Israel Journal of Entomology

Vol. XX (1986) pp. 37-44

PHENOLOGY AND NATURAL ENEMIES OF THE CITRUS RED MITE, *PANONYCHUS CITRI* (McGREGOR) IN ISRAEL

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ABSTRACT

The citrus red mite, *Panonyehus citri* (McGregor), was first discovered in Israel in the winter of 1979/80 on citrus trees at Kefar Brandeis (in the central Coastal Plain), and has since spread on all varieties of citrus throughout the Coastal Plain, northern Negev, and Hula Valley, causing substantial damage. Periodic counts of *P. citri* populations, carried out from November 1979 to March 1983, showed that the population peak occurred at the end of autumn or early winter, and the ebb during summer. The phytoseiid mite *Amblyseius swirskii* Athias-Henriot was common in plots infested with *P. citri,* but this predator as well as other local natural enemies did not curb the outbreaks of the pest. *KEY WORDS:* Acarina, *Panonychus citri,* phenology, natural enemies, Israel.

INTRODUCTION

The citrus red mite, *Panonychus citri* (McGregor), was first discovered in Israel in winter 1979/80 on citrus at Kefar Brandeis (central Coastal Plain). The damage inflicted to many trees was severe, owing to mite-induced defoliation, withering of branches, and reduced quality of the infested fruits (Sternlicht *et al.*, 1979).

During the years 1979-1983 periodic counts of P. *citri* were carried out at Kefar Brandeis. In addition, from 1979 to 1985, sporadic assessments and collections of natural enemies were made at various other sites in the country.

MATERIALS AND METHODS

Two methods were used to assess *P. citri* populations (all stages including eggs): i) Each leaf or fruit was rated in the following manner: no mites, 0; 1-10 mites, 1; 11-20 mites, 2; and 21 or more mites — 3. ii). Mites on areas of 1cm x 1cm were counted by means of a piece of celluloid which had a 1 cm^2 hole cut in it. Four such 1 cm^2 areas were examined on each fruit or on each leaf. In 1979/80 ten trees were

chosen at random in each plot, 20 leaves and 20 fruits being checked per tree (Fig. 1). During the years 1980-1983, 20 fixed trees were checked periodically in each plot (Figs. 2-4). Ten leaves and ten fruits, distributed in the four points of the compass, were examined per tree. Thus also in this case 200 leaves and 200 fruits were checked per plot. In the sporadic assessments ten trees per plot were checked and on each tree ten leaves and ten fruits were examined. In summer 1985, 100 leaves and 50 fruits per tree, as well as trunks, branches and canopies of the trees were examined thoroughly. On fruits, the mites were sought out also under the calyces.

Predacious mites were collected in 70% alcohol, cleared in Nesbitt's solution and mounted in Hoyer's fluid.

RESULTS AND DISCUSSION

Distribution

Panonychus citri was first discovered in Israel in winter 1979/80 in the groves of Kefar Brandeis (central Coastal Plain). In 1981 it was found at Giv'at Hayyim and Gan Shemuel (about 3-4 km from Kefar Brandeis), and in 1982 it was present at 16 sites, from Kabri (northern Coastal Plain) to Sede Warburg (central Coastal Plain). One year later the pest was present in many locations from Kabri to Neta'im (southern Coastal Plain). Today it is found throughout the Coastal Plain, northern Negev and Hula Valley.

Hosts

Panonychus citri was found in Israel on the following citrus species and varieties: Shamouti orange, Valencia orange, Navel orange, Temple orange, Ortanique tangor, Minneola tangelo, grapefruit varieties, pummelo and sour orange. In other countries this mite attacks other hosts in addition to citrus (Jeppson *et al.*, 1975).

Population counts were carried out at Gan Shemuel on 14.X.81 on Shamouti and Navel oranges (cvs. Skaggs Bonanza and Tulegold Navel) (Table 1). The high rate of infestation of these two Navel varieties, in comparison with Shamouti orange, should be noted.

TABLE 1. INFESTATION OF THREE VARIETIES OF ORANGE TREES BY *PANONYCHUS CITRI*; GAN SHEMUEL, 14.X.1981

	Number of mites per 1 cm^2		% infested	
Variety	leaves	fruits	leaves	fruits
Shamouti orange	2.43	0.35	23	10
Skaggs Bonanza Navel	25.20	12.78	75	57
Tulegold Navel	11.60	0.58	43	10

According to our observations, not confirmed by quantitative assessments, *P. citri* prefers Shamouti and Valencia oranges to grapefruit.

