

INFLUENCE OF PLANT TEXTURE ON THE FEEDING CAPACITY AND FECUNDITY OF THE PREDATORY MITE *Phytoseiulus persimilis* (A. – H.).

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ABSTRACT

Feeding capacity and fecundity of the predatory mite *Phytoseiulus persimilis* fed on nymphal stages of the two – spotted spider mites were highly affected by the plant texture and rearing substrates. The predatory mite individually attacked more preys on bean leaves. The feeding capacity during 10 days in the oviposition period was declined gradually on apple, fig, cotton and mango with an average of 16.37, 15.92, 10.28, 9.95 and 8.97 prey individuals/day, respectively. The statistical analysis proved that there were no significant differences between the values of prey consumption of *P. persimilis* on either bean and apple leaves or fig and cotton leaves, in spite of the differences in morphological characters between the aforementioned plants and the others are significant. Therefore, it can be concluded that both bean and apple leaves are more suitable substrates to rear and maintain *P. persimilis*. Also, egg deposition was significantly decreased when maintained on cucumber and squash leaves. The lowest rates of fecundity were obtained on mango and cotton leaves. Adult female of the predatory mite laid an average of 39.5, 37.3 and 36.1 eggs/10 days with daily rate of 3.95, 3.73 and 3.61 eggs / ♀ / day on bean, apple and fig leaves, respectively, compared to 31.5, 30.5, 25.6 and 25.1 eggs / ♀ on squash, cucumber, mango and cotton leaves, respectively.

Among structures differences on the surfaces of leaves not only the venation type and hair density but also the raised veins that play an important role on the number of deposited eggs of predator and its feeding capacity on prey.

P. persimilis attacked more prey and laid more eggs on smooth hairy leaves like those of bean and apple while cucumber, squash and cotton leaves are not suitable. Therefore, bean leaves are recommended to maintain *P. persimilis* cultures for biological control purposes.

INTRODUCTION

Few studies done on the Influence of Plant Texture on the Consumption and Fecundity of *Phytoseiulus persimilis* (A. – H.). Raised viens, dense hairs, tunneled margins and cave – like structures in the vein axils which called domatia, These structures affect searching, feeding, mating, oviposition, hiding and other behaviours of *P. persimilis*. (Walter, 1996). Leaves with domatia often harbor more phytoseiids or greater densities of a species than leaves without domatia. Such shelters and leaf pubescence , may be as important as food for some phytoseiids (McMurtry and Croft, 1997). Moreover, Skrivin and Fenlon (2001) stated that the leaf morphology is considered to be one of the most important factor affecting predation rate and feeding capacity of *P. persimilis* which attacked more prey individuals on smooth hairy leaves. Therefore the present work aims to study

effect of different Plant Texture on the Consumption and Fecundity of *Phytoseiulus persimilis* (A. – H.)

MATERIALS AND METHODS

For studying the effect of plant texture on the feeding capacity and fecundity of *P. persimilis*, seven types of plant texture Bean *Phaseolus vulgaris* L., Apple *Malus Sylvesters* L., Fig *Ficus carica* L., Squash *Cucurbita pepo* L., Cucumber *Cucumis satirus* L., Mango *Mangifera indica* L. and Cotton *Gossypium barbadens* L. were used. From each one small plant leaf discs (1 inch each) were taken and kept on moist cotton pad in petri dishes (15cm in diameter). Pure culture of the predatory mite *P. persimilis* was obtained from IRC. Cairo, Egypt. Newly emerged females of the predator were divided into seven according to the previous host plants. Each group consist of ten leaf discs (1 inch each) of the particular host plant and each carry singly newly emerged female of the predatory mite. All groups were fed on nymphs of *Tetranychus urticae* Koch for 10 days at 25 ± 1 °C and 70 ± 5 % RH.. In all cases, consumed prey individuals were counted and replaced by alive ones daily. Egg deposition of the predatory mite females were recorded daily.

