Israel Journal of Entomology

Vol. XXIX (1995) pp. 191-198

DISTRIBUTION, POPULATION FLUCTUATIONS AND NATURAL ENEMIES OF THE WHITE PEACH SCALE, *PSEUDAULACASPIS PENTAGONA* (TARGIONI TOZZETTI) (HOMOPTERA: DIASPIDIDAE) IN THE EAST MEDITERRANEAN REGION OF TURKEY

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ABSTRACT

The white peach scale, *Pseudaulacaspis pentagona* (Targioni Tozzetti) (PP) is considered a main pest of peach orchards in the East Mediterranean region of Turkey. Peach is grown traditionally in the mountain area, but in the last two decades the number of peach orchards increased significantly in the coastal plains of the East Mediterranean region. PP is distributed in all peach-growing localities and heavy infestation occurs in orchards of the coastal plain. During this study two parasitoids — *Encarsia berlesei* (Howard) and *Azotus perspeciosus* (Girault) — and four predators — *Cybocephalus fodori minor* (Endrody-Younga), *Chilocorus bipustulatus* (L.), *Rhyzobius lophanthae* (Blaisdell) and *Pharoscymnus pharoides* Marseul — were found. The white peach scale occurs in Turkey on 14 host plants including several fruit trees, ornamental plants and some herbaceous plants under the canopy of heavily infested peach trees. Population fluctuations from November 1991 through November 1993 were observed at four locations representing two different ecological conditions. In the mountain area two distinct generations were recorded, the first in June/July and the second in September/October. In the coastal plain three generations were observed, the first in mid-April, the second in June/July and the third in October/November. PP population peaks are not followed by the parasitoid and predator populations, suggesting that the effectiveness of these natural enemies is not sufficient to control the pest.

KEY WORDS: *Pseudaulacaspis pentagona*, white peach scale, Diaspididae, distribution, parasitoids, predators, population fluctuations, Turkey.

INTRODUCTION

Horticulture has been developing alongside with cotton, com and other field crops in the East Mediterranean region of Turkey. Traditionally, peach was grown mainly in the mountain area, but in the last two decades the area of peach orchards has also increased significantly in the coastal plains of the East Mediterranean region. Many entomological problems have occurred parallel to the increase in the peach production area. The white peach scale, *Pseudaulacaspis pentagona* (Targioni Tozzetti) (PP) (Homoptera: Diaspididae) is a major pest of peach in Turkey, where it has been recorded in most of the peach-growing area (Anonymous, 1993). Although PP is a most serious pest of peach in the East Mediterranean region (Anonymous,

1993), there was no detailed study on its distribution, natural enemies and economical impact. Therefore, this study was initiated to provide information on the distribution, population fluctuations and natural enemies of PP in the peach-growing area along the Southeastern Mediterranean coast of Turkey.

MATERIALS AND METHODS

The distribution of the white peach scale was surveyed in three provinces of the East Mediterranean region in the summer and autumn of 1989. In each peach-growing district, 5% of all peach trees were examined for PP. The number of trees evaluated in each peach orchard depended on the number of trees grown, following a method previously described by Lazarov et al. (1959).

The infestation rate was indexed as noninfested, low, moderately or heavily infested. According to the average infestation degree of the orchards, the regional infestation rate was estimated.

During this general survey, we also sampled parasitoids and predators of the white peach scale. Infested twigs (10–15 cm long) were collected, brought into the laboratory and kept for emergence of parasitoids. Reared specimens were sent for identification to the International Institute of Entomology, London, England. Predatory insects were collected by the strike method (Steiner, 1962) and identified by the junior author.

The population fluctuations of PP and its natural enemies were determined in four peach orchards from November 1991 through November 1993. These orchards represent two different ecological conditions: the coastal plain and the mountain area. In each orchard, three trees infested with PP were selected and the scale population was counted separately on trunk, branches, twigs and the four quadrants of the tree. For each tissue substrate and each quadrant of the tree the number of PP was determined on a 5-cm^2 area. The population fluctuations of the white peach scale were monitored biweekly from March to October and monthly from November to February.

The population densities of natural enemies were determined in the same orchards by biweekly yellow sticky trap sampling for parasitoids and by the strike method (Steiner, 1962) for predatory insects. One sticky yellow trap was placed at 1.5–2 m height inside each of the three trees. In each orchard, the predator population was sampled by 100 strikes at each date.

