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RELEASE OF *PHYTOSEIULUS MACROPILIS* (BANKS) TO CONTROL *TETRANYCHUS URTICAE* KOCH ON STRAWBERRY IN ISMAILIA GOVERNORATE - EGYPT (ACARI : PHYTOSEIIDAE & TETRANYCHIDAE)

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Abstract

The predatory mite, *Phytoseiulus macropilis* was released in a strawberry field at Serabium district (Ismailia Governorate) to control the two-spotted spider mite, *Tetranychus urticae* Koch. A single release of the predator at a rate of about 5 predator individuals/bit was applied at different early dates in the season (Nov. 29, Dec. 7 and Dec. 14, 1999) compared with one late in the season (Feb. 14, 2000). Each of the early release ones, proved to be effective sufficiently than the late release to control the two-spotted spider mites. Percentages of the pest reduction ranged between 60-90 % after 3-7 weeks from the predator release. Accordingly, the pest population greatly declined during the strawberry flowering and fruiting period which might positively affect the strawberry yield. Highest pest reductions existed when the predator individuals were released without mixing with "vermiculite" or "sawdust".

The predator individuals moved from the release plots to the control, intermediate non-release plots, adjacent strawberries and cucumber fields and associated weeds, specially when the two-spotted spider mite was available on these plantations. This also, might indicate the possibility of this predator to be established under the Egyptian conditions on the associated weeds and adjacent plantations.

INTRODUCTION

In Egypt, the cultivated area of strawberry is expected to be increased in the coming years for its importance in local markets and exportation. Yet, the two-spotted spider mite, *Tetranychus urticae* Koch is known to be its principal pest here and in different countries (Cross, 1984; Charles *et al.*, 1987; Charles, 1988; Galli, 1990; Garcia *et al.*, 1991; Gonzalez *et al.*, 1993). Thus, it could be successfully controlled by mass releases of different phytosteiid mite species (Oatman *et al.*, 1977 in California; Masis & Aguilar, 1990 in Costarica; Decou, 1994 in Florida). Our preliminary experiments in 1999 at El-Kanater district (about 40 kilometers north of Cairo) gave indication of the possibility of controlling *T. urticae* population on strawberry in Egypt by using the pre-

daceous mite, *Phytoseiulus macropilis* (Banks) (Heikal *et al.*, 1999). Therefore, the present work aimed to control the two- spotted spider mite in a strawberry field by releasing the predatory mite, *P. macropilis* on bean leaflets alone or mixed with vermiculite or sawdust early or late in the strawberry season. Population density of *T. urticae* on associated weeds, adjacent strawberry and cucumber and faraway strawberry plantations were also estimated.

MATERIALS AND METHODS

Rearing the predator : The predatory mite, *P. macropilis* was mass reared on the two-spotted spider mite, *T. urticae* on bean plants in a small greenhouse (6 m wide x 8 m long) covered with plastic net (500 holes/inch) at Dokki district (Giza Governorate).

Collecting the predator individuals : Bean leaflets harbouring high density levels of the predator individuals and few numbers of *T. urticae* were collected, early the morning of the release day, in paper bags, free or mixed with suitable amount of vermiculite or sawdust. These additives might reduce predator escaping and cannibalism specially in hot weather.

Predator release : An area of about 3 feddans (12600 m^2) cultivated with 3 commercial strawberry varieties (Chandler, Camarosa and Ossograndy) was chosen at Serabium district (Ismailia Governorate) and left without any pesticide treatment (except one fungal treatment with Chema-Z 50 % at a rate of 300 g/400 liter in January 15, 2000). The field area was divided into 30 plots each of about 420 m^2. The predatory mite, *P. macropilis* was released at different dates at a rate of about 5 predators/bit as shown in Table 1. Ten treatments (A, B, C, D. E, F, G, H, I and J) were used and replicated 3 times, where the first seven ones (for early season release) were established in a randomized complete block design and the eighth was considered as a check "1", restricted in the corner of the field and separated with buffer strawberry lines. The rest (two treatments) were also separated by different buffer strawberry lines and kept for late release of the predator and check "2".

Randomized samples of 30 leaflets/treatment were taken just before the predator release and then at weekly intervals. Samples were also taken from associated weeds (mainly Mexican tea), adjacent strawberry and cucumber fields and from a faraway strawberry field (about 2 kms far). Counts of moving stages of *P. macropilis* and *T. urticae* were estimated in the field by a special magnified hand lens (X20). Henderson and Tilton equation (1955) was applied to calculate the reduction of *T. urticae* populations.