RESULTS AND DISCUSSION

Data obtained in Table (1) showed that feeding capacity and fecundity of *Phytoseiulus persimilis* fed on nymphal stages of the two – spotted spider mite *T. urticae* was highly affected by the plant texture and rearing substrates. The predatory mite individual attacked more prey nymphs on bean leaves and the feeding capacity during 10 days in the oviposition period was declined gradually on apple, fig, cotton and mango with an average of 16.37, 15.92, 10.28, 9.95 and 8.97 prey individuals / day, respectively (Table 1 and Fig. 1) The statistical analysis proved that there were no significant differences between the values of prey consumption of *P. persimilis* on either bean and apple leaves or fig and cotton leaves. Moreover, the differences between the aforementioned plants and the others are significant. Therefore, it can be concluded that both bean and apple leaves are more suitable substrates to rear and maintain *P. persimilis*.

These results agree with the finding of Fouly (1982) who found that *Euseius scutalis* (A. – H.) had a faster development and laid more eggs when it fed on *T. urticae* and kept on ficus leaves more than lantana camara leaves. Also, Rasmy (1990) found that cucumber leaves were inadequate as a rearing substrate for *Euseius scutalis* (A. – H.) but it was suitable for rearing *Phytoseius finitimus* Ribbaga. On the other hand, Skirvin and Williams (1999) stated that plant species had a significant effect on fecundity and movement of the prey *T. urticae* but no effect on the movement of *P. persimilis*. Phytoseiid mite species live mostly on leaf undersurface that have raised viens, dense hairs, tunneled margins and cave – like structures in the vein axils which called domatia.

Table (1) : Effect of plant texture on feeding capacity and fecundity of *Phytoseiulus persimilis* fed on nymphs of *Tetranychus urticae* (koch) at 25 °C and 70 ± 5 % RH. during 10 days

Plant	No. consumed prey nymphs / day (\bar{x})	No. deposited eggs	
		T	D
Bean	16.37 ± 0.41 a	39.5	3.95 ± 0.12 a
Apple	15.92 ± 0.18 a	37.3	3.73 ± 0.11 ab
Fig	10.28 ± 0.20 b	36.1	3.61 ± 0.11 b
Squash	5.91 ± 0.21 e	31.5	3.15 ± 0.14 c
Cucumber	6.70 ± 0.25 d	30.5	3.05 ± 0.12 c
Mango	8.97 ± 0.23 c	25.6	2.56 ± 0.08 d
Cotton	9.95 ± 0.34 b	25.1	2.51 ± 0.19 d

Means in each column by a different letter are significantly different, P < 0.05 by SAS, L.S.D test.

± SE : Standard errors.

T : Total No. of deposited egg / 10 days.

D : Daily rate of deposited egg / days.

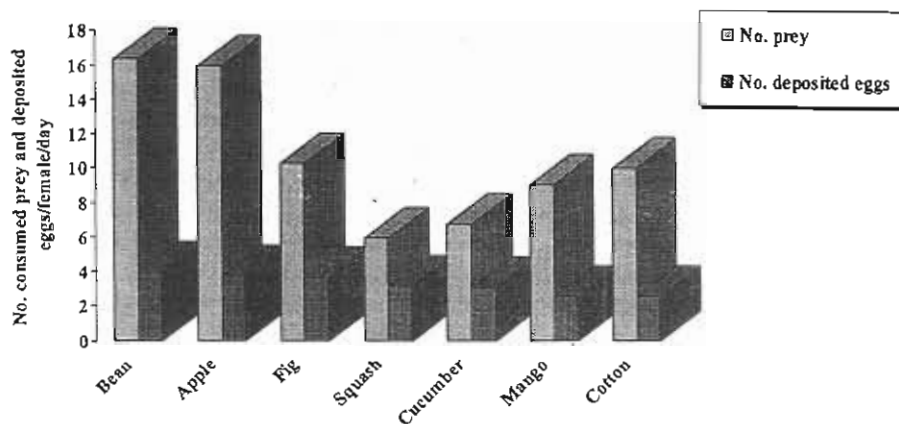


Fig 1 : Effect of plant surface on feeding capacity and fecundity of *Phytoseiulus persimilis* females fed on *Tetranychus urticae* nymphs for 10 days.

