs should be widened to include a wide range of biological agents adapted to local conditions.

REFERENCES

Anonymous, 1993. VII. Beş Yillik Kalkinma Plani, Örtüalti Sebze Yetiştiriciliği Özel □htisas Komisyonu Raporu. Seracilik Araştirma Ens., Antalya, Turkey.

Freuler, J., 1987. Evolution de la lutte biologique contre les ravageurs des légumes sous abris et serres en Suisse romande. Revue Suisse Vitic. Arboric Hortic., 19 (4): 219- 223.

Kilinçer, N. & H. Bulut,1986. Sera beyazsineği *Trialeurodes vaporariorum* ile paraziti *Encarsia formosa* (Gahan) arasindaki bazi ilişkiler üzerinde araştirmalar. Türkiye I. Biyolojik Mücadele Kongresi (12-14 şubat, 1986, Adana), 206-217.

Koch, W., 1989. Eine neve weibe Fliege im gewachshaus. Beschreibung und Bekampfungs-möglichkeiten von *Bemisia tabaci*. Deutscher Gartenbau, 14: 892-894.

Lenteren, J.C. van & J. Woets, 1988. Biological and integrated pest control in greenhouses. Ann. Rev. Entomol., 33: 239-269.

Madanlar, N. & C. Öncüer, 1994. Izmir ilinde sera domatesi zararlisi olarak *Aculops lycopersici* (Massee) (Acarina, Eriophyidae). Turkish Journal of Entomology, 18 (4): 237- 240.

Madanlar, N. & Y. Karsavuran, 1995. Sanayi domatesi üretim alanlarinda akarlara karşi kimyasal mücadele programinin geliştirilmesi. SANDOM No. 9: 54-63.

Maisonneuve, J.C., 1989. La lutte biologique sous serre. Revue Horticole, 300: 7-9.

Markkula, M. & K. Tiittanen, 1980. Biological control of pests in glass-houses in Finland-the situation today and in the future. Working Group Integrated Control in Glasshouses, Vontoa, Finland, 12-15.5.1979, Bulletin SROP, 3(3): 127-133.

Öncüer, C., Z. Yoldaş, N. Madanlar & A. Gül, 1994. Izmir'de sebze seralarinda zararlilara karşi biyolojik savaş uygulamalari. Türkiye 3. Biyolojik Mücadele Kongresi (25-28 Ocak, 1994), 395-407.

Roermund, H.J.W. van & J.C. van Lenteren, 1992. The parasite-host relationship between *Encarsia formosa* (Hym., Aphelinidae) and *Trialeurodes vaporariorum* (Hom.,Aleyrodidae). XXXIV. Life history parameters of the greenhouse whitefly. *Trialeurodes vaporariorum* as a function of host plant and temperature. Wageningen Agric. Univ. Papers, 92 (3): 1-102.

Sunderland, K.D., R.J. Chambers, N.L. Helyer & P.I. Scopp, 1992. Integrated pest management of greenhouse crops in Northern Europe. Horticultural Reviews, 13: 1-66.

Yoldaş, Z. , 1995. Hiyar seralarinda zararli *Bemisia tabaci* Genn. (Homoptera , Aleyrodidae)' ye karşi biyolojik savaşta *Encarsia formosa* (Gahan) (Hymenoptera, Aphelinidae) 'nin etkinliği üzerinde bir araştirma . Turkish Journal of Entomology, 19 (2): 95 -100 .