Ecological Studies on the Mango Red Spider Mite *Oligonychus mangiferus* (Rahman and Sapra) in Mango Orchards (Acari: Tetranychidae)

B. A. Abou-Awad[*], S. I. Afia[*] and M. M. Al-Azzazy[**]
[*]Plant Protection Dept., National Research Center, Dokki, Giza, Egypt
[**]Agric. Zoology and Nematology Dept., Faculty of Agric., Al-Azhar Univ., Cairo, Egypt

ABSTRACT

Ecological studies and management of the red spider mite, *Oligonychus mangiferus* (Rahman and Sapra) infesting mango orchards near Cairo in Egypt were carried out for two years. Population behaviour of the pest was influenced by climatic conditions, host preference, predation and vertical distribution. About 14 & 15 generations were recorded for *O. mangiferus* on Hindi and 16 & 14 generations on Alphonso cultivars during the two successive years respectively. Leaves at top level of both mango cultivars were found preferable to the mite infestation than those at the middle and bottom. Alphonso mango trees were nearly more susceptible to mite pest compared with Hindi cultivar. One acaricide application was sufficient to suppress the mite outbreak below the economic level when it applied as mite population started to increase.

Key Words: Ecology, Control, *Oligonychus mangiferus*, Tetranychidae, Phytoseiidae, Phytophagous and Predacious mites.

INTRODUCTION

The red spider mite, *Oligonychus mangiferus* (Rahman and Sapra) is one of the most important mango pests (Gerson, 1986; Zaman and Maiti, 1994 and Abbassy *et al.*, 2008). Mite infestation occurred on the upper leaf surfaces, causing great damage and premature leaves drop. Zaher & Shehata (1971) reported that the mite was firstly collected in Egypt from mango, pomegranate, grapes and terminalia by Sayed (1946) who identified the mite as *Paratetranychus terminalis* Sayed . In 1960, Baker & Pritchard, considered this mite as *O. coffeae* Nietner, but examining numerous specimens collected from mango, pomegranate and terminalia, revealed that this species was *O. mangiferus* (R. and S.) (Zaher & Shehata 1971).

Therefore, the present work is conducted to find out efficient control based on ecological approach. Susceptibility of mango varieties to *O. mangiferus* was also studied.

MATERIALS AND METHODS

Ecological studies:

Population studies on the red spider mite, *O. mangiferus* and its predators, *Typhlodromus mangiferus* Zaher and El-Borolossy and *Typhlodromips swirskii* (Athias-Henriot) were carried out in abandoned mango orchard, 13 years old, near Cairo, for two years. In order to provide comparative measures of the tetranychid prey and its predacious mites under different conditions, two groups, each consisted of five mango trees from Hindi and Alphonso cultivars were selected. Samples of 25 leaves were collected from each cultivar at random every week for examinations.

To determine the number of annual generations of *O. mangiferus* under the local environmental conditions, the percentage of immatures to all mite population was estimated weekly and each of the highest percentages (peaks) represented a generation.

To study the comparative abundance of *O. mangiferus* and its vertical distribution, 60 leaves were collected randomly from the top, bottom and middle of each mango cultivar. Observations were made for two successive years, from January to December. Sampling was performed on the 15th of every month. In the present study, leaves of mango trees from the upper branches, represented the top-level leaves, while those on the branches of the trees up to 150-200 cm above ground level, represented the bottom-level leaves. The foliage between the top and the bottom level was regarded as middle-level leaves.

To investigate the susceptibility of the two mango cultivars to *O. mangiferus*, the equilibrium position (XUZ) of mite infesting Alphonso and Hindi mango leaves was estimated according to the following equation (Mansour *et. al.*, 2000):

$$XUZ = \frac{X1 + \text{-----} XN}{N}$$

Where:

XUZ= The general mean of mites on each mango cultivar during a whole year

X1 ..... X48= The mean number of *O. mangiferus* infesting mango leaves for each week throughout the entire year.

The value of (XUZ) is represented by a line known as the steady population line. The calculation of positive and negative departure from the steady

population line based on the difference between the original mean number of the mite species on mango cultivar and the general mean (XUZ). The departure from the general mean of mite clarified the different susceptibility of mango cultivar towards harmful mite infestation.