Table 1. Date and type of release of the predatory mite, *P. macropilis* against *T. urticae* in a strawberry field at Ismailia Governorate.

Date of release		Treatments and type of release
Early releases	Nov. 30, 1999	(A) Bean leaflets harbouring predators alone
		(B) Bean leaflets harbouring predators mixed with vermiculite
	Dec. 7	(C) Bean leaflets harbouring predators alone
		(D) Bean leaflets harbouring predators mixed with sawdust
	Dec. 14	(E) Bean leaflets harbouring predators alone
		(F) Bean leaflets harbouring predators mixed with sawdust
		(G) No release (intermediate plots)
		(H) No release (Check 1)
Late release	Feb. 14, 2000	(I) Bean leaflets harbouring predators alone
		(J) No release (Check 2)

RESULTS AND DISCUSSION

In the early season, releases of the predatory mite, *P. macropilis* on the two-spotted spider mite populations were generally moderate in the pre-count (just before the predator releases). They were 274 & 170 (Nov. 29), Table 2; 186 & 228 (Dec. 7), Table 3 and 201 & 149 (Dec. 14), Table 4 moving stages/30 leaflets in plots A, B, C, D. E and F, respectively. These values were 124, 164 and 152 moving stages/30 leaflets in check "1" Tables 2, 3 and 4. After the predator was released, *T. urticae* populations continued at apparently similar same levels or slightly increased in the release plots during early December to mid January. Then, the pest populations generally declined rapidly from mid January (plots A and B) or late January (plots C, D, E, F and G) to reach their lowest populations during the last inspection in April 24. Thus, the pest population declined during the critical period of flowering which might positively affect the strawberry yield. On the opposite, the pest population increased gradually in control plots and remained at relatively high levels from late December to early March, then the pest population tended to decline with a rapid rate until the last inspection.

The percentage of leaflets infested with the two- spotted spider mites ranged between 73 to 97 % in plots A, B, C, D, E and F, in the pre-count. It generally de-

Table 2. Effect of early release of *P. macropilis* on strawberry to control *T. urticae* (The first date of release).

Sampling date	Plot*	Infested leaflets (%)	No. mites/30 leaflets		Reduction of *T. urticae* (%)
			T.urticae	*P. macropilis*	
Nov. 27, 1999 Pre-count, date of release	A	90	274	-	-
	B	93	170	-	-
	H	57	124	-	-
	G	87	190	-	-
Dec., 7 (1*st* post-count)	A	83	174	24	52
	B	77	151	6	33
	H	87	161	-	-
	G	90	223	-	-
Dec., 14	A	83	155	40	54
	B	80	180	2	14
	H	80	152	-	-
	G	77	181	0	-
Dec., 21	A	70	156	46	77
	B	67	258	34	38
	H	80	302	-	-
	G	83	299	0	-
Dec., 28	A	98	270	33	75
	B	90	264	29	61
	H	97	494	-	-
	G	87	388	5	49
Jan. 4, 2000	A	77	172	7	88
	B	87	160	22	83
	H	97	668	3	-
	G	83	360	7	65
Jan., 17	A	20	14	22	94
	B	30	16	8	98
	H	100	470	8	-
	G	93	456	12	37
Jan., 24	A	30	34	10	97
	B	37	50	18	93
	H	100	520	24	-
	G	90	180	53	77

Table 2. Continued.

Sampling date	Plot*	Infested leaflets (%)	No. mites/30 leaflets		Reduction of *T. urticae* (%)
			T.urticae	*P. macropilis*	
Jan. 31, 2000	A	13	16	6	99
	B	26	16	1	98
	H	100	604	16	-
	G	47	93	9	90
Feb., 7	A	3	2	6	100
	B	7	4	1	99
	H	100	428	10	-
	G	33	25	10	96
Feb., 14	A	0	0	0	100
	B	7	2	2	100
	H	100	738	20	-
	G	3	79	-	93
Feb., 28	A	7	2	2	100
	B	0	0	0	100
	H	80	706	44	-
	G	7	6	7	99
March, 13	A	0	0	2	100
	B	0	0	0	100
	H	87	296	32	-
	G	7	4	1	99
March, 27	A	0	3	5	100
	B	0	0	0	100
	H	87	80	51	-
	G	0	0	0	100
April, 10	A	0	0	0	100
	B	0	0	1	100
	H	37	77	13	-
	G	0	0	0	100
April, 24	A	3	3	2	95
	B	3	1	3	97
	H	17	27	3	-
	G	10	11	1	73

* plot : A : Bean leaflets harbouring predators alone

B : Bean leaflets harbouring predators mixed with vermiculite

H : No release (check 1)

G : No release (intermediate plots)

Table 3. Effect of early release of *P. macropilis* on strawberry to control *T. urticae* (The second date of release).