In addition, non-peach host plants of PP were surveyed in all the orchards studied and over the entire survey period.

RESULTS AND DISCUSSION

Pseudaulacaspis pentagona was found in most areas of the East Mediterranean region of Turkey. However, the infestation rates were significantly higher in the coastal plain as compared to the mountain area. The scale was not found at Gülnar, Mut, Findikpinari, Aslanköy, Pozanti, Feke and Saimbeyli and its populations were considerably low in other mountain districts (Fig. 1). This is most probably due to different climatic conditions, therefore there are only two generations per year in the mountain area, as compared to three in the coastal plain.

On the average, 21% of all peach trees were infested by PP in the mountain area whereas in

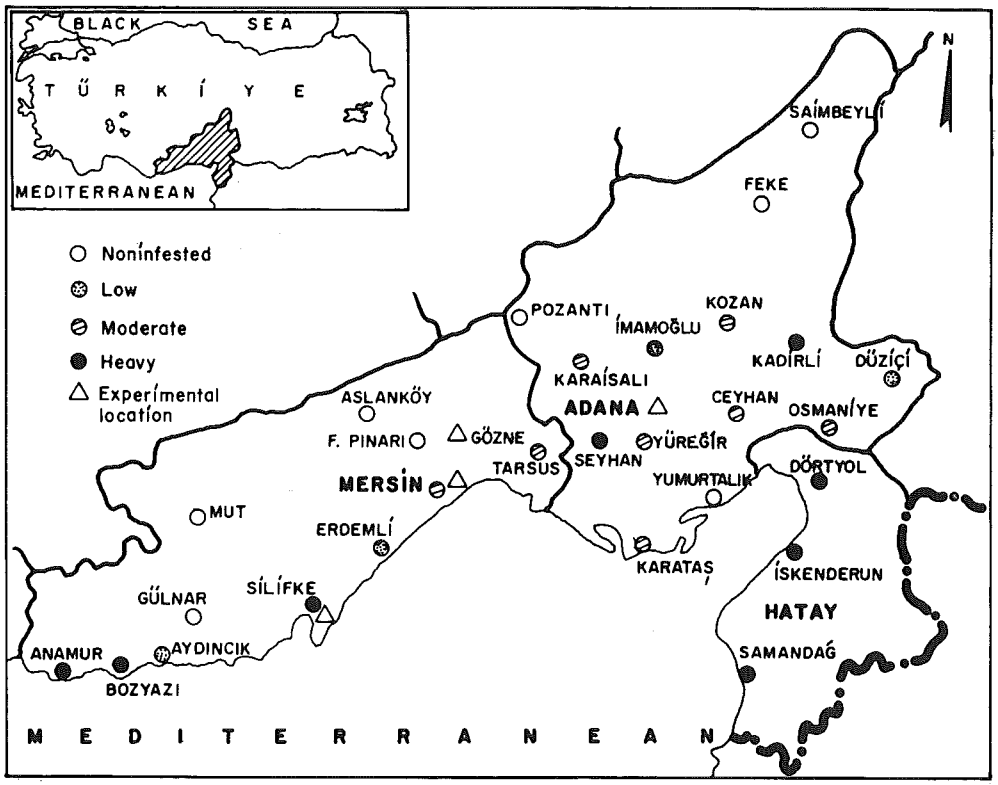

Fig. 1. Distribution of *Pseudaulacaspis pentagona* and its average infestation rate in peach-growing districts in the East Mediterranean region of Turkey in 1989.