Chemical control:

An area (half-acre) of the same abandoned Alphonso mango trees, with a history of tetranychid mite infestations was selected. Abamectin (Vertimec 1.8% EC at the rate of 27 oz., 764 g/ha), Mancozeb (Diathane M-45 at the rate of 169 oz., 4775 g/ha), Chlorfenapyr (Chalenger 36% Sc at the rate of 34 oz., 955 g/ha), Sulphur (Micronized sulphur 99.8% at the rate of 169 oz., 4775 g/ha), Sulphur + Mancozeb (4775 g + 4775 g/ha), Spinosad (Tracer 24% Sc at the rate of 34 oz., 955 g/ha), Azadirachtin (Achook at the rate of 135 oz., 3820 g/ha) and Methoxyfenozide (Runner 24% Sc at the rate of 68 oz., 1910 g/ha) were applied. Treatments were carried out when tetranychid populations started to increase (3mites/leaf). Each treatment was replicated four times and every replicate consisted of two mango trees. Treated and untreated replicates were represented, each by 25 leaves. Pre-spray counts were made for all treatments to determine the initial distribution and density of the mites. Observations were made one, three days and eight weeks after treatments. Reduction percentage was estimated according to the formula of Hinderson and Tilton (1955). Pesticide treatments were applied with a conventional high pressure spray motor.

RESULTS AND DISCUSSION

The population dynamics of *O. mangiferus* and its predatory mites for a 2-year study on the mango trees (cvs. Alphonso and Hindi) and weather records are presented in Figs. 1 and 2.

The tetranychid mite *O. mangiferus* is the prominent acarine pest on the upper mango leaf surface preferring concave areas between veins and along the main ribs, but may attack both sides of the leaf at high infestation. The succulent red young leaves, may also be affected (deformed). The damage caused by this mite started as pale stipples on the upper leaf surface. Thereafter, these patches darken, until the whole leaf eventually becomes reddish or bronzed and falls off. In the meantime, mites spin webs forming a sheet over the leaf surface which become full of dust.

The mite infests Alphonso and Hindi cultivars; but the first being nearly more susceptible. In 1966, Osman mentioned that the mite was high on Timour, moderate on Hindi, low on Romance and lacking on Zebda. Two annual peaks of seasonal abundance on Hindi and Alphonso cultivars occurred in August (summer) and November (fall), as well as in August and October (fall) of the two study years, respectively. During these annual peaks, the mean of mite population recorded 20 & 16 and 11 & 10 as well as 23 & 18 and 15 & 12 individuals per leaf when temperature and relative humidity ranged between 21°C & 32°C and 55% & 64%; respectively. The population was positively correlated with prevailing temperature for the two successive seasons, while no significant correlation was noted with the relative humidity (Table 1).

Pruning of infested blossoms and leaves in June or July removes many of the old infested leaves and consequently decreases infestation.

About 16 & 14 generations of *O. mangiferus* were recorded on Alphonso and 14 & 15 on Hindi in the two successive years (Figs. 3 and 4). The longest generations were throughout the late fall and winter and lasted for about 4 and 5 weeks, while the short generations occurred in spring and summer and lasted for about two weeks intervals for both cultivars during the two successive years.

The numerical changes in vertical distribution of *O. mangiferus* on Alphonso and Hindi mango trees for the two successive years are shown in Figs. 5 and 6. Tracing the population trend at the three levels, it was found that its peak mostly occurred during August, then declined in September. Its density exhibited a gradual increase and decrease throughout summer and winter and still remained at a noxious level during these intervals. In the meantime upper leaf surface of both mango cultivars had significantly more density of mite species in comparison to the lower leaf surface at the three vertical levels. The data indicated that the top leaves were preferable to the mite infestation and considered useful for sampling mite population to evolve suitable strategies for the application of chemical control.

Table (1): Correlation coefficient between temperature, relative humidity and *Oligonychus mangiferus* population in abandoned Hindi and Alphonso mango orcards

Correlation coefficient values							
Hindi leaves				Alphonso leaves			
1st season		2nd season		1st season		2nd season	
Temperature	R.H.	Temperature	R.H.	Temperature	R.H.	Temperature	R.H.
0.633**	-0.166	0.624**	-0.243	0.621**	-0.2[illegible]	0.3[illegible]0	-0.275