These structures affect searching, feeding, mating, oviposition, hiding and other behaviours of these arthropods (Walter, 1996). Leaves with domatia often harbor more phytoseiids or greater densities of a species than leaves without domatia. Such shelters and leaf pubescence , may be as important as food for some phytoseiids (McMurtry and Croft, 1997).

In general, data showed that there were some important parameters affecting the predatory mite searching behavior such as walking speed, walking activity, leaf characteristics, and prey density. The present results clearly indicated that walking speed and activity of *P. persimilis* had a

negative relationship where they declined when the predatory mite was reared on hairy leaves. Also, the time needed by the predator to find its prey increased when the hair density increased. That may be the reason why the feeding capacity of *P. persimilis* was lower on hairy leaves such as cucumber and squash while it was at its highest level on smooth or fine hairy leaves such as beans and apple. Similar results were previously obtained by Gillespie and Quiring (1994) who found that life span and reproduction of *P. persimilis* were lower on tomato leaves than on beans *Phaseolus vulgaris* and the feeding capacity was higher on beans than on tomato leaves.

Also, Garms *et al.* (1998) found that *P. persimilis* females needed a time to prey on *T. urticae* 4 to 10 times shorter when they were kept on lima bean *P. lunatus* than on gerbera leaves. Moreover, Skrivin and Fenlon (2001) stated that the leaf morphology is considered to be one of the most important factors affecting predation rate and feeding capacity for both predator and prey species. They found that *P. persimilis* attacked more prey individuals on smooth hairy leaves.

Contradicting results were obtained by Kreiter *et al.* (2002) who found that *Kampimodromus aberrans* (Oudemans) fed on tetranychid mites was highly influenced by plant texture and leaf domatia. The phytoseiid predatory mite was found to prefer leaves with pits or concentration of hairs as shelter.

Concerning the fecundity of *P. persimilis*, data in Table (1) showed that adult female preferred leaves of bean, apple and fig to lay its eggs and the egg deposition was significantly decreased when predatory mites were maintained on cucumber and squash leaves. The lowest rates of fecundity were obtained on mango and cotton leaves. Adult female laid an average of 39.5, 37.3 and 36.1 eggs / 10 days with daily rate of 3.95, 3.73 and 3.61 eggs / ♀ / day on bean, apple and fig leaves, respectively. These values significantly decreased to an average of 3.15, 3.05, 2.56 and 2.51 eggs / ♀ / day when adult females of *P. persimilis* was kept with its prey on squash, cucumber, mango and cotton leaves, respectively Table 1 and Fig. 1.

On the other hand, a comparison leaves surfaces structure might give some light on the relationship between leaves surfaces structure and number of deposited eggs and feeding capacity of *P. persimilis* on *T. urticae*.

Data in Table (1) showed that structure of the leaf surfaces strongly affect the number of deposited eggs and feeding capacity of *P. persimilis* on *T. urticae*. Among structures on the surfaces of leaves not only the venation type and hair density but also the raised veins play an important role in number of deposited eggs of predator and its feeding capacity on prey. It is clear from Fig. 2, the venation of all investigated plants was reticulate, some genera i. e. apple and mango has pinnate venation Fig. 2 and other plant genera i.e. Fig leaf has palmate venation Fig. 2. It is also shown that apple leaf surface characterized by more raised veins and covered with dense tufts and appressed hairs Fig. 2.

Summarizing the results in Table (2) the highest number of deposited eggs and predator feeding capacity on bean and apple leaves surfaces were correlated with high density of hairs and more raised veins. Moreover, the leaf surface of bean had shrunked leaf surface. These features might prove numerous hiding places as houses of predator. In this respect, Walter, (1996)

noted that, on the surface of leaves numerous hiding places formed by large, raised veins, dense covering of hairs, cave like structures in the vein axils are house of arthropods. While the leaf surface of squash as a moderate feeding capacity of *P. persimilis* had a lower number with acute tips of multiseriate hairs.

