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RELEASE OF THE PREDATORY MITES *PHYTOSEIULUS persimilis* ATHIAS-HENRIOT AND *NEOSEIULUS californicus* MCGREGOR TO CONTROL THE TWO-SPOTTED SPIDER MITE *TETRANYCHUS urticae* KOCH INFESTING CUCUMBER AND ROSE IN PLASTICHOUSES IN EGYPT

[53]

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ABSTRACT

Utilization of the predatory mites *Neoseiulus californicus* McGregor and *Phytoseiulus persimilis* Athias-Henroit for biocontrol of the two spotted spider mite *Tetranychus urticae* Koch in unheated plastic houses was studied in Egypt. This experiment was carried out in three plastic houses cultivated with cucumber plants. Average damage classes of patches per cucumber plant infested *T. urticae* were 0.05 - 0.40, 0.05-0.85 and 0.06-0.75 by using *N. californicus, P. persimilis* and Ortis acaricide, respectively. Such promising results encouraged introduction of *N. californicus* in a commercial green house planted with ten exotic cultivars of rose bushes. One year later, *N. californicus* spread in the entire greenhouse and suppressed successfully population of *T. urticae.*

Keywords: Phytoseiidae, Tetranychidae, Plastic houses, Bio-control, Chemical control

INTRODUCTION

Cucumber, rose and carnation are recently grown in Egypt in commercial plastic houses, which provide suitable environments for classical bio-control programs. Because of the aesthetic injury to ornamental crops, they have a lower pest economic threshold compared with vegetable and field crops. The two-spotted spider mite, *Tetranychus urtica* Koch may be the best candidate for biological control on rose in greenhouses than other insect pests e.g. the peach aphid *Mysus persicae* (Sulzer), the white fly *Bemesia tabaci* Gennadius, thrips *Thrips tabaci* Lindeman and the leaf miner *Agromyza phaseoli* Coqillet. This is attributed to that *T. urtica* is preyed upon by several natural enemies that have a high predacious capacity **McMurtry *et al* (1970)**. In addition, ornamental plant pests are generally controlled by chemical means, which develop resistant strains of natural enemies of spider mites (**Croft *et al* 1976; Schulten, 1976; Hoy, 1985**).

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Moreover, *T. urtica* is the least mobile as a wind born pest, and therefore its dispersion and distribution are patchy in greenhouses with reduced air movement. There are several physical and biological factors as temperature and humidity tolerance, pesticide resistance, searching and predacious capability, prey requirements and dispersal, which gauge the economic regulation of *T. urticae by* using predatory mites or insects (**Field and Hoy, 1986**). Phytoseiidae mites, thrips *Scolothrips sp.* and beetle *Stethorus sp.* are mainly concerned for bio-control of *T. urticae* and their permanent establishment in greenhouses is adequately judged by the above mentioned factors.

Egypt as a subtropical country is always favorable for the presence of *T. urticae*, which has no diapause and reproduces throughout the year. The hot and dry climate in plastic tunnels is the main constraints in using predatory mites for bio-control of *T. urticae*. **McMurtry (1977)** and **Castagnoli and Simoni (1991 and 1994)** ascertained adaptability of *Neoseiulus californicus* McGregor to high temperatures and low levels of relative humidity.

The present investigation aimed to evaluate the potential efficiency of *Phytoseiulus persimilis* Athies-Henriot and *N. californicus* as natural enemies of *T. urticae* infesting cucumber and rose under plastic tunnels.

MATERIAL AND METHODS

Predatory mite stock cultures

Neoseiulus californicus colony used in this study originated from a culture which was collected from an apple orchard in southern France and maintained in the National Research Center laboratory since 1996, (Dr. G. Fuvel, INRA and A. El-laithy, personal communication). Colonies of the predatory mites *P. persimilis* and *N. californicus* were reared in large plastic boxes (260 x 150 x 100 mm) with a tangle foot strip around the edge in the inner side to prevent mites from escaping and a water barrier for additional protection. Bean leaves highly infested with the prey *T. urticae* were provided as needed. Temperature in the rearing incubator was 28 ± 2°C, and the relative humidity ranged from 50-60 %.