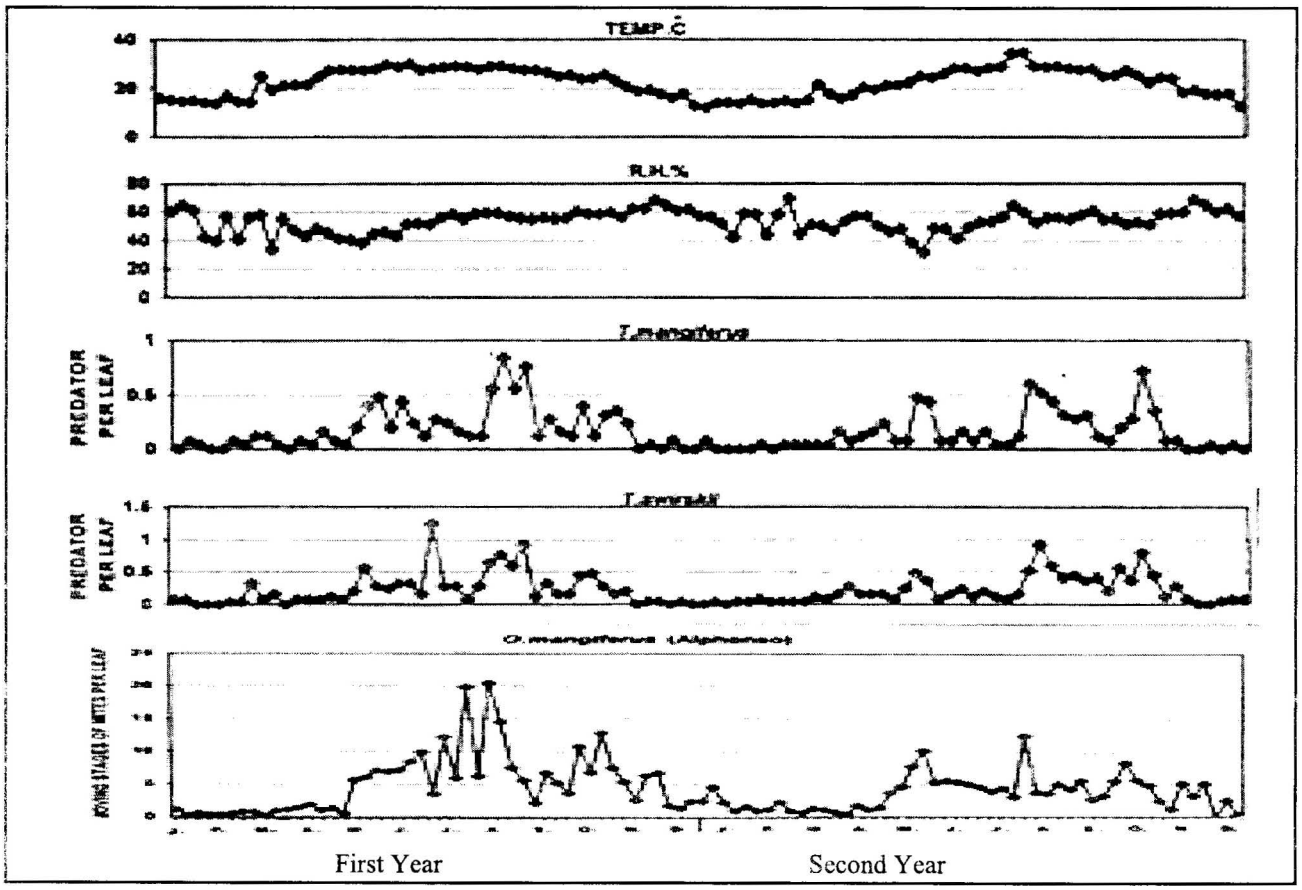

Fig. (1): Population density of the red spider mite, *O. mangiferus* and their phytoseiid predators on Alphonso mango leaves in abandoned orchard.

