Benha Journal of Applied Sciences (BJAS) **print: ISSN 2356–9751**
Vol. (7) Issue (12) (2022), (1-6) **online: ISSN 2356–976x**
http://bjas.journals.ekb.eg

Biological aspects and consumption rate of the predatory mite, *Phytoseiulus persimilis* Athias - Henriot on *Tetranychus urticae* Koch (Acari:Phytoseiidae, Tetranychidae)

Asmaa M. Nagah[1]; S. A. Allam[2]; H.E. Abdelnabby[1]; Ghada R. Mohamed[1] and G.H. Rady[1]
[1]Plant Protection Dept, Fac. Agric. Benha University
[2]Plant Protection .Res. Institute. Agric. Res. Center, Dokki – Giza, Egypt
E-mail:asmaa.nagah@fagr.bu.edu.eg

ABSTRACT

This work was conducted to study the effect of different temperatures (20, 25 and 30°C) on biological aspects of predatory mite, *Phytoseiulus persimilis* **Athias – Henriot, 1957[1]** (Acari: Phytoseiidae). The developmental periods of *P. persimilis* was shortened with increasing temperature. Incubation period of *P. persimilis*, was 2.45 days at 30°C followed by 2.84 at 25°C and 5.04 days at 20 °C, respectively. The life cycle of *P. persimilis* female differed according to temperature degree, its shortest period was 6.45 days at 30°C, while its longest period 12.03 days at 20 °C. Total immatures of *P. persimilis* consumed more preys at high temperature compared with low temperature; it was 21.32, 14.81 and 11.37 preys for females at 30, 25 and 20 °C respectively. Also females consumed higher numbers of preys at the ovipostion period reached to 127.94, with maximum average fecundity (43.17 eggs) was deposited by female at 30 °C followed by 25°C (37.00 eggs) ,whereas the longest period was recorded at 20°C with an average of 29.75 eggs/female. *P. persimilis* proved to be a good bio-control against *Tetranychus urticae* infesting strawberry plants under field conditions at release ratios 1:5, 1:10 and 1:15 predator / prey. Reduction percent appeared one week after release, generally it revealed 71.38, 62.89 and 22.16 % mean reduction for each release ratios after 8 weeks, respectively. The releasing of *P. persimilis* at level 1:5 gave the best results of bio-control of *T. urticae*.

Key words: *Phytoseiulus persimilis* ; Biological aspects ; Temperatures ; Releasing ; Strawberry.

INTRODUCTION

Traditionally, control strategies for two spotted spider mite, *Tetranychus urticae* **Koch** have relied on several applications of pesticides during the strawberry production season resulting in high control costs and the development of resistance. In addition, the use of acaricides can result in high residues on strawberries (**Oatman *et al.*, 1967[13]**; **Easterbrook *et al.*, 2001[5])**.

The phytoseiid that has been most widely mass-produced and sold commercially is *Phytoseiulus persimilis* **Athias-Henriot, 1957[1]**. This predatory mite is mass-produced by biological control companies throughout the world. The specialist predatory mites *P. persimilis* feeds mainly on *T. urticae* and belongs to the specialist class of Phytoseiidae predators, as it is closely associated with its "unique" prey *T. urticae* (**McMurtry & Croft, 1997[10]; McMurtry *et al.*, 2015[11]**).

Today, growers around the world use *P. persimilis* to control the two-spotted spider mite *Tetranychus urticae* **Koch** and other tetranychid mites on crops grown in greenhouses and in the field (**Van Lenteren, 2003[14], 2012[12]**). *Tetranychus urticae* causes significant economic damage in many crops including, strawberries (**Walsh *et al.*, 1998) [16]**

The objective of this study was to determine the effect of different temperatures on biology of *Phytoseiulus persimilis* and it's releasing for controlling *Tetranychus urticae* on strawberry crop.

MATERIALS AND METHODS

I- Biological aspects:

The experiment was carried out at the Acarology laboratory of Plant Protection Department, Faculty of Agriculture, Benha University. *P. persimilis* was obtained from cultures of Plant Protection Research Institute, Dokki – Giza.

This study, aims to study the effect of various degrees of temperature 20, 25 and 30°C on the basic biological aspects of *P. persimilis* which fed on known number of the prey (*T. urticae* immature) collected from leaves of Acalypha plant (*Acalypha marginata*) .