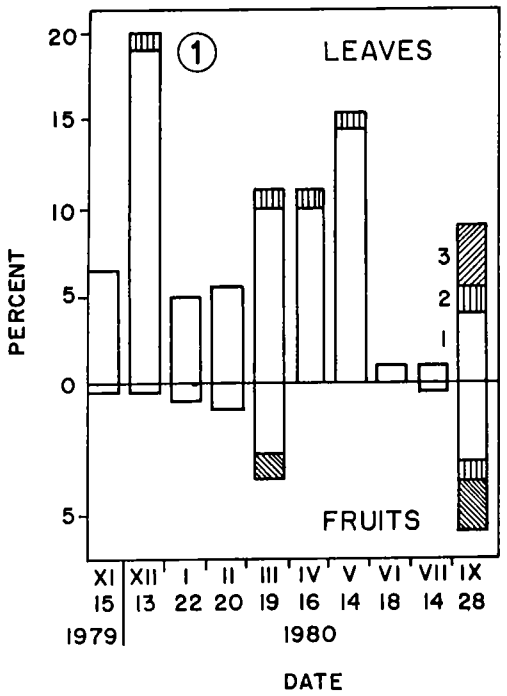

Fig. 1. Fluctuations in % of infested Valencia leaves and fruits with *Panonychus citri* at Kefar Brandeis in 1979-1980; for explanation of degrees of infestation see Materials and Methods.

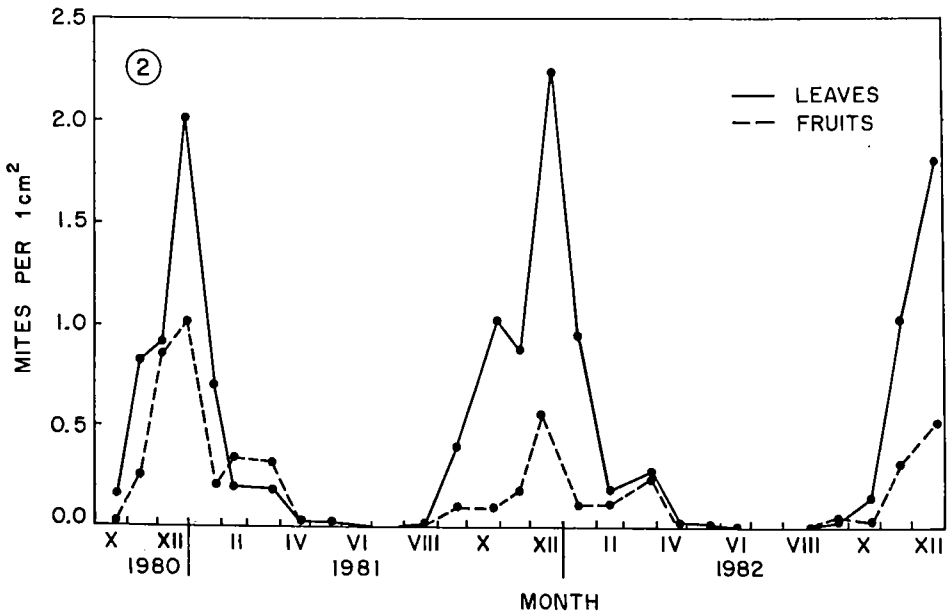

Fig. 2. Fluctuations in infestation of Valencia trees with *Panonychus citri* at Kefar Brandeis (number of mites per 1 cm^2).