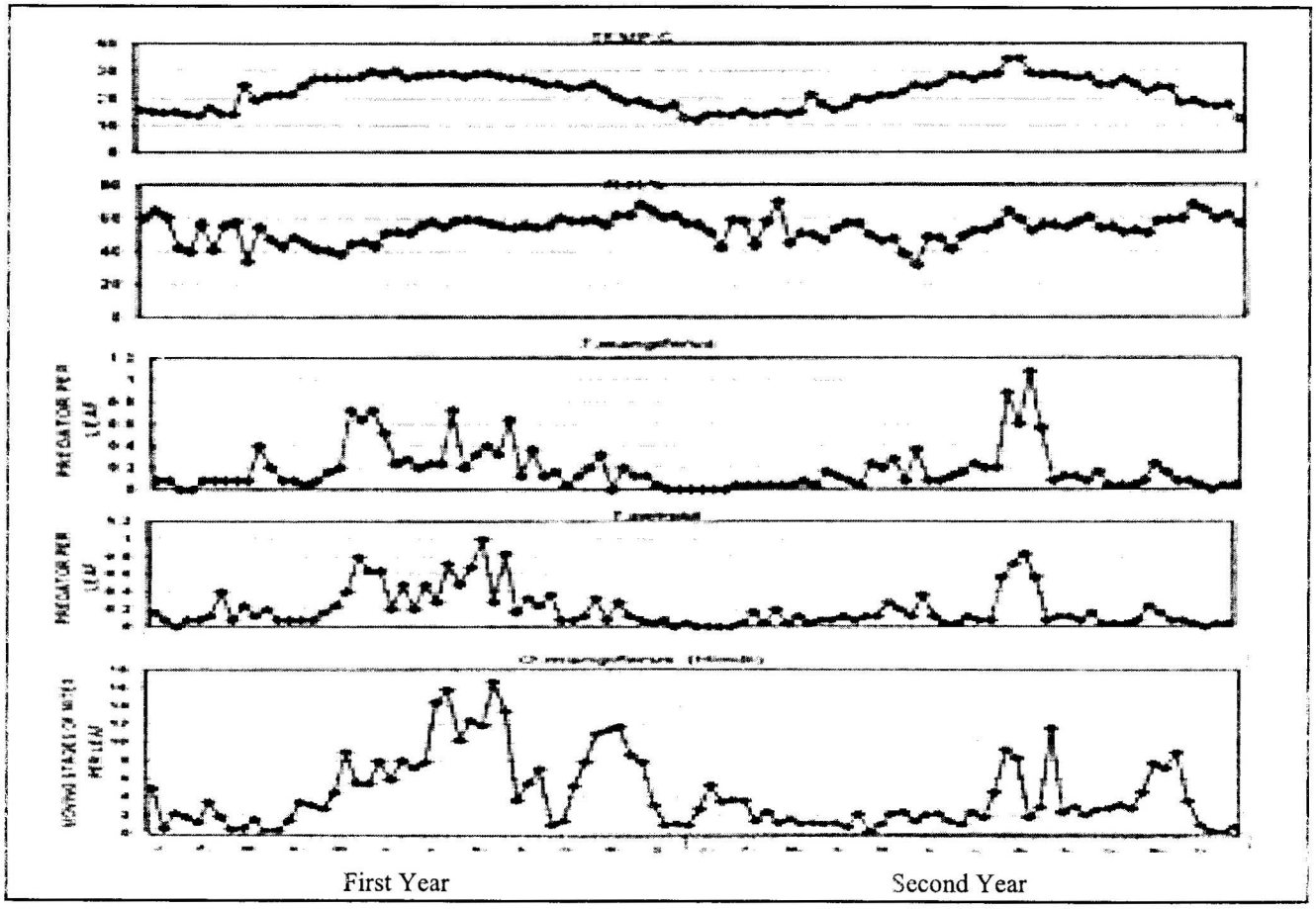

Fig. (2): Population density of the red spider mite, *O. mangiferus* and their phytoseiid predators on Hindi mango leaves in abandoned orchard.

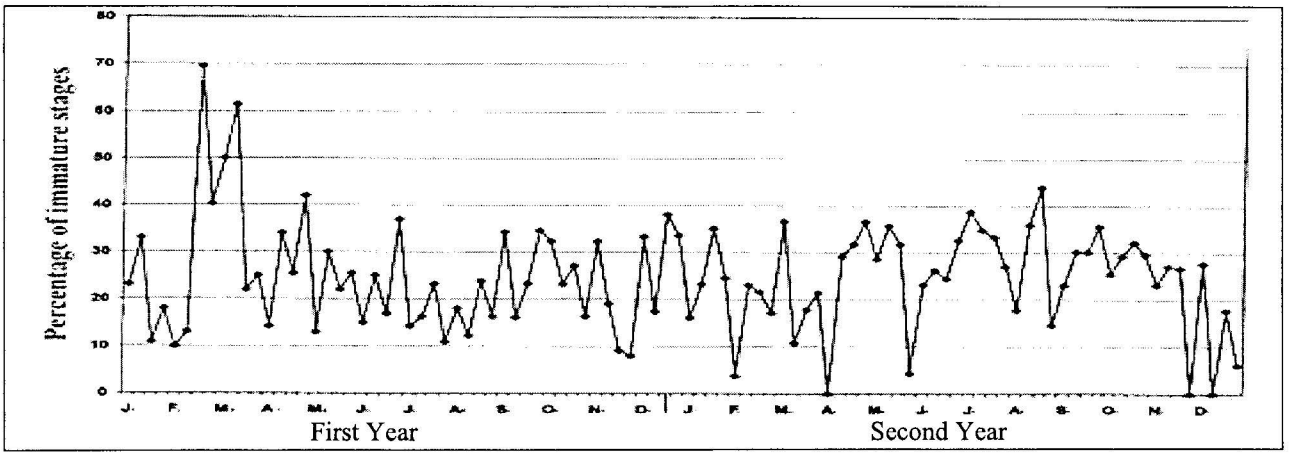

Fig. (3): Percentage of immature stages of the red spider mite, *O. mangiferus* on Alphonso mango in abandoned orchard.