On the other hand, the lower number of deposited eggs and feeding capacity of *P. persimilis* on mango leaf surface correlated with thinner veins and smooth leaf surface.

Grevstad and Klepetka (1992) concluded that lower number of the four coccinellid predators on cabbage leaves surfaces have been correlated with smooth leaf surface. The obtained results confirmed simple relationship existing between the surface of investigated leaves and number of deposited eggs of predator as well as feeding capacity of *P. persimilis* on *T. urticae*.

Table (2): Relationship between leaf surface structure and number of deposited eggs and feeding capacity of *P. persimilis* on *T. urticae*.

Plant	No. of hairs per microscopic field (obj. x10. oc. x10)	Venation type	Hairs type	No. of deposited eggs per female / 10 days	Feeding capacity
Bean	40	Palmate	Uniseriate hairs	39.5	High
Apple	35	Pinnate	Uniseriate tufts hairs	37.3	High
Fig	30	Palmate	Uniseriate tufts hairs	36.1	Moderate
Squash	17	Palmate	Multiseriate hairs	31.5	Moderate
Cucumber	27	Palmate	Multiseriate hairs	30.5	Moderate
Mango	0	Pinnate	Without hairs	25.6	Low
Cotton	10	Palmate	Branched uniseriate hairs	25.1	Low

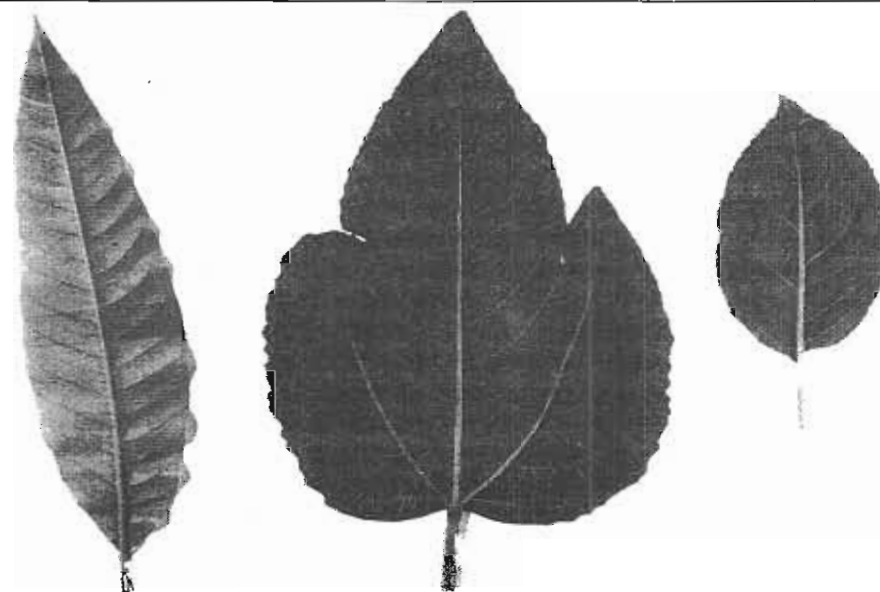


Fig. (2): Venation type in some investigated plants (obj. x 10. oc. x10).

From the previous results, it can be noticed that *P. persimilis* attacked more prey individuals and laid more eggs on smooth hairy leaves like bean and apple plant while cucumber, squash and cotton leaves were not suitable substrates to get high populations of the predatory mite. Therefore, it is highly recommended to use such plant leaves to maintain *P. persimilis* for biological control purposes. Similar results were obtained by Gillespie and Quiring (1994) who found that reproduction which is turned in high rates of fecundity of *P. persimilis* fed on *T. urticae* was obtained on bean leaves more than on tomato leaves.