Cucumber experiments

The present experiments were designed almost similar to those mentioned by **El-laithy (1996)**, but herein location was a private farm in Tahrir province with sandy soil. Three plastic houses (9 m. W., 50 m.L. and 3 m.H.) were planted with cucumber, *Cucumis sativa* L. cv. Magdy. Plants were spaced 0.4 m. in six rows of 240 plant/row. Transplanting occurred from 19 to 30 November. Two plastic houses were respectively devoted to the release of *P. persimilis* and *N. californicus*, while a third one (3) was kept as a check in which acaricide was applied against *T. urticae*. Acaricidal spraying was carried out using Ortis 5% Sc at the rate of 0.5 ml/L for five times based on *T. urticae* population build up on February 14, 21, March 7, 14 and April 5.

P. persimilis and *N. californicus* were released, each in a plastichouse, three times along the growing season with a total of ten thousand individuals. The first release was in January 31 followed by two releases at four week interval i.e. end of February and March, respectively. Bean leaves having predatory mites (about 10 individual/trifoliate were distributed in the vicinity of mite damages. Relative humidity was increased in the biological control houses using two overhead sprinklers, which were built on each side 2.25 m. height adjacent to the plastic cover to minimize direct wetting of leaves. Diffusion of water occurred daily, 3 minutes/ hour, from 10 a .m. to 4 p.m. in order to keep the average relative humidity about 50 ± 10%. Also, rate of plant watering was slightly increased in this time to increase relative humidity. The average damage class was weekly checked on 20 excised cucumber leaves randomly sampled from the plastic house. Damaged classes recorded in the current study are derived from those proposed by **Hussey and Scopes (1977)**, they propose six classes 0, 1, 2, 3, 4, 5 (each number was divided by 5 referring to the feeding patches of the leaf) and the corresponding mite intensity were 0, 3, 12, 107, 228, 592 individuals/ sq. in. Another evaluation was carried out on 20 cucumber plants randomly nominated and marked. The average damage class of the entire plant was weekly evaluated. Damage class due to infestation patches of *T. urticae* varied ascendingly from 0.1 to 0.9.

II -Rose experiment

This experiment was conducted in a commercial farm cultivated with ten exotic rose cultivars, i.e. First Red, Red Velvet; Dallas; Orange cv.; Tennessee; Yellow cv.; Cocktail and Texas; White cv.; White Texas and Anna at the Qalubiya Governorate. Two plastic houses, each with an area of 225 m^2 were planted with Anna cv., and isolated from other houses by using plastic sheets on all sides. Also, they were far enough from each other to assure complete separation of mite communities. The multi-span house is semicircular in its cross section (5.5 m. high) with a basal stand of stones (1m. high) along the sides and it's top was covered with plastic sheets. It had an area of 225$m.^2$ and contained four planted hedges, each of two rows 40 cm. apart with 30 cm. between plants along the row. Water was supplied by an under bush spray system. A heating system was constructed to keep the daily temperature 18-25 ±3°C. *N. Californicus* was introduced in one house on February 28 and March, 20/1997. A total of 10,000 mites were distributed in two releases on infested leaves every 1 meter. *T. urticae* population in the second house was controlled by using Vertemic, which was sprayed every three weeks around the year at the rate of 0.5 ml/L (1.8% Abamectin). The bio-control greenhouse and chemical control greenhouse were coded GH 52 and GH 22, respectively. To estimate the population density of the pests, 25 random compound leaves from each multi-span house were weekly taken from the maintenance section (lower leaves) of rose plants. The upper level of leaves (production section), were not sampled, because they are present on harvested stems. Samples were transported in ice boxes to the laboratory, where they were examined using a stereomicroscope and numbers of mobile and resting mites as well as eggs were recorded. Sampling in both multi-span houses began in mid February 1997 until the first week of January 1998.

RESULTS AND DISCUSSION

I- Cucumber experiments

Results illustrated in Fig. (1) show the damaged class of cucumber leaf in the experimental plastic houses. Both of the