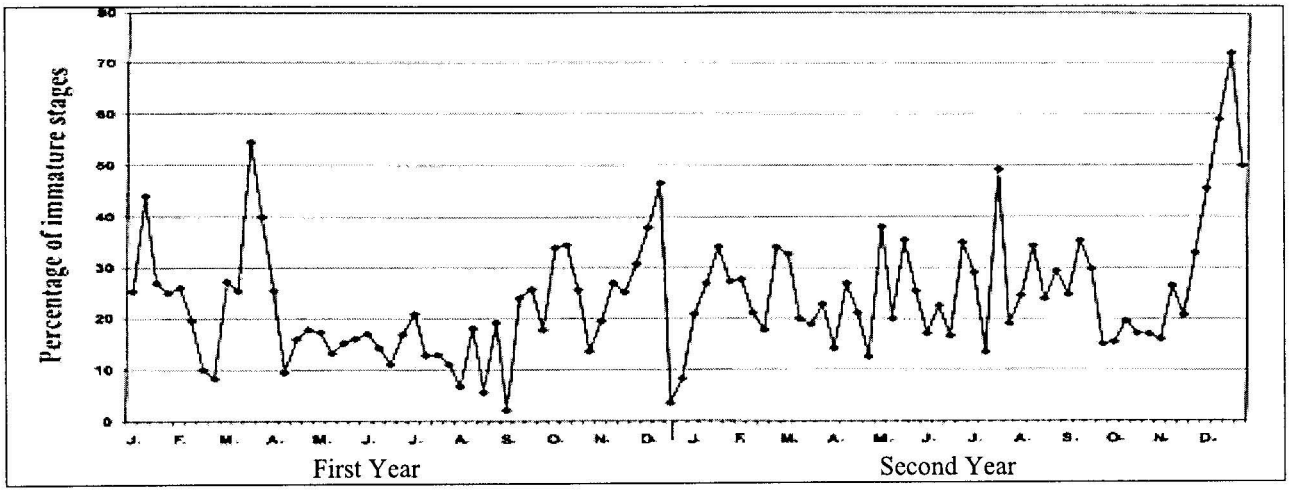

Fig. (4): Percentage of immature stages of the red spider mite, *O. mangiferus* on Hindi mango in abandoned orchard.

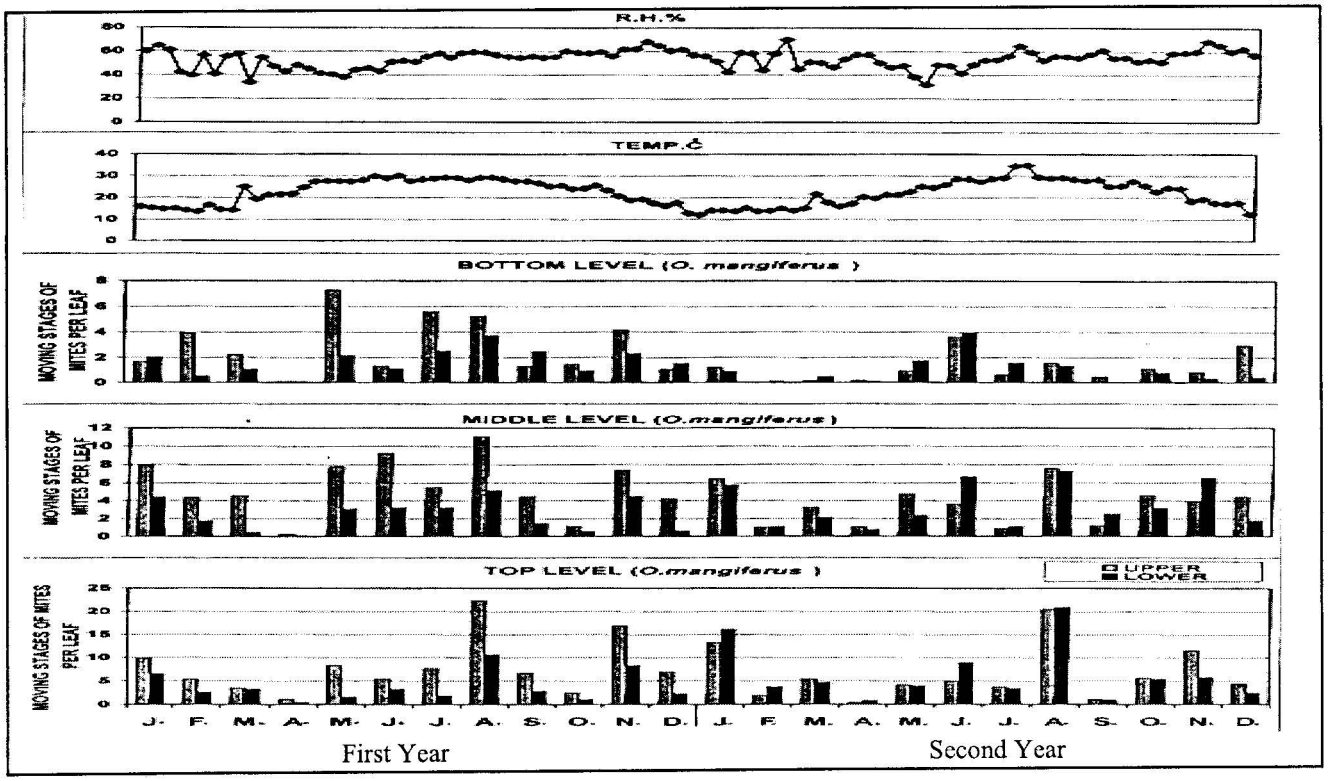

Fig. (5): Population trends of the red spider mite, *O. mangiferus* on Alphonso mango leaves in abandoned orchard from January to December and weather records.