The mated females of *P. persimilis* were transferred from established culture to leaf green bean, *Phaseolus vulgaris* L. discs to lay eggs. The newly deposited eggs of the same age were singly transferred to another leaf green bean discs, every petri dish contained four discs placed on wet cotton pads in Petri dishes. Each leaf disc was surrounded by a wet strip of cotton wool to prevent mite individuals from escaping and to supply them with water **(Castagnoli** &**Simoni, 1999) [3]**. Moisture was maintained by adding a few drops of water daily and leaves were replaced every 3 days.

P. persimilis eggs were separated into three major groups, 30 eggs each, according to the tested temperatures 20, 25and 30 °C until hatched and incubation period was recorded. Each newly hatched larva (30 replicates as 30 discs) each replicate contain 1 larva which supplied with sufficient known number of prey (immature of *T. urticae*) the numbers of consumed prey were recorded and replaced by new ones all over the

predator life span. Before the final molt of the female, one adult male was introduced to the replicate for mating and removed after one day and female was observed at 6-12 h intervals to record the first oviposition date to measure fecundity.

Π- Release of predatory mite, *P. persimilis* for controlling of *T.urticae* in open field:-

An area of about 8 karats (1400 m^2) cultivated with strawberry plant was chosen at Arab Elhssania Village, Qalubia Governorate and left without any pesticide treatments. Twelve strawberry lines were selected and divided into 4 treatments each with 3 lines (considered as replicates).

Additional strawberry lines were left between each replicate to avoid the predatory mite escaping to the other one; three lines of strawberry were used as control. Releasing the predatory mite was carried out on florida Beauty cultivar plant, while the population of *T. urticae* being high on March. The work study was 9 weeks from 8 March to 3 May 2022. The predatory mite *P. persimilis* was released in three levels (1:5, 1:10 and 1:15 respectively. Sample of 30 leaflet / replicate were taken just before the predator release as Pre-count, the required population numbers of predatory mite individuals were calculated according to the following formula:

$$\text{Released number} = \frac{\text{Total no. of } T.\ urticae \text{ in treatment} \times \text{predator ratio}}{\text{Prey ratio}}$$

Bean leaves with predatory mite species were put separately in plastic bags, then bags were put in ice box until reaching open field; the release was carried out 1-2 hours before sunset. The leaves with known number of predatory mites were hung between strawberry leaves at a distance of 2 m along on each line. After one week of releasing 30 strawberry leaflets were picked up and transferred to laboratory in paper bags for 8 subsequent weeks, the movable stage of *T. urticae* were counted then the reduction percentages were calculated using equation of **Henderson and Tilton (1955) [8]**.

The data obtained were subjected to statistical anaylsis by **Duncan's (1955) [4]** multiple range tests were used to determine the significal of the differences between mean values of the treatment.

Results and Discussion:

The present study was conducted to determine the effect of different temperatures (20, 25 and 30°C) on the duration of various life stages, of *P. persimilis* and its releasing for controlling *Tetranychus urticae* on strawberry**.**

The average duration of every stage of females and males at each temperature degree were presented in **Table (1)**.

Incubation period of *P. persimilis* was decreased with temperature increase; it was 2.45 days at 30°C followed by 2.84 at 25°C and 5.04 days at 20 °C, respectively. On the other hand for male it was lasted for 2.45 , 2.40 and 4.88 days at 30, 25 and 20 °C , respectively. The male followed similar trend, but having shorter periods.

The duration of larval stage lasted for 0.56, 0.80 and 1.50 days for female, while it was 0.68, 1.92 and 1.34 days for male at 30, 25 and 20 °C respectively.

The duration of female protonymph lasted for 1.31, 2.40 and 2.66 days, while the male protonymph lasted for 1.18, 2.11 and 2.60 days, at 30, 25 and 20 °C, respectively.

The mean deutonymphal period of *P. persimilis* was 2.13, 2.60 and 2.83 days for female when reared at 30, 25 and 20 °C respectively. This period was 2.09, 2.40 and 2.52 days for males respectively.

The female total immatures which included larval, protonymphal and deutonymphal stages lasted for 4.00 , 5.80 and 6.99 days **,**while those of male lasted 3.95, 6.43 and 6.46 days when reared at 30, 25 and 20 °C respectively **(Table 1)**

The life cycle duration of *P. persimilis* differed according to temperature degree , the shortest period was at 30°C (6.45) while the longest was at 20 and 25 °C (12.03 , 8.64 days) respectively. Temperature had an opposite effect on female longevity period; it was decreased with increasing temperature from 20 to 30 °C. Average female lived for 25.97, 21.28 and 18.48 days at 20, 25 and 30 °C, respectively. This period was 18.54 , 15.69 and 13.45 days for males.