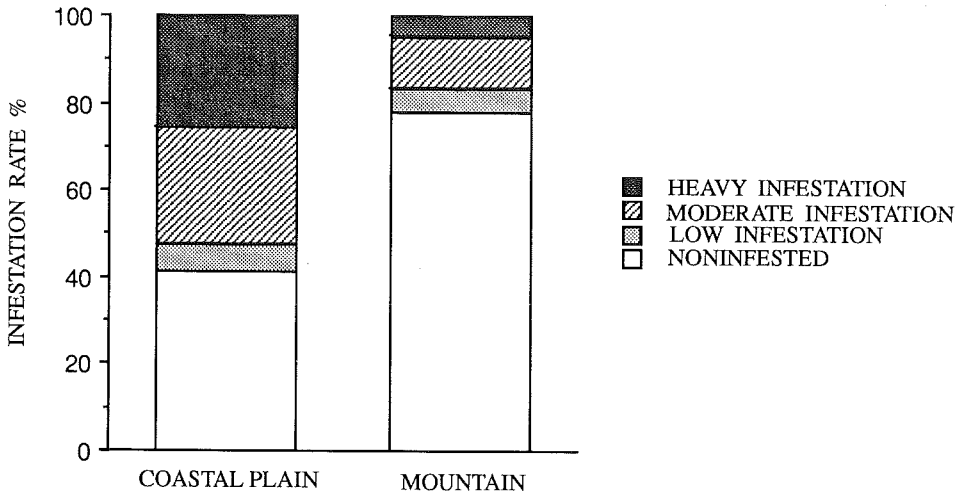

Fig. 2. Infestation rate of *Pseudaulacaspis pentagona* at two ecological sites in the East Mediterranean region of Turkey in 1989.

the coastal plain 58% of the trees were infested. Likewise, the rate of moderately and heavily infested trees was much higher in the coastal plain as compared to the mountain area (Fig. 2).

During this study two parasitoids of PP were found, namely *Encarsia berlesei* (Howard) and *Azotus perspeciosus* (Girault). *Azotus perspeciosus* was rarely found and some scientists reported that it is a hyperparasitoid rather than a primary parasitoid (Kozarzhevskaya and Mihailovic, 1983; Rosen, 1990). Four Coleopteran predators were found to prey on PP: *Cybocephalus fodori minor* (Endrody-Younga), *Chilocorus bipustulatus* (L.), *Rhyzobius lophanthae* (Blaisdell) and *Pharoscymnus pharoides* Marseul. The most common predator was *C. fodori minor,* followed by *C. bipustulatus,* whereas the other species were rare.

In this study PP was found on 14 different host plants (Table 1). Beside fruit trees and ornamental plants, several infested herbaceous plants were found under the canopy of heavily infested peach trees. The white peach scale is a highly polyphagous species and was recorded from subtropical and tropical fruit trees, ornamental plants, shrubs and even some vegetables and weeds (Borchsenius, 1966; Bennett, 1957; Tippins and Dupree, 1970; Whitmore and Medina Gaud, 1974; Ugolini and Brussino, 1977; Hanks and Denno, 1993a).

We have not found significant differences in population density between the four compass directions of the tree. The average number of scales ranged from 117 in the eastern direction to 147 in the north-facing quarter. However, PP was not evenly distributed within a tree but clumped, independent of the tissue substrate or quadrant of the tree.

TABLE 1
Host plants of *Pseudaulacaspis pentagona* in the East Mediterranean region of Turkey

Common name	Scientific name
Fruit trees	
Almond	*Prunus amygdalus* Stoke
Cherry	*Prunus avium* L.
Grapevine	*Vitis vinifera* L.
Kiwi	*Actinidia chinensis* Planch.
Peach	*Prunus persica* L.
Walnut	*Juglans regia* L.
Ornamental plants	
Lilac	*Syringa* sp.
Geranium	*Pelargonium* sp.
Vegetables	
Phaseolus beans	*Phaseolus vulgaris* L.
Rape	*Raphanus sativus* L.
Weeds	
Black night shade	*Solanum nigrum* L.
Common Lamb's quarter	*Chenopodium album* L.
Hearleaf cocklebur	*Xanthium strumarium* L.
Jimson weed	*Datura stramonium* L.
Swallow wort	*Cynadium acutum* L.

The population fluctuations of PP and its natural enemies were studied in four orchards; however, the results of only two representative locations will be presented here.

At Ayvagediği, located in the mountain area at an altitude of about 1000 m, two distinct generations were observed each year (Fig. 3). The first generation occurred in June/July and the second in September/October. The number of PP in autumn was twice as high as in the early summer. Most of the PP population was found on branches and twigs. The trunks sometimes appeared white due to dense cover of PP scales, but almost all the scale insects were dead.

On the average, 44 scales were counted on branches in June 1993, but the population of PP sharply declined in the summer of 1993 and did not recover until the end of the year. We suppose that this decline is attributable to the fact that the orchard was not irrigated during that summer. As PP is sensitive to low water contents in plants and soil (Hanks and Denno, 1993b), the population decreased.