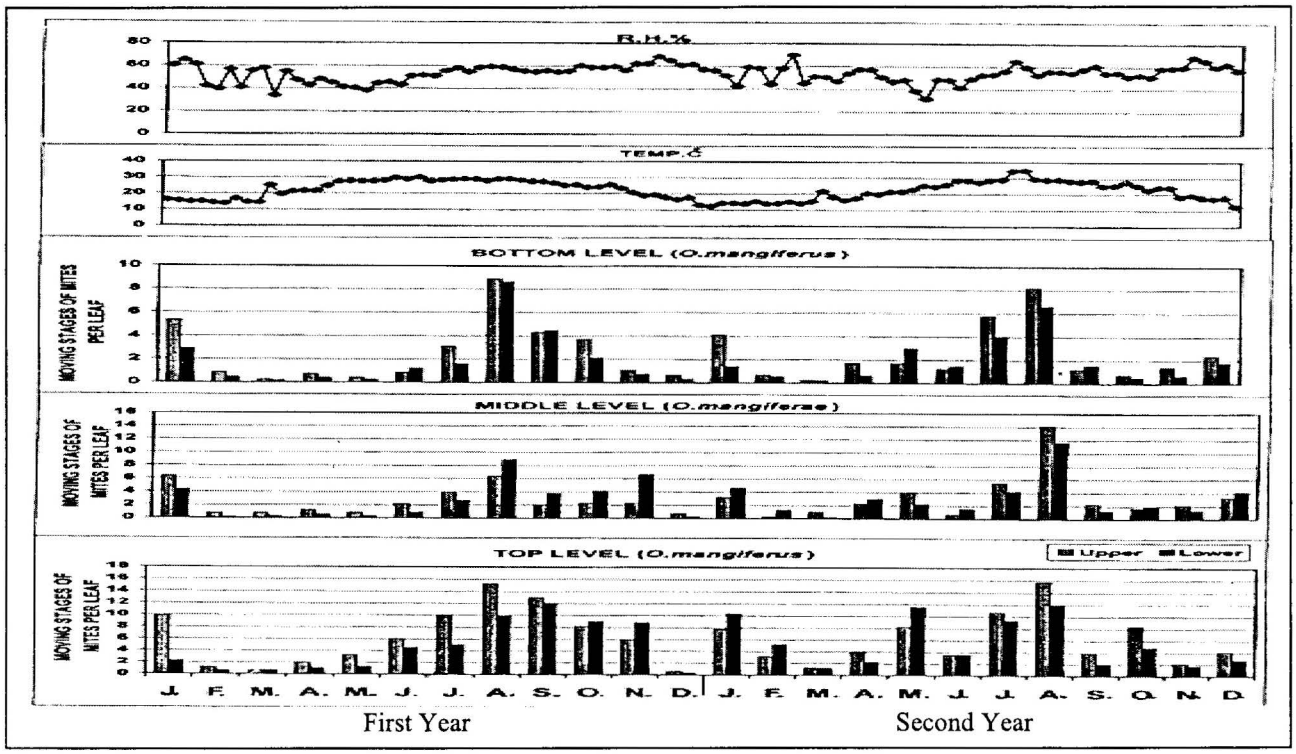

Fig. (6): Population trends of the red spider mite, *O. mangiferus* on Hindi mango leaves in abandoned orchard from January to December and weather records.

