RELEASE OF THE PREDATOR *PHYTOSEIULUS MACROPILIS* (BANKS) ON KIDNEY BEAN PLANTS TO CONTROL *TETRANYCHUS URTICAE* KOCH IN DIFFERENT SEASONS (ACARI: PHYTOSEIIDAE & TETRANYCHIDAE) IN EGYPT

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(Manuscript received 23 December 2003)

Abstract

The predator mite *Phytoseiulus macropilis* (Banks) was released on kidney bean plants to control the two-spotted spider mite, *Teranychus urticae* Koch in different seasons under a screenhouse at Dokki district (Giza Governorate). Winter season proved to be the best for predator release at the rate of 9, 6 and 3 individuals/2plants. The red spider mite population was greatly reduced. Its percentage reduction at the first post- count (after 2 weeks) was 100, 81 and 78% at the release levels 9, 6 and 3 predators/2 plants , recteptively. This might be attributed to the low spider mite population, due to unfavorable low temperature, which allowed the predator to suppress the pest population. Spring and autumn seasons were also suitable for increasing and flourishing this predator species. Which resulted in controlling the red spider mite population specially at the high release level of, of 9 & 6 individuals/2 bean plants. On the opposite, high temperature during summer months stimulated spider mites population to rapidly increase causing severe deterioration to the bean the plants before giving chance to predator individuals to control the mite pest. On the other hand, this high temperature and the occurrence of hot spells during summer had certainly a negative effect on the predator activity.

INTRODUCTION

In Egypt, attention has been focused in the recent years on the possibility of using biological control methods against mite pests of some economic plants. The use of prodaceous mites to control mite pest is undoubtly one of the most important recent trends, which helps for reducing the environmental pollution when using acaricides and keeping the natural balance of environment.

Phytoseiid mites are of economic importance as natural enemies of various phytophagous mites on many crops. The effect of releasing the predaceous mite, *Phytoseiulus macropilis* (Banks) on certain economic plants to control the spider mites was investigated by several authors: Smith and Summers (1949), Prasad (1973),

Hamlen & Lindquist (1981), McMurtry *et al.* (1984), Osborne (1987), Watanabe *et al.* (1994), Ramos & Rodriguez (1995), Strong & Croft (1995). In previous work of Heikal & Mowafi (1998), Heikal *et al.* (2000) and Heikal & Ibrahim (2001) successfully trails were done for releasing the predatory mite, *P. macropilis* against the two-spotted spider mite, *T. urticae* Koch on certain plants, and this encouraged the authors to continue their studies to emphasize the suitable time and rate of release.

MATERIALS AND METHODS

The effective of *P. macropilis* release on the two-spotted spider mite, *T. urticae* was studied at different seasons under a screenhouse belonging to Plant Protection Research Institute at Dokki district, Giza Governorate. The dimensions of this greenhouse were 8 m long, 5 m wide and 2 m high. Roof and sides were covered with fine mesh plastic net (500 meshes/inch^2) and each provided with a 1.5 x 2 m wooden door at one side. The area of the greenhouse was divided into twelve equal plots, sown with kidney bean seeds, variety Giza 6 treated with 0.1 % Vitavax WP (as a fungicide) at 1 – 2 cm deep in the first plot.

Thirty bean plants were sown in each plot in two lines, surrounded with other bean plants to serve as buffer plants. Four treatments each with three replicates were applied. Two to four days after emergence of the first leaflets, bean plants in each plot were inoculated with relatively light level of *T. urticae* infestation from a laboratory stock culture at the rate of about 2 moving stages/bit. About 7 days later, the predator was released twice at a two weeks interval at the rate of 3, 6 and 9 individuals/bit in the first three treatments, respectively, while the fourth treatment was left without release as a control.

The predator individuals were collected in gelatin capsules No. 3 (1.5 – 0.5 dm) by using a special vacuum bump, then released in the greenhouse by opening the gelatin capsules and pinning the separated parts on the bean leaflets. Randomized samples of 30 leaflets/replicate were taken biweekly just before every release, where the first sample was considered as the pre-count and the second one as the first post-count and the other two biweekly samples were the second and third post counts samples. The samples were put in paper bags and directly transferred to the laboratory. Eggs and postembryonic stages of *P. macropilis* and *T. urticae* were counted with the aid of a stereomicroscope and reduction in the two-spotted spider mite population was assessed.