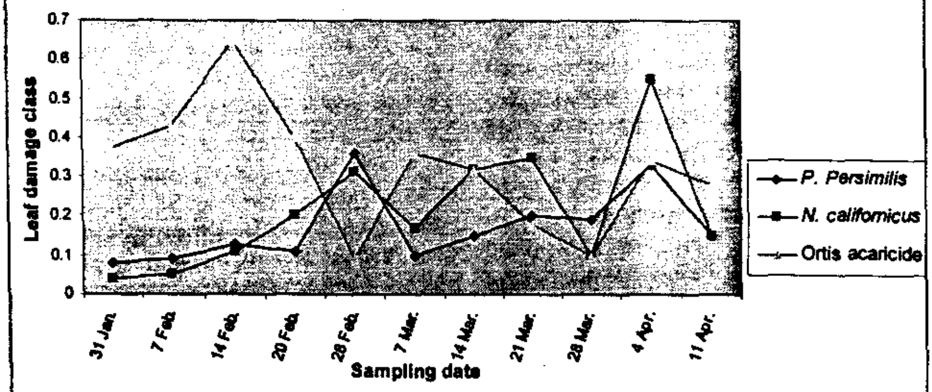

Fig. (1). Leaf damage class of cucumber in three plastichouses in which *P. persimilis* (1), *N. californicus* (2) and Ortis acaricide (3) were used, respectively.

predatory mites *P. persimilis* and *N. californicus* succeeded to suppress damage to a lower level of 0.1-0.4 compared to 0.1-0.7 for the plastic house (3), in which Ortis acaricide was applied five times during the experiment. The obtained average damage classes are near to those mentioned by **Hussey and Scopes** (1977). Fig. (2) summarizes the average damaged classes in marked cucumber plants along the experimental time. It shows a higher predacious capacity for *N. californicus* than *P. persimilis*. Damage classes for both species were 0.02-0.33 and 0.02-0.81, respectively. In the presence of *P. persimilis*, *T. urticae* population increased from early March until early April because of the high temperature which occurred in this period and required an acaricidal application. Such difference in the activity between the two predatory species may reflect the greater tolerance of *N. californicus* to dry and hot climate than as mentioned by **McMurtry** (1977). Average of cucumber yield in plastic houses 1, 2 and 3 were 2888.6, 3394.2 and 2876.7 kg., respectively. This shows that release of *N. californicus* increased the yield about 19% more than using Ortis, whilst for *P. persimilis* the yield was almost similar.

II- Rose experiment

As shown in Fig. (3) the population of *T. urticae* in GH 52 was suppressed for more than two years without re-introduction of predators or integration with miticides. However, *T. urticae* increased substantially as temperature increased in March and April 1997. This increase required two successive applications with Vertemic to both the maintenance and production sections. The production section was only treated in order to protect the predatory population on the maintenance section. The population density of *T. urticae* per compound leaf

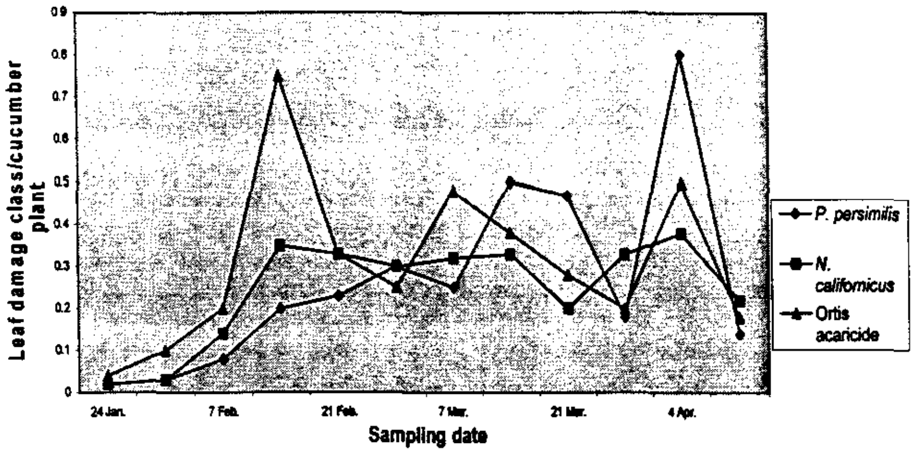

Fig. (2). Average damage class/entire cucumber plant infested with *T. urticae* in three plastichouses in which *P. persimilis* (1) *N. californicus* (2) and Ortis acaricide (3) were used, respectively