The life span (which included the period of life cycle and longevity) averaged 24.93 , 29.92 and 38.00 days for female , while it was 19.85 , 24.52 and 29.88 days for male when reared at 30, 25 and 20 °C respectively .

Female generation period (The period of life cycle and Pre-oviposition) required 7.81 , 10.37 and 14.58 days at 30, 25 and 20 °C respectively. There were significant differences among different temperature, was the shortest generation time with average 7.81 days when reared at 30°C, but prolonged at 20°C.

In general, the time required for female life span was longer than the male; the predacious mites developed successfully over the range of 20 to 30°C with allow mortality. These results clearly indicated that, rising temperature had an obvious effect on the development of immature stages where increasing temperature significantly shortened the developmental periods. These results were in agreement with **Kazak (2008) [9]** who observed that duration of all immature stages of females decreased as temperature increased. Life cycle of *P. persimilis* was 7.13 and 7.06 days for female and male respectively when fed on *T. urticae* at 25 ± 2°C and 70 ± 5 %RH **(Mohamed and Omar, 2011) [12].** .

.

Table (1) Development time (in days) and fecundity of *phytoseiulus persimilis* on three different temperatures.

Temp (˚C)	Sex	Development duration in days (mean ± S.E)					Life cycle	Pre – Oviposition period	Generation	Ovi - position period	Post- Ovi position period	longevity	Life span	fecundity
		Egg	Larva	Proto - nymph	Deuto- nymph	Total immatures								
30	♀	2.45± 0.22^{c}	0.56± 0.01^{b}	1.31± 0.06^{c}	2.13± 0.11^{b}	4.00± 0.32^{c}	6.45± 0.61^{c}	1.36± 0.08 ^{b}	7.81± 0.86^{c}	14.85± 1.46 ^{b}	2.27± 0.29^{b}	18.48± 1.86 ^{b}	24.93± 2.17 ^{c}	43.17± 3.51 ^{a}
	♂	2.45± 0.19	0.68± 0.01	1.18± 0.04	2.09± 0.10	3.95± 0.29	6.40± 0.55	--	-	-	-	13.45± 1.28	19.85± 1.92	-
25	♀	2.84± 0.26^{b}	0.80± 0.03^{b}	2.40± 0.21^{b}	2.60± 0.22^{ab}	5.80± 0.46^{b}	8.64± 0.95 ^{b}	1.73± 0.11^{b}	10.37± 0.94^{b}	17.00± 1.54 ^{ab}	2.55± 0.34^{b}	21.28± 2.07 ^{ab}	29.92± 2.91 ^{b}	37.00± 2.96 ^{b}
	♂	2.40± 0.16	1.92± 0.11	2.11± 0.13	2.40± 0.16	6.43± 0.59	8.83± 0.79	-	-	-	-	15.69± 1.77	24.52± 2.21	-
20	♀	5.04± 0.41^{a}	1.50± 0.08^{a}	2.66± 0.24^{a}	2.83± 0.26^{a}	6.99± 0.63^{a}	12.03± 1.00 ^{a}	2.55± 0.23 ^{a}	14.58± 1.32 ^{a}	20.17± 1.95 ^{a}	3.25± 0.39 ^{a}	25.97± 2.25 ^{a}	38.00± 3.05 ^{a}	29.75± 2.27 ^{c}
	♂	4.88± 0.36	1.34± 0.06	2.60± 0.17	2.52± 0.19	6.46± 0.52	11.34± 0.99	-	-	-	-	18.54± 1.89	29.88± 2.77	-

Data are presented as mean ± Standard Error

- Means in rows followed by the same letter are not significantly different at P≤ 5% according to Duncan's multiple range test (Duncan, 1955)

Table (2) food consumption of *Phytoseiulus persimilis* fed on *Tetranychus urticae* at different temperatures.