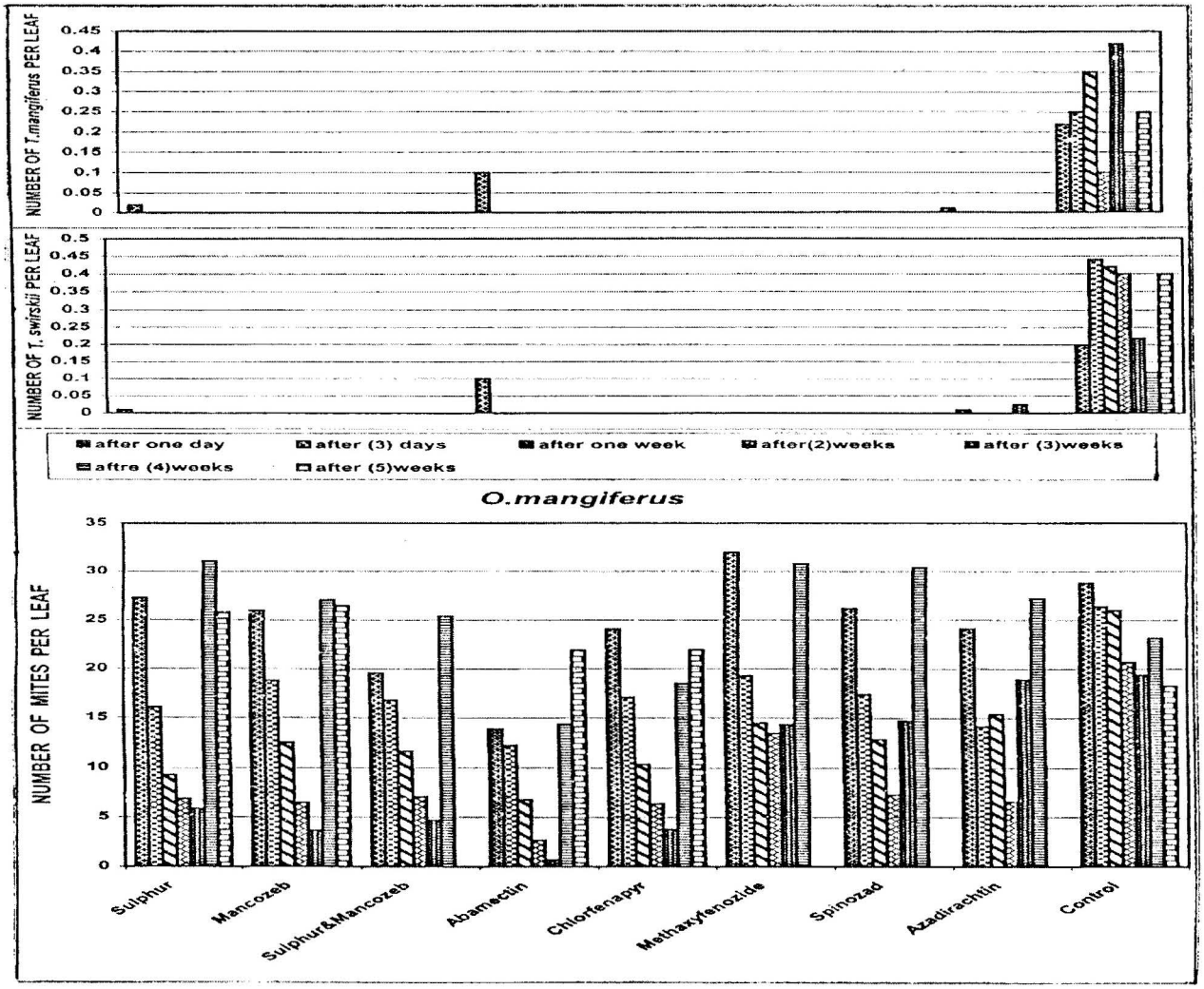

Fig. (7): Number of the red spider mite, *O. mangiferus* and their phytoseiid predators in treated Alphonso mango trees.

It is important to measure the degree of harmful mite *O. mangiferus* fluctuations on Alphonso and Hindi mango cultivars with regard to the equilibrium position of mites. Data indicated that the equilibrium position (steady point) during the two successive years was 4.26 individuals of the red spider mite per leaf. It was also noted that the two mango cultivars differed in their susceptibility to the mite species. Alphonso leaves were found to harbour number of mites above the steady point, represented by the positive departure of 0.02 individuals per leaf; while less number of mites was noted on Hindi cultivar below the steady point by the negative departure of -0.03 (Table 2), which proved to be the least attractive for the mite. Thus, Alphonso mango trees were more susceptible to *O. mangiferus* infestation compared with Hindi cultivar. Similar result was reported by Wahba *et. al.,* (1986) and Abdallah (2001).

Predacious mites:

It was of interest to study the population dynamics of phytoseiid predators during two successive years. The general trends in the occurrence and the abundance of the predatory mites *Typhlodromips swirskii* (Athias-Henriot) and *T. mangiferus* are given in Figs. 1 and 2. *T. swirskii* was the most predominant in Alphonso orchard and was found in 85% of leaf samples having predators.

T. mangiferus was the second in abundance forming 81% of the total samples. Their population density started to increase in May then fluctuated till reached a peak in August, then tailed off in December. The predators populations positively correlated with that of *O. mangiferus.* Their densities averaged from 0.3 to 1.2 individuals per leaf. These results clearly indicated that *T. swirskii* and *T. mangiferus* seemed to be important in biological control of tetranychid mites infesting mango trees in Egypt.

Pesticides applications:

The present study revealed that the predatory phytoseiid mites were rarely noted after budding in February ,and ineffective in reducing the population of the mango red mite below the economic injury level. Thus, one winter application of acaricides was effective to control *O. mangiferus* throughout the whole year when applied as mite population started to increase (Figs. 1 and 2). This allowed for a longest biological control role.