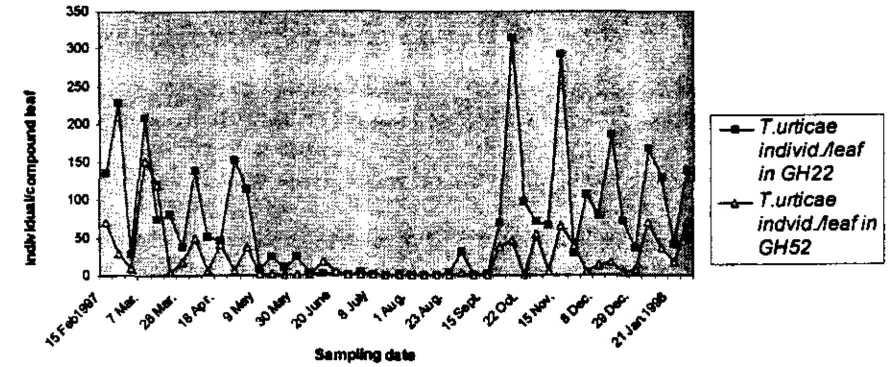

Fig. (3). Population dynamic of *T. urtica* on rose leaf in two greenhouses in which biological (GH52) and chemical (GH22) control were used, respictively.

during this period increased to 120 individuals then declined to 6.87 after Vertemic applications. Hence, population levels trailed off in early September, when they began to increase and reached 71.4 individuals per compound leaf in January. This population increased in winter months due to the heating system of the farm, which kept the average night temperature about 18°C. This condition encouraged a build up of mite population. The prey-predator ratio of *T. urticae* and *N. californicus* is presented in Fig. (4) reveals that the interaction between prey and predator was in favor of the predatory mite *N. californicus* which reached the highest density of 12.28 individuals per compound leaf in December 29 and the lowest values (ranged from 0.1- 0.3) were frequently recorded in September and October. In GH 22, in which Vertemic was used routinely at three week intervals, *T. urticae* population showed a high density that ranged from 38.6 to 228 individuals per compound leaf in the period from mid February until early May. However, levels were significantly reduced from May to September, when the population number began to rebuild up. It is obvious in GH 22 and 52 that *T. urticae* population dropped sharply during July and August 1997. This reflects the environmental conditions such as high relative humidity and intense use of sulfur against mildew diseases, which elicited adverse effect *T. urticae*. On the other hand, survival of *N. californicus* during this period was expected due to its higher capability to tolerate starvation as mentioned by **Palevsky *et al* (1999)**. The sharp decline in population of both *N. Californicus* and the red mite *Panonychus ulni* Koch during long term study was also demonstrated by **Monetti and Fernandez (1995)** in their four year study on apple orchards. It was also due to heavy applications of OP pesticides and Carbamated acaricides.

However, the present study reveal that the predatory mite *N. californicus* was noted throughout all rose beds in the multi-span house and had spread to the plastic houses. The predatory mite overcame *T. urticae* as shown in Fig. (5). It was worth mentioning that leaf samples examined during February 2000 show that the majority of beds were free of *T. urticae*. No further spraying against *T. urticae* was required in the plastic house and an efficient pest control was maintained for the whole year. During April 2001, few plastic house units were highly infested with the cotton leaf worm, *Spodoptera littoralis* Boisduval and Lannate was intensivly sprayed at one week intervals. After removal of highly infested leaves *N. californicus* was only released at hot spots and the pest control was noted. In December 2001, the prey-predator ratio in glasshouse units favored the predatory mites. Similar results were obtained with *P. persimilis* used in greenhouse rose (**Simmonds, 1972; Gough, 1991**). However, release of the Carbaryl resistant strain of *Metaseiulus occidentalis* Nesbitt in glasshouse rose did not lead to a successful control of *T. urticae* (**Field and Hoy, 1986**). Failure of *M. occidentalis* in suppression of *T. urticae* population was attributed to diapausing of the predatory females in late autumn and winter (**Field and Hoy, 1986**). Ultimately, the present experiment reveals that introduction of *N. californicus* on one bed of greenhouse rose (multi-span unit) led to its spread on 34 surrounding beds after one year. There are also two additional advantages of *N. californicus*,