At Ayvagediği, only the predator *C. fodori minor* was found and not *Chilocorus bipustulatus*; the latter species is usually found in the coastal plain rather than in the mountain area (Uygun, 1981). Although *C. fodori minor* is a common predator of scale insects, it was not effective enough on the PP population. It is pertinent to indicate that this predator was even observed at very low PP densities. However, there were no other scale insect species on the sampling trees. It is likely that *C. fodori minor* has alternative preys other than PP (Fig. 3).

The only parasitoid of PP encountered on yellow sticky traps was *E. berlesei*. As indexed by the trap catches, this species revealed a peak in flight activity at the beginning of July when an average of 35.3 individuals were caught per trap. Only few individuals of *E. berlesei* were trapped during the population peak of PP (Fig. 3).

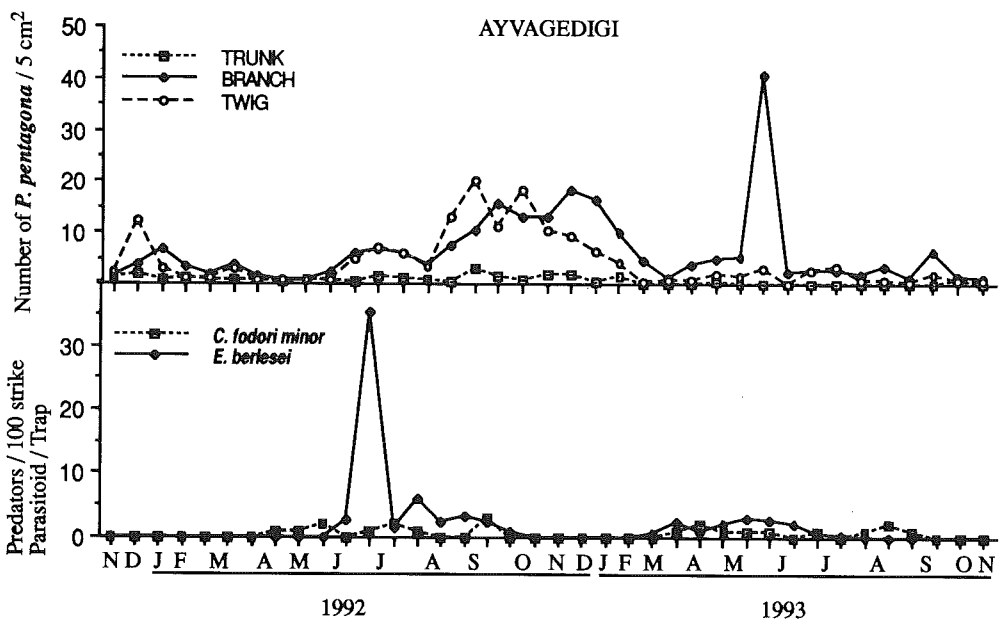

Fig. 3. Population fluctuations of *Pseudaulacaspis pentagona* and its natural enemies at Ayvagediği/İçel, Turkey.

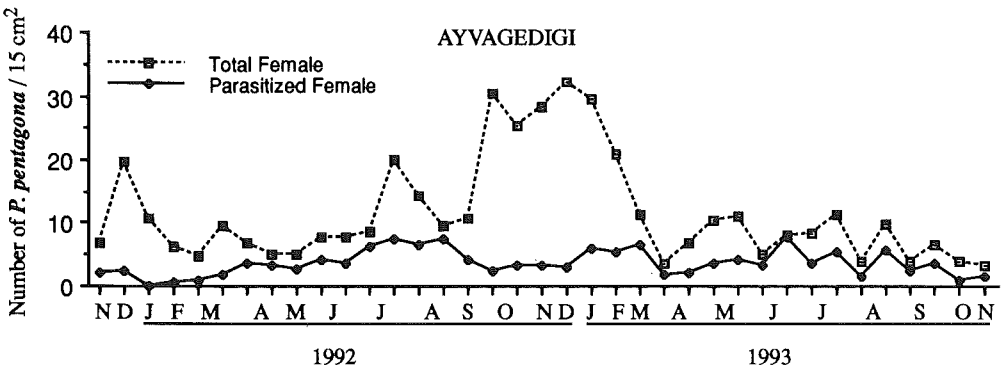

Fig. 4. Population fluctuations of total and parasitized *Pseudaulacaspis pentagona* females at Ayvagediği/İçel, Turkey.

Figure 4 presents the fluctuations in the population of *E. berlesei* and that of PP females. Most parasitized females were found in the spring and summer of 1992 and 1993. During the population peak of the PP autumn generation, the parasitization rate did not increase, ranging between 7.4 and 2.3 parasitized females per 5 cm^2. This number was even lower than in spring and summer. Up to 50% of all PP females were parasitized in 1993.