Temp (˚C)	Sex	Total immatures	Oviposition period	Longevity	Life span
30	♀	21.32 ± 2.13[a]	127.94 ± 6.01[a]	151.09 ± 8.07[a]	172.41 ± 8.79[a]
	♂	15.90 ± 1.98	-	103.49 ± 4.23	119.39 ± 5.43
25	♀	14.81 ± 1.32[b]	105.26 ± 4.35[b]	138.45 ± 7.49[b]	153.26 ± 8.11[b]
	♂	12.53 ± 1.13	-	93.09 ± 3.25	105.62 ± 4.72
20	♀	11.37 ± 1.98[c]	74.62 ± 3.02[c]	102.43 ± 4.26[c]	113.80 ± 5.39[c]
	♂	7.60 ± 0.46	-	70.11 ± 2.92	76.81± 2.96

Data are presented as mean ± Standard Error

- **Means in rows followed by the same letter are not significantly different at P≤ 5% according to Duncan's multiple range test (Duncan, 1955).**

Influence of temperature on rate consumption of *P. persimilis*:

Results presented in **Table (2)** showed that, temperature had significant differences with prey consumed when fed on *T. urticae* .Total immatures of *P. persimilis* consumed more preys at high temperature compared with low temperature , was 21.32, 14.81 and 11.37 preys for females at 30, 25 and 20 °C respectively ,while it was 15.90 ,12.53 and 7.60 preys for males.

The shorter period of ovipostion was noticed at 30°C (14.85 days) , with the greatest number of eggs (43.17 eggs) was deposited by female at 30 °C followed by 25°C (37.00 eggs) ,whereas the longest period was recorded at 20°C with the number of deposited eggs with an average of 29.75 eggs/female (Table 1) .

Females consumed higher numbers of preys at the ovipostion period during longevity reached to 127.94 while longevity 151.09 at 30°C (Table 2).

These results agree with Eleawa., 2011[6] who studied the effect of the three temperature degree 30, 25 and 20°C on different stages of the predaceous mite, *P. persimilis* life cycle was very low at 30°C; while it increased at 20°C, also temperature had significant differences with prey consumed when fed on *T. urticae* at (30, 25 and 20 °C) as the best results with regard prey consumption at 30 °C.

Releasing of the predatory mites, Phytoseiulus persimilis on strawberry in open field:

Data in Table (3) revealed that , the examined strawberry leaflet collected just before releasing the predatory mite , *Phytoseiulus persimilis* infestation with two spotted spider mites , *T. urticae* was moderate as its populations at the pre-count 112 , 96 and 103 individuals /30 leaflet for three different treatment (1:5 , 1:10 and 1:15 predator: prey) and 115 individuals /30 leaflet for control , as three both released levels (1:5 , 1:10 , 1:15) decreased number of *T. urticae* to 80 , 75 and 85 individuals / 30 leaflet, respectively , one week after release the obtained results reduction in number of *T. urticae* in all mentioned treatment, while it average 125 individuals/30 leaflet for control.

Then , the reduction percent of the target pest was increased gradually by increasing the time after releasing of *P. persimilis* until reaching the maximum (92.57%) for the level of 1 predator : 5 preys in the 8th week after release , while for the second level 1:10 ,it reached after 7th week as the calculated reduction percentage was (85.29%), but in the case of the third ratio 1:15 the maximum reduction percent 34.72 % recorded during the 4th week of release .

The reduction percent fluctuated until the end of season during the 8 week of evaluation. During observation , regarding the mean reduction for three levels of treatment , it was observed that , the mean percentage 71.38 , 62.89 , 22.16 % for levels 1:5 , 1:10 , 1:15 predator :prey respectively .

Table (3) The numbers of *T. urticae* mobile stages before and after releasing *P. persimilis* on strawberry plant with the corresponding reduction percentage (R%) under field condition during 2022 season.

Releasing level		1 :5 predator: preys		1:10 predator: preys		1:15 predator: preys		control
Sampling data		No *T. urticae* /30 leaflet	R%	No *T. urticae* /30 leaflet	R%	No *T.urticae* /30 leaflet	R%	No *T. urticae* /30 leaflet
Pre- Count		112	-	96	-	103	-	115
Weeks after releasing	1st	80	34.28	75	28.12	85	24.07	125
	2nd	57	57.89	58	50.01	96	22.88	139
	3rd	60	57.51	70	42.16	105	19.14	145
	4th	50	73.67	56	65.59	114	34.72	195
	5th	35	82.03	47	71.84	129	27.98	200
	6th	30	85.26	34	80.51	141	24.67	209
	7th	26	87.86	27	85.29	171	13.21	220
	8th	17	92.57	40	79.60	188	10.67	235
Mean reduction%		-	71.38[a]	-	62.89[b]		22.16 [c]	-

Means in rows followed by the same letter are not significantly different at P≤ 5% according to Duncan's multiple range test (Duncan, 1955).

These results proved that releasing of *P. persimilis* at the level of 1:5 gave the best results of bio-control of *T. urticae* infesting strawberry in open field , as statistically , this treatment occupied the first degree , followed significantly by the 1:10 ratio , while the 1:15 treatment was significantly lower than the previously two mentioned levels.