Sampling date	Plot*	Infested leaflets (%)	No. mites/30 leaflets		Reduction of *T. urticae* (%)
			T.urticae	*P. macropilis*	
Dec. 7, 1999	C	87	186	-	-
Pre-count, date of	D	73	228	-	-
release	H	87	164	-	-
Dec., 14	C	80	132	38	23
(1*st* post-count)	D	73	138	58	35
	H	80	152	-	-
Dec., 21	C	97	268	40	22
	D	86	292	28	30
	H	80	302	2	-
Dec., 28	C	97	280	15	50
	D	86	456	12	57
	H	97	494	-	-
Jan. 4, 2000	C	87	312	27	59
	D	97	512	9	45
	H	97	668	3	-
Jan., 17	C	73	160	150	70
	D	87	322	12	51
	H	100	470	8	-
Jan., 24	C	53	72	36	88
	D	87	174	22	76
	H	100	520	24	-
Jan., 31	C	20	26	16	96
	D	93	230	6	73
	H	100	604	16	-
Feb., 7	C	7	2	14	100
	D	53	108	20	82
	H	100	428	10	-
Feb., 14, 2000	C	7	1	2	100
	D	73	90	28	91
	H	100	738	28	-
Feb., 28	C	7	2	0	100
	D	50	70	110	91
	H	80	706	44	-
March, 13	C	0	0	0	100
	D	0	0	4	100
	H	87	296	32	-
March, 27	C	13	7	21	92
	D	7	1	4	100
	H	87	80	51	-
April, 10	C	0	0	0	100
	D	7	2	0	100
	H	37	77	13	-
April, 24	C	10	10	1	67
	D	7	2	1	100
	H	17	27	3	-

* Plot : C : Bean leaflets harbouring predators alone

D : Bean leaflets harbouring predators mixed with sawdust

H : No release (check 1)

Table 4. Effect of early release of *P. macropilis* on strawberry to control *T. urticae* (The third date of release).

Sampling date	Plot*	Infested leaflets (%)	No. mites/30 leaflets		Reduction of *T. urticae* (%)
			T.urticae	*P. macropilis*	
Dec. 14, 1999	E	73	201	-	-
Pre-count, date of	F	80	149	-	-
release	H	80	152	-	-
Dec., 21	E	87	240	13	40
(1*st* post-count)	F	90	213	9	28
	H	80	302	2	-
Dec., 28	E	73	214	38	64
	F	93	253	53	43
	H	98	454	2	-
Jan. 4, 2000	E	53	168	64	81
	F	73	227	35	65
	H	93	664	3	-
Jan., 17	E	80	151	33	76
	F	93	212	36	54
	H	100	470	8	-
Jan., 24	E	40	176	16	74
	F	47	61	9	88
	H	100	520	24	-
Jan., 31	E	40	61	25	92
	F	87	118	47	86
	H	100	604	16	-
Feb., 7	E	7	2	4	100
	F	80	38	3	91
	H	100	428	10	-
Feb., 14	E	33	23	7	98
	F	33	24	15	97
	H	100	738	28	-
Feb., 28, 2000	E	3	1	0	100
	F	13	11	2	98
	H	80	706	44	-
March, 13	E	0	0	2	100
	F	0	0	2	100
	H	87	296	32	-
March, 27	E	0	0	0	100
	F	0	0	0	100
	H	87	80	51	-
April, 10	E	0	0	0	100
	F	0	0	0	100
	H	37	73	13	-
April, 24	E	7	2	2	-
	F	10	24	7	-
	H	17	27	3	-

* Plot : E : Bean leaflets harbouring predators alone

F : Bean leaflets harbouring predators mixed with sawdust

H : No release (check 1)

creased after the predator release to reach lower levels from late January to the last inspection in April 24. On the contrary, in the check, it increased to reach about 100 % from early January to early March.

Reductions of the two-spotted spider mite population following different predator releases were also estimated. Data in Tables 2, 3 