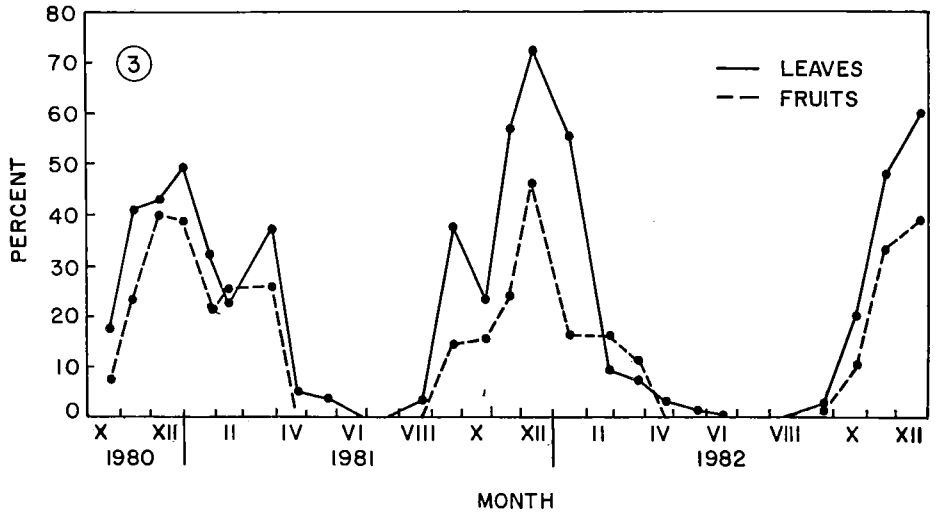

Fig. 3. Fluctuations in % of infested Valencia leaves and fruits with *Panonychus citri* at Kefar Brandeis in 1980-1982.

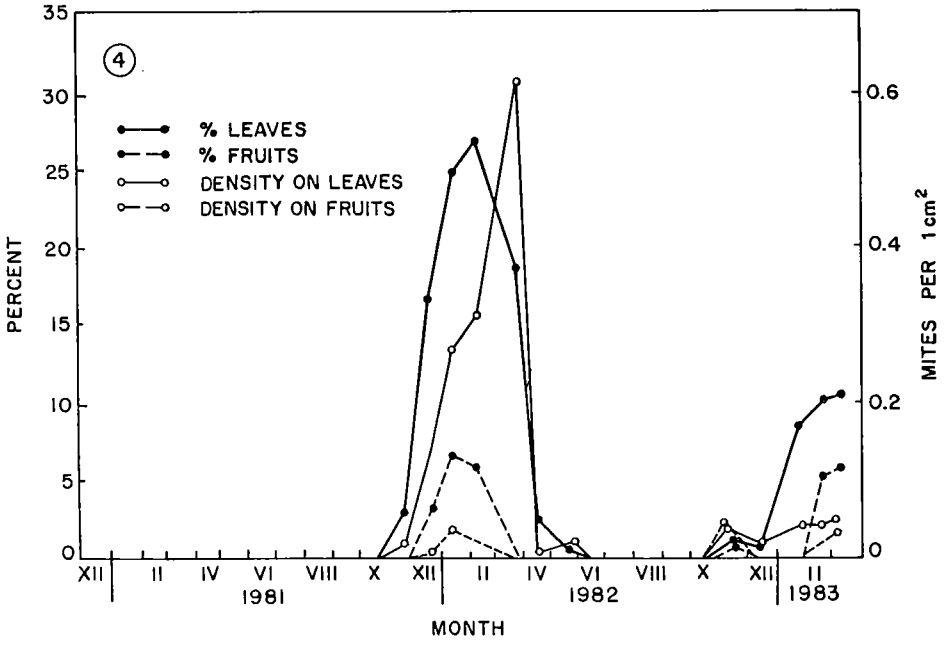

Fig. 4. Fluctuations in infestation of Shamouti orange trees with *Panonychus citri* at Kefar Brandeis (number of mites per 1 cm^2, % of infested leaves and fruits).

Fluctuations in populations

Figures 1-4 present data on the fluctuations in population of *P. citri* on Valencia and Shamouti orange trees at Kefar Brandeis. The periodic counts showed a peak of population at the end of autumn and/or in winter, a slight rise in early spring, and an ebb in summer. Since the high levels of infestation of Valencia trees in December 1980 and 1981 necessitated intervention, an oil spray was applied to the plot. Outbreaks of *P. citri* are unpredictable. For example, in a Shamouti orange plot that had been heavily infested with *P. citri* in winter 1979, sparse numbers were discovered only once (20.II.80); an increase in population was noted in October 1981 (see Fig. 4).

In our counts on leaves and fruits in the summers of the years 1979-1982 (Figs. 1-4), only a few mites were observed. Therefore, in summer 1985 leaves and fruits, as well as trunks, branches and canopies, were examined (Table 2). No mites were found on trunks or branches. All stages of *P. citri* were found in July in small numbers, and the population started to build up in August.

TABLE 2. INFESTATION OF VALENCIA TREES BY *PANONYCHUS CITRI* AT KEFAR BRANDEIS, SUMMER 1985

(7 trees, 700 leaves and 350 fruits were examined)

	Number of mites per 1 cm^2		% Infested	
DATE	leaves	fruits	leaves	fruits
24.VII	0.07	0	1.86	0
22.VIII	0.12	0.04	11.71	4

In southern California and in Yugoslavia population peaks occur usually in spring and autumn (Ebeling, 1959; Mizushkevitz and Tomashevits, 1975). In California, long hot periods in the summer may kill all active stages of the pest. Many mites die in autumn or summer if the temperature reaches 40°C, or following a few days of stress conditions of heat and drought (32°C, 5% relative humidity) and wind (Jeppson *et al.*, 1975). In Israel the population drops in spring, probably due to the prevalence of dry conditions. However before drawing final conclusions more observations and laboratory tests are required.