Biocontrol of *P. persimilis* against *T. urticae* was proved on many hosts by several authors but on eggplant by **El-saiedy *et al*., (2008)** [7], also similar results were obtained by **Bonomo *et al*. (1991) [2]** reported that releases of *P. persimilis* gave effective control of *T. urticae* at lower density**.**

REFERENCES

[1] **Athias-Henriot, C. (1957).** Phytoseiidae et Aceosejidae (Acarina, Gamasina) d'Algerie. I. Genres *Blattisocius Keegan*, Iphiseius Berlese, Amblyseius Berlese, Phytoseius Ribaga, Phytoseiulus Evans. Bulletin de la Societe d'Histoire Naturelle de l'Afrique du Nord, 48, 319-352.

[2] **Bonomo, G., Catalano, G., Maltese, V., and Sparta, S. (1991):** Biological and integrated control experiment in Marsalese strawberry crops. – Informatore Agrario 47: 97-100.

[3] **Castagnoli, M., and Simoni, S. (1999).** Effect of long-term feeding history on functional and numerical response of *Neoseiulus californicus* (Acari: Phytoseiidae). Experimental & Applied Acarology, 23(3), 217-234.

[4] **Duncan, D. B. (1955).** Multiple range and multiple F tests. biometrics, 11(1), 1-42.

[5] **Easterbrook, M. A., Fitzgerald, J. D., and Solomon, M. G. (2001).** Biological control of strawberry tarsonemid mite *Phytonemus pallidus* and two-spotted spider mite *Tetranychus urticae* on strawberry in the UK using species of Neoseiulus (Amblyseius)(Acari: Phytoseiidae). Experimental & applied acarology, 25(1), 25-36.

[6] **Eleawa , M.M. (2011)** Using some species of predaceous mites as a potential biocontrol agent and some pesticides against. Ph.D. Thesis Fac, Agri, Benha Univ., 208 pp.

[7] **El-Saiedy, E. M. A., Abou-Elella, G. M. A., and Alotaibi, S. A. (2008).** Efficiency of three predatory phytoseiid mites and biocide chemical for controlling *Tetranychus urticae* Koch on eggplant at Beheira Governorate. Research Journal of Agriculture and Biological Sciences, 4(3), 238-244.

[8] **Hinderson, C. F., and Telton, E. W. (1955).** Test with acaricides against brown white mite. J. Econ. Entomol, 48, 157-161.

[9] **Kazak, C. (2008).** The development, predation, and reproduction of *Phytoseiulus persimilis* Athias-Henriot (Acari: Phytoseiidae) from hatay fed *Tetranychus cinnabarinus* Boisduval (Acari: Tetranychidae) larvae and protonymphs at different temperature. Turk. J. Zool. 32: 407- 413.

[10] **McMurtry, J. A., and Croft, B. A. (1997).** Life-styles of phytoseiid mites and their roles in biological control. Annual review of entomology, 42(1), 291-321.

[11] **McMurtry, J. A., Sourassou, N. F., and Demite, P. R. (2015).** The Phytoseiidae (Acari: Mesostigmata) as biological control agents. In Prospects for biological control of plant feeding mites and other harmful organisms (pp. 133-149). Springer, Cham.

[12] Mohamed, O. M. O. and Omar, N. A. A. (2011). Life table parameters of predatory mite, *Phytoseiulus persimilis* Athias-Henriot on four tetranychid pry species (Phytoseiidae – Tetranychidae). Acarines, 5(1): 19 -22.

[13] **Oatman, E. R., McMurtry, J. A., Shorey, H. H., and Voth, V. (1967).** Studies on integrating *Phytoseiulus persimilis* releases, chemical applications, cultural manipulations, and natural predation for control of the two-spotted spider mite on strawberry in southern California. Journal of Economic Entomology, 60(5), 1344-1351.

[14] **Van Lenteren, J. C. (2003).** Commercial availability of biological control agents. Quality control and production of biological control agents: theory and testing procedures, 167-179.

[15] **Van Lenteren, J. C. (2012).** The state of commercial augmentative biological control: plenty of natural enemies, but a frustrating lack of uptake. Bio Control, 57(1), 1-20.

[16] **Walsh, D. B., Zalom, F. G., and Shaw, D. V. (1998).** Interaction of the two spotted spider mite (Acari: Tetranychidae) with yield of day-neutral strawberries in California. Journal of economic entomology, 91(3), 678-685.