RESULTS AND DISCUSSION

Data of releasing the predatory mite, *P. macropilis* on bean plants to control the two-spotted spider mite, *T. urticae* during autumn season are presented in Table 1. The percentage of infested leaflets at the beginning of the predator release on September 29, 1999 ranged between 20 and 53%, while the numbers of *T. urticae* ranged between 22 and 62 moving stages / replicate. These values were 40% infested leaves and 43 moving stages / replicate in the non-release plots. The first and second post-counts showed some increase in the mean numbers of *T. urticae* averaging 26, 103 and 330 moving stages/replicate in the first post-count after two weeks then 85, 283 and 1725 in the second post-count at the predator release level 9, 6 and 3 individuals/2 plants, respectively. On the other hand, the numbers of *T. urticae* greatly increased in the no release plots to reached 654 and 2583 moving stages/replicate in the first and second post-counts. Reduction percentage of *T. urticae* reached 92% - 87% on the first post-count, increased to over 90% in both levels of 9 and 6 individuals/2 plants on the second and third count after 4 and 6 weeks. For the low level of predator release that of 3 individuals, the percentage of spider mite reduction was about 60% in the first and second post-count then increased to 80 and 75% in the third and fourth counts after $1^{1/2}$ and two moths. This proved that this level was not suitable as giving time to the pest to destroy the plants.

Few numbers of the predatory mite, *P. macropilis* were found in different release plots at the first and second post-counts. Number/replicate at the second post-count was 8, 4 and 2 at the releasing levels 9, 6 and 3 predators/2 plants, respectively, where direct proportions were found between the numbers of the predatory mite and the releasing levels. However, these numbers greatly increased in an opposite direction, at the fourth post-count to reach 79, 891 and 945 predators/replicate in the releasing plots 9, 6 and 3 predators/2 plants, respectively. This high increase in the low releasing plots in the fourth post-count many be correlated with the increase of the red spider mite, *T. urticae*, the preferable prey to these predator species. In addition, the predator individuals were recorded in the no releasing plots as a result of its wide dispersal. These might indicate its high dispersal potential and importance as a biological control agent. Similar results were obtained by Heikal & Mowafi (1998) and Heikal & Ibrahim (2001).

Table 1. Release of *P. macropilis* to control *T.urticae* on bean plants during autumn season

Sampling date	Rate of released predators /2 plants	Mean no. of *T.urticae*/replicate	*T. urticae* Reduction %	Infested leaflets %	No. of *P. macropilis* / replicate		
					Eggs	M.S.	Total
Sep. 29,1999 *	A (9 predators)	22	-	20	-	-	-
	B (6 predators)	53	-	47	-	-	-
	D (3 predators)	62	-	53	-	-	-
	E (no release)	43	-	40	-	-	-
Oct. 10,1999 * **	A (9 predators)	26	92	20	2	2	4
	B (6 predators)	103	87	40	2	1	3
	D (3 predators)	330	65	86	0	1	1
	E (no releasing)	654	-	100	0	0	0
Oct. 29,1999 * ** ***	A (9 predators)	85	94	47	6	2	8
	B (6 predators)	283	91	73	3	1	4
	D (3 predators)	1725	54	100	1	1	2
	E (no releasing)	2583	-	100	0	0	0
Nov. 12,1999 * ** *** ****	A (9 predators)	50	96	73	28	26	54
	B (6 predators)	252	92	100	27	163	190
	D (3 predators)	744	80	100	182	114	296
	E (no releasing)	2631	-	100	-	-	-
Nov. 27,1999	A (9 predators)	11	99	20	20	50	79
	B (6 predators)	620	83	100	100	340	891
	D (3 predators)	1080	75	100	100	332	945
	E (no releasing)	3003	-	100	100	73	211

* Pre-count, time of first release.

** First post-count, time of second release.

*** Second post-count

**** Third post-count

M.S = Moving Stages

Table 2. Release of *P. macropilis* to control *T.urticae* on bean plants during winter season.

Sampling date	Rate of released predators /2 plants	Mean no. of *T.urticae*/replicate	*T. urticae* Reduct-ion %	Infested leaflets %	No. of *P. macropilis* / replicate		
					Eggs	M.S.	Total
Jan. 11, 2000 *	A (9 predators)	15	-	40	-	-	-
	B (6 predators)	13	-	27	-	-	-
	D (3 predators)	9	-	20	-	-	-
	E (no releasing)	16	-	33	-	-	-
Jan. 25, 2000 **	A (9 predators)	0	100	0	0	2	2
	B (6 predators)	10	81	20	0	6	6
	D (3 predators)	8	78	20	0	4	4
	E (no releasing)	66	-	67	0	0	0
Feb. 8, 2000 ** *	A (9 predators)	0	100	0	0	3	3
	B (6 predators)	3	87	13	0	0	0
	D (3 predators)	5	68	13	1	1	1
	E (no releasing)	28	-	40	0	0	0
Feb. 22, 2000 ** **	A (9 predators)	0	100	0	1	1	2
	B (6 predators)	0	100	0	0	0	0
	D (3 predators/2plants)	0	100	0	0	0	0
	E (no releasing)	53	-	73	2	1	3
Mar. 9, 2000	A (9 predators)	0	100	0	1	3	4
	B (6 predators)	2	96	7	0	0	0
	D (3 predators)	4	94	20	0	0	0
	E (no releasing)	88	-	87	2	2	4

* Pre-count, time of first release.