The orchard at Yaka represents the coastal plain area of the East Mediterranean region of Turkey. In the coastal plain three distinct generations of PP were observed: the first in mid-April, the second in June/July and the third in October/November (Fig. 5). As in the

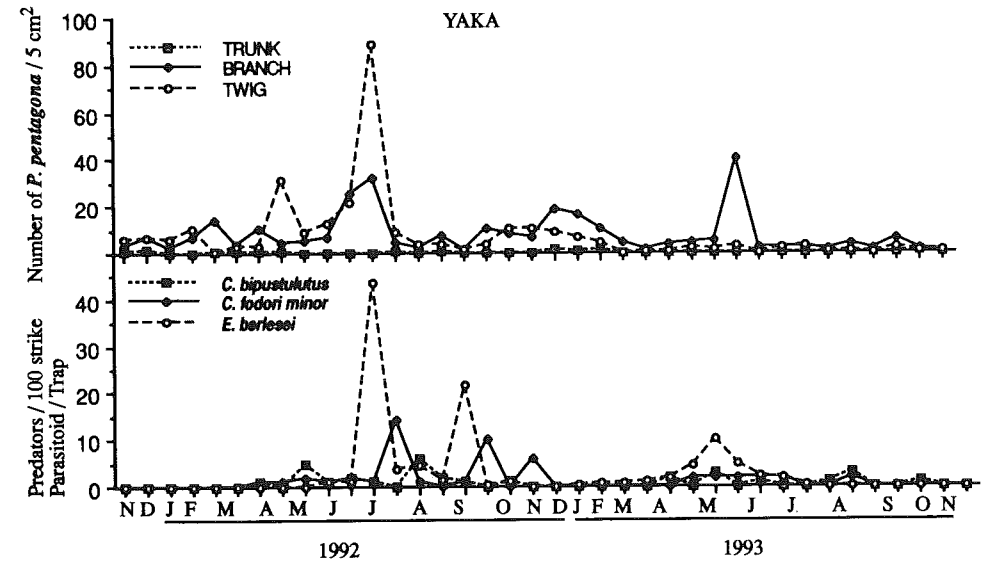

Fig. 5. Population fluctuations of *Pseudaulacaspis pentagona* and its natural enemies at Yaka/İçel, Turkey.

mountain region, most scales were found on branches and twigs, while very few live individuals were observed on trunks. The number of individuals counted in the plain region in the spring/summer generation was almost twice as high as in the mountain region, whereas the number of PP in the autumn generation was almost the same in the coastal plain and the mountains. In the Yaka orchard the PP population declined in 1993, probably due to the heavy infestation (in 1992) of this 19-year-old orchard, resulting in shoot dieback in 1993. It is very likely that PP was the major agent which caused the dieback of this orchard.

In the coastal plain region, both *C. fodori minor* and *Chilocorus bipustulatus* were collected on the sampled peach trees. Furthermore, the number of predators was significantly higher in the plain as compared to the mountain region. Up to 14 *C. fodori minor* and 6 *C. bipustulatus* specimens were caught per 100 strikes (Fig. 5).

Both in the coastal plain and in the mountains, *E. berlesei* was the only parasitoid caught on the yellow sticky traps. This parasitoid displayed two distinct peaks in 1992, but only one in 1993. In 1992 the highest flight activity of *E. berlesei* was observed about 2 months following the PP population peak of the first and second generations. In 1993 comparatively few parasitoids were caught as early as at the beginning of May, before the population peak of PP occurred on the branches and twigs (Fig. 5). It was observed in this orchard that population fluctuations of parasitized and non-parasitized white peach scale female were not consecutive, suggesting that natural enemies were not effectively regulating the scale population (Huffaker, 1971). Moreover, the parasitization rate was low in 1992 and 1993. Our results suggest that the impact of this parasitoid on the PP population is limited.

The results of this study showed that the distribution and abundance of PP are highly dependent on geographical and climatic factors resulting in three generations and higher population density in the coastal plain. Although several natural enemies of the white peach scale were found, neither the parasitoids nor the predators proved to have great effect on the population dynamics of PP.

ACKNOWLEDGMENTS

The authors are grateful to Dr. U. Kersting for his kind scientific and editorial comments.

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