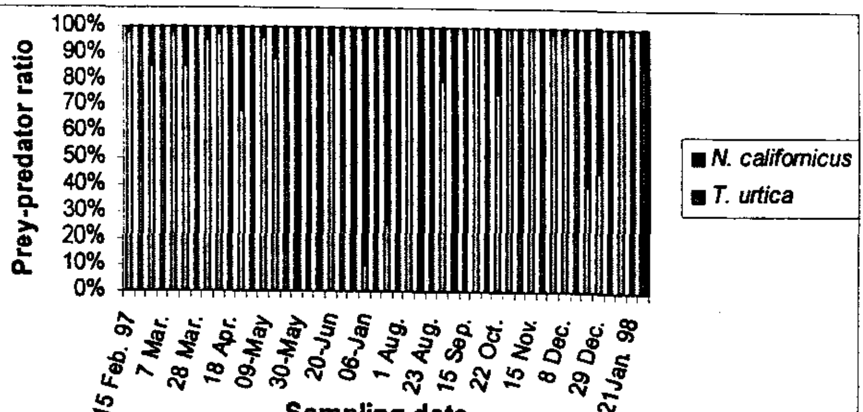

Fig. (4). Prey-predator ratio of *T. urtica* and *N. californicus* on rose leaf in GH52.

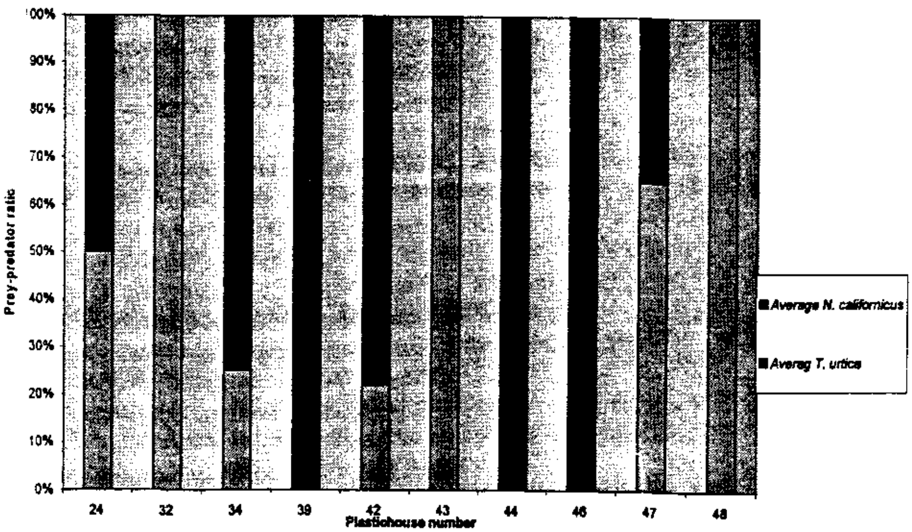

Fig. (5). Prey-predator ratio of *T. urtica* and *N. californicus* on ten rose cultivars two years after predator release in GH52 (Anna cv.)

i.e. its survival during frequent fungicide applications maintains a stable population of the prey *T. urticae* and it's tolerance to high temperature and drought that prevail in the Egyptian greenhouses. These results also confirm the findings of **Castagnoli and Simmon (1991 and 1994)**. However, **El-laithy (1992)** reported the susceptibility of *P. persimilis* to high temperature and dryness.

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مجلة حوليات العلوم الزراعية ، كلية الزراعة ، جامعة عين شمس ، القاهرة ، م٥٠ ، ع(٢)، ٧٥٩-٧٦٧ ، ٢٠٠٥

استخدام المفترسات فيتوسيلاس برسميلس ونيوسيللس كاليفورنيكس لمقاومة العنكبوت الاحمر تترانكس يورتكا الذي يصيب نباتات الورد والخيار في الصوب البلاستيكية بمصر

[٥٣]

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تمت دراسة المكافحة الحيوية للعنكبوت الاحمر تترانكس يورتكا الذي يصيب الخيار في الصوب البلاستيكية وذلك باستخدام الاكاروسات المختلفة المفترسات فيتوسيلاس برسميلس ونيوسيللس كاليفورنيكس في ثلاث صوب وقد كانت نتائج الدراسة ايجابية حيث لوحظ ان تعداد العنكبوت الاحمر في الصوب التي تم اطلاق المفترسات بها اقل منها في الصوب التي تم علاجها بالمبيد الاكاروسي اورتس.

كذلك تمت دراسة المكافحة البيولوجية للعنكبوت الاحمر الذي يصيب الزهور في احدى الصوب البلاستيكية حيث أمكن السيطرة على تعداد العنكبوت الاحمر باستخدام المفترس نيوسيللس كانيفورنيكس.

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