In conclusion, many questions remain about adaptations of phytoseiid mites to plant attributes. For example, how does leaf structure allow some phytoseiid species to colonize on a plant while others not? Can two or more species cohabit a leaf by habitat portioning? If so, do some refuges minimize interspecific competition more than others? Answers to the aforementioned questions have implications for biological control.

Phytoseiid mites may show inconsistent control of pest mites but, in general, few studies have examined how host plant traits influence control (Walter, 1996).

REFERENCES

- Fouly, A. H. (1982). Studies on Phytoseiid mites. M. Sc. Thesis, Fac. Agric., Mansoura Univ., Egypt.
- Garms, L. M.; Krips, O. E.; Schutte, C. and Dicke, M. (1998). The ability of the predatory mite *Phytoseiulus persimilis* to find a prey colony: effect of host plant species and herbivore induced volatiles. Proceedings of the Section Experimental and Applied Entomology of the Netherlands Entomological Society. 9: 67-72.
- Gillespie, D. R. and Quiring, D. J. M. (1994). Reproduction and longevity of the predatory mite, *Phytoseiulus persimilis* (Acari: Phytoseiidae) and its prey, *Tetranychus urticae* (Acari: Tetranychidae) on different host plants. Journal of the Entomological Society of British Columbia. 91: 3-8.
- Grevstad, F.S. and Klepetka, B.W. (1992). The influence of plant architecture on the foraging efficiencies of a suite of ladybird beetles feeding on aphids. *Oecologia* 92(3): 399-404.
- Kreiter, S.; Tixier, M.-S.; Croft B. A.; Auger, P. AND Barret, D. (2002). Plants and Leaf Characteristics Influencing the Predaceous Mite *Kampimodromus aberrans* (Acari: Phytoseiidae) in Habitats Surrounding Vineyards. *Environ. Entomol.* 31(4): 648 – 660 (2002)
- McMurtry, J.A. and Croft, B.A. (1997). Life-styles of phytoseiid mites and their roles in biological control. *Annu. Rev. Entomol.* 42: 291-321.
- Rasmy, A. H.; Abdel-Rahman, H. A. and Hussein, H. E. (1990). Biology and efficiency of phytoseiid mites as affected by cucumber leaves. *Anzeiger fur Schadlings kunde, Pflanzenschutz, Umweltschutz.* 63: 6: 117 - 116

- Skirvin, D. and Williams, M. de C. (1999). The effect of plant species on the biology of *Tetranychus urticae* and *Phytoseiulus persimilis*. Bulletin OILB/SROP. International Organization for Biological and Integrated Control of Noxious Animals and Plants (OIBC/OILB), West Palaearctic Regional Section (WPRS/SROP), Dijon, France: 22: 1, 233-236.
- Walter D. E. (1996). Living on leaves: Mites, tomenta and leaf domatia. Annu. Rev. Entomol. 41, 101-114.

تأثير السطح النباتي على تغذية وكفاءة المفترس الأكاروسى *Phytoseiulus persimilis* فى وضع البيض.

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تمت دراسة تأثير السطح النباتي على تغذية وكفاءة المفترس الأكاروسى *Phytoseiulus persimilis* فى وضع البيض لمدة عشرة أيام وتغذيته على حوريات العنكبوت الأحمر *T. urticae* وقد تم استخدام سبعة أسطح نباتية وهى الفاصوليا - التفاح - المانجو - التين - الخيار - الكوسة - القطن وقد وجد أن أحسن هذه الأسطح من حيث التغذية ووضع البيض هو الفاصوليا حيث تغذى المفترس على ١٦,٣٧ حورية من العنكبوت الأحمر فى اليوم الواحد وأعطى ٣,٩٥ بيضة فى اليوم. وقد كان أقل هذه الأسطح من حيث التغذية هو الكوسة بمعدل تغذية ٥,٩١ حورية من العنكبوت الأحمر وأقل الأسطح التى تم وضع البيض عليها هى القطن حيث وضعت أنثى المفترس ٢,٥١ بيضة فى اليوم.

قام بتحكيم البحث

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