** First post-count, time of second release.

*** Second post-count

**** Third post-count

M.S. = Moving Stages

In winter the reductions percentages of the red spider mite *T. urticae* at the first post-count were 100, 81 and 78% at the releasing levels 9, 6 and 3 predators/2 plants, respectively, which increased in the releasing plots at the fourth inspection (on Mar. 9th 2000) to reach 100, 96 and 94% in the releasing plots of the same releasing levels, respectively Table 2. This high percentage reduction of the pest in winter which began from the first post-count especially in the high level of predator release could be due to the small infestation with spider mites during this season which is not suitable for *T. urticae* reproduction.

In spring the percentage reduction of the spider mite was not as good as in autumn and winter as it reached 90% & 75% in the 3rd post-count after 1$^{1/2}$ month for the two levels of predator release 9 & 6 individuals/2plants, respectively Table 3.

In summer, the percentages of infested leaflets at the pre-count (the time of *P. macropilis* first release on July 13, 2000) were 87, 93 and 93% and the mean numbers of *T. urticae* were 349, 294 and 261 moving stages/replicate in plots of the releasing levels 9, 6 and 3 predators/2 plants, respectively. These levels of *T. urticae* infestations were considered very high at the time of the first predator release and rapidly increased in all releasing plots to reach 100% infestation in all plots at the first post-count on July 27,2000 with *T. urticae* mean numbers of 2826, 3262, 3356 and 3662 moving stages/replicate at releasing plots levels 9, 6 and 3 predators/2 plants and the no release plot, respectively. The prevailing temperature during summer months seemed to be the main factor that stimulated the build up of the two-spotted spider mite population as recorded by Heikal (1977) and on the contrary not suitable for predator increase Ali (1998).

Table 3. Release of *P. macropilis* to control *T. urticae* on bean plants during spring season.

Sampling date	Rate of released predators /2 plants	Mean no. of *T. urticae*/replicate	*T. urticae* Reduct-ion %	Infe-sted leaflets %	No. of *P. macropilis* / replicate		
					Eggs	M.S.	Total
Apr. 14,2000 *	A (9 predators)	29	-	47	-	-	-
	B (6 predators)	20	-	33	-	-	-
	D (3 predators)	25	-	47	-	-	-
	E (no releasing)	27	-	47	-	-	-
Apr. 28,2000 **	A (9 predators)	44	82	47	8	4	12
	B (6 predators)	36	79	40	0	0	0
	D (3 predators)	181	16	73	0	0	0
	E (no releasing)	234	-	93	0	0	0
May 13,2000 ***	A (9 predators)	116	88	80	8	9	17
	B (6 predators)	206	70	87	21	37	58
	D (3 predators)	405	17	93	22	32	55
	E (no releasing)	912	-	100	0	0	0
May 27,2000 ****	A (9 predators)	131	90	87	69	94	163
	B (6 predators)	235	75	100	171	324	495
	D (3 predators)	848	28	100	109	161	270
	E (no releasing)	1270	-	100	36	98	134
Jun. 7,2000	A (9 predators)	46	91	60	4	18	22
	B (6 predators)	61	82	73	11	10	21
	D (3 predators)	168	61	87	3	18	31
	E (no releasing)	470	-	100	39	41	80

* Pre-count, time of first release.

** First post-count, time of second release.

*** Second post-count

**** Third post-count

M.S. = Moving Stages

Table 4. Release of *P. macropilis* to control *T. urticae* on bean plants during summer season.