Table 3 shows the effect of some pesticides on the tetranychid mango mite during the season. The results indicated that application of Abamectin resulted in a promising control as it caused a reduction of 96.70% in pest population during the 35 days period after application, followed by Mancozeb (86%), then Chlorfenapyr (82.96%). Sulphur, Sulphur + Mancozeb, Spinosad and Azadirachtin were less effective (71.5-77.6%); while Methoxyfenozide was ineffective (50.70% reduction), and therefore appeared to have a limited role in field control. Similar effects of Abamectin against phytophagous mites were found on olive and mango trees in Egypt (Abou-Awad *et al.,* 2000 & 2009).

Table (2): Mean number, steady point and departure of the red spider mite *Oligonichus mangiferus* per leaf infesting Hindi and Alphonso mango leaves during two successive years in abandoned orchard

Mango cultivar	Mean no. of tetranychid/leaf	Steady point	Departure
Hindi	4.23		-0.03
Alphonso	4.28	4.26	0.02

Table (3): Pesticides effect on the red spider mite *Oligonichus mangiferus* within 35 days after application

Pesticides	Concentration (%)	Number of mites per leaf		
		Pre-spray count	Average post-spray count*	Reduction %)**
Abamectin	0.04	6.90	0.17	96.7[a]
Mancozeb	0.25	8.42	0.92	86.0[b]
Chlorfenapyr	0.05	7.07	0.95	82.9[b]
Sulphur	0.25	8.37	1.45	77.6[c]
Sulphur + Mancozeb	0.25+0.25	6.57	1.17	77.2[c]
Spinosad	0.05	7.85	1.82	72.2[d]
Azadirachtin	0.20	6.92	1.65	71.5[d]
Methoxyfenozide	0.10	8.17	3.37	50.7[e]
Control	-	6.17	4.85	-

*Counts made 1, 3 days and 5 weeks post treatment.

Different letters in vertical column denote significant difference (F-test, $P<0.05$, $P<0.01$).

REFERENCES

Abbassy, M. R.; Ibrahim, G. A. and Abdalla, A. A. M. 2008. Biological studies on the mango red mite, *Oligonychus mangiferus* (R. & S.) (Tetranychidae: Acarina) when fed on different mango leaves varieties. Egypt J. Agric. Res., 86: 921-930.

Abdallah, A. A. M. 2001. Studies on mites infesting mango trees. Agric. Zoology and Nematology Dept., Fac. Agric., Al-Azhar Univ., M. Sc. Thesis, 154pp.

Abou-Awad, B. A.; Metwally, A. M. and Al-Azzazy, M. M. 2009. Ecological, biological and control studies on the leaf coating and webbing mite *Cisaberoptus kenyae* Keifer (Eriophyoidea: Eriophyidae) in Egypt. Acarines, 3: 65-71.

Abou-Awad, B. A.; El-Sawaf, B. M., Reda, A. S and Abdel-khalek, A. A. 2000. Environmental management and biological aspects of two eriophyoid fig mites in Egypt: *Aceria ficus* and *Rhyncaphytoptus ficifoliae*. Acarologia, 40: 419-429.

Baker, E. W. and Pritchard, A. E. 1960. The tetranychid mites of Africa. Hilgardia, 24: 455-574.

Gerson, U. 1986. The spider mite *Oligonychus mangiferus* found on mango in Israel. Phytoparasitica, 14: 148.

Henderson, C. F. and Tilton, E. W. 1955. Test with acaricides against the brown wheat mite. J. Econ. Entomol., 48: 157-161.

Mansour, M. H.; Ahmed, S. H.; Salem, N. Y. and Ramadan, A. R. 2000. Evaluation of the susceptibility of different corn varieties towards aphid *Rhopalasiphum maidis* (Fitch) infestation. Bull. Ent. Soc. Egypt, 78: 205-216.

Osman, A. A. 1966. Ecological studies on mites of mango trees and the control of phytophagous mites. Agric. Zoology and Nematology Dept., Fac. Agric., Cairo Univ. M. Sc. Thesis, 86pp.

Sayed, M. T. 1946. Contribution to the knowledge of the Acarina of Egypt. V. Five new species of Tetranychidae. Bull. Soc. Fouad 1st Entom., 30:79-98.

Wahba, M. F.; El-Enany, M. A. M. and Farrag, A. M. I. 1986. Five mango varieties as affected by malformation phenomenon and bud mite infestation in Egypt. Agric. Res. Rev., 61: 193-201.

Zaher, M. A. and Shehata, K. K. 1971. Biology of the red spider mite *Oligonychus mangiferus* (R. & S.) (Acarina: Tetranychidae). Bull. Soc. ent. Egypt, 55: 393-401.

Zaman, Z. and Maiti, B. 1994. Insects and mites infesting seedling of mango in West Bengal. Environ. & Ecol., 12-13: 734-736.