In Israel's winters, especially warm ones, *P. citri* populations may reach vast numbers. In California, even in hard winters, the mortality rate of this mite is not high, but its activity is limited (Ebeling, 1959). In Japan heavy rains may suppress the mite populations, and typhoons have a strong adverse affect on them (Muraoka and Seki, 1980).

Distribution of *P. citri* on various parts of the tree

In our counts (Table 3) the mites preferred the upper side of leaves to the lower surface. The distribution of *P. citri* on young and mature leaves is given in Table 4. In autumn many mites migrate to young foliage, probably preferring it to mature leaves. In Yugoslavia fully developed young leaves are particularly suitable for the development and reproduction of the mite. However, on small very young leaves the

mortality rate is high and the oviposition rate low (Mizushkevitz and Tomashevits, 1975).

TABLE 3. INFESTATION OF UPPER AND UNDERSIDE OF VALENCIA LEAVES BY *PANONYCHUS CITRI* AT KEFAR BRANDEIS

	Number of mites per 1 cm ^{2}		% Infested	
Date	upper surface	underside	upper surface	underside
25.XI.81	1.27	0.15	66	29
23.XII.81	2.90	0.32	80	39
18.II.82	0.01	0.005	4	2

TABLE 4. DISTRIBUTION OF *PANONYCHUS CITRI* ON YOUNG AND MATURE LEAVES OF VALENCIA TREES AT KEFAR BRANDEIS

	Number of mites per 1 cm^2		% Infested	
DATE	young leaves	mature leaves	young leaves	mature leaves
23.IX.81	0.56	0.47	32	42
27.X.81	1.21	0.71	53	45
21.IV.82	0.01	0.007	2	3
17.XI.82	1.80	1.36	56	55

In Japan it is difficult to point out favorable biotopes for *P. citri* during the peak, but during ebb periods the mite prefers lower parts of the tree, the upper surface of leaves, and the sunny side of the tree (Nohara, 1970).

Natral enemies

In Israel the phytoseiid mite *Amblyseius swirskii* Athias-Henriot preys upon *P. citri*. It was found in large numbers at Kefar Brandeis in July and August 1985 in association with the pest. *A. swirskii* is he most abundant phytoseiid mite in the Coastal Plain of Israel (Porath and Swirski, 1965). *Euseius rubini* (Swirski and Amitai) was found once at Rishon LeZiyyon in association with *P. citri*.

It should be pointed out that since the local natural enemies are not sufficiently effective in curbing the pest population, intervention is often required. Thus it is recommended to import into Israel additional natural enemies of *P. citri. Euseius hibisci* (Chant), an important predator of *P. citri* in the citrus orchards of California in spring (and in coastal areas, in the summer too) (McMurtry, 1982), was introduced into Israel in 1964 (Swirski *et al.*, 1970) and 1984. *Euseius stipulatus* (Athias-Henriot), the most abundant and widespread phytoseiid mite in the citrus orchards of Algeria, Spain, Italy, Greece and Turkey (Athias-Henriot, 1960; Garcia Mari and del Rivero, 1981; McMurtry, 1977; Ragusa, 1985; Swirski and Ragusa, 1976), was imported in 1985 from Sicily. Both species were mass-bred and released in various orchards, but have not yet been recovered. *Amblyseius eharai* Amitai and Swirski, the most efficient

natural enemy of *P. citri* in Japan (Ehara, 1977; Kashio and Tanaka, 1978; Tanaka and Kashio, 1977), was introduced into Israel in 1960, released, and apparently has not become established (Amitai and Swirski, 1981; Swirski and Amitai, 1961; Swirski and Shechter, 1961). Since *A. eharai* is susceptible to low humidities (Kashio and Tanaka, 1978) the climatic conditions in Israel, at least during hot and dry spells, are unfavorable to it.

ACKNOWLEDGEMENTS

This work was sponsored by the Ministry of Agriculture and the Citrus Marketing Board of Israel. Prof. J.A. McMurtry (Riverside, California) and Prof. S. Ragusa (Palermo, Italy) kindly supplied us with *Euseius hibisci* (Chant) and *E. stipulatus* (Athias-Henriot), respectively. The authors wish to thank all the above-mentioned.

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