Sampling date	Rate of released predators /2 plants	Mean no. of *T.urticae*/ replicate	*T. urticae* Reduct-ion %	Infested leaflets %	No. of *P. macropilis* / replicate		
					Eggs	M.S.	Total
July 13,2000 *	A (9 predators)	349	-	87	-	-	-
	B (6 predators)	294	-	93	-	-	-
	D (3 predators)	261	-	93	-	-	-
	E (no releasing)	259	-	80	-	-	-
July 27,2000 **	A (9 predators)	2826	42	100	5	13	18
	B (6 predators)	3262	21	100	5	9	14
	D (3 predators)	3356	9	100	2	1	3
	E (no releasing)	3662	-	100	0	0	0
Aug. 10,2000 ***	A (9 predators)	294	80	100	13	4	20
	B (6 predators)	399	68	100	24	3	27
	D (3 predators)	985	12	100	20	5	25
	E (no releasing)	1114	-	100	2	1	1
Aug. 24,2000 ****	-	-	-	-	-	-	-

* Pre-count, time of first release.

** First post-count, time of second release.

** Second post-count

**The plant leaflets were highly infested with the two-spotted spider mites and completely damaged so, leaflet samples could not be taken.

M.S. = Moving Stages

From the foregoing results, the suitability of the different year, seasons for *P. macropilis* release against the two-spotted spider mite infesting bean plants could be concluded in the following:

1- Winter season was considered the best as the spider mite population greatly reduced after the first release at the three release levels. This might be attributed to the low level of the spider mite population at the time of the predator release, that might allow the predator to suppress pest population (Heikal and Mowafi, 1998) . The low mite population is certainly due to low temperature that prevails generally, throughout winter months and negatively affects spider mite development and fecundity (Heikal, 1977).

2- The population of the two-spotted spider mite, *T. urticae* was relatively low in the spring season at the time of the first predator release that encouraged the predator individuals to control the pest population rapidly in spite of this period was generally suitable for development and reproduction of the mite pest (Rasmy *et al.*, 1971 and Heikal & Mowafi, 1998). On the other hand, the spring months were also seamed to be suitable for increasing and flourishing this predator species.

3- Autumn season was also suitable for predator release as it could effectively control the two-spotted spider mite. Heikal (2001) indicated that mass production of the predatory mite, *P. macropilis* under greenhouse conditions was easy and suitable most of the year seasons with comparatively high increase during autumn and spring months where the predator can be easily used for biological control of the two-spotted spider mite.

4- In summer high temperature stimulated spider mites population to rapid increase causing severe deterioration to the leaflets and destroying the plants before giving chance to the predator to control the mite pest. On the other hand, the prevailing high temperature and the occurrence of hot spells during summer months, had certainly a negative effect on the predator activity.

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إطلاق المفترس الأكاروسي فيتوسيولاس ميكروبيليس *Phytoseiulus macropilis* (Banks) على نباتات الفاصوليا لمكافحة العنكبوت الأحمر *Tetranychus urticae* Koch في المواسم المختلفة

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تم إطلاق المفترس الأكاروسي *Phytoseiulus macropilis* (Banks) على نباتات الفاصوليا لمكافحة العنكبوت الأحمر، *Tetranychus urticae* Koch تحت ظروف صوبة شبكية بمنطقة الدقـي (محافظة الجيزة) في فصول السنة المختلفة.

وقد دلت النتائج أن فصل الشتاء كان الأفضل لإطلاق المفترس بمعدلات ٩، ٦، ٣، أفراد/ نباتين. وقد أنخفض تعداد العنكبوت الأحمر كثيرا، حيث وصلت النسبة المئوية للخفض. في الفحصة الأولى بعد الإطلاق (بعد اسبوعين) ١٠٠، ٨١، ٧٨% عند مستويات الإطلاق ٩، ٦، ٣ أفراد / نباتين، على التوالي. وقد يرجع ذلك لقلة العنكبوت الأحمر نظرا لضعف تكاثره في برودة الشتاء والتي سمحت للمفترس بالسيطرة على تعداد الآفة.

وكان تعداد العنكبوت الأحمر منخفض نسبيا في فصل الربيع وقت إطلاق المفترس والذي شجع أفراد المفترس للنمو والتكاثر أفضل من الآفة. وعموما كان فصلي الربيع والخريف مناسبين لزيادة وازدهار هذا المفترس والذي ينتج عنه مكافحة العنكبوت الأحمر وخاصة في مستوى الإطلاق الأعلى وهو ٩، ٦ أفراد/ نباتين. وعلى العكس من ذلك، فإن درجات الحرارة السائدة في أشهر الصيف حفزت الزيادة السريعة لتعداد العنكبوت الأحمر مسببا تدهورا في نباتات الفاصوليا قبل إتاحة الفرصة لإفراد المفترس لمكافحة الآفة الأكاروسية. ومن ناحية أخرى، فإن زيادة درجات الحرارة والموجات الحارة خلال الصيف كان لها بالتأكيد تأثيرا سلبيا على نشاط المفترس الذي لا يناسبه درجات الحرارة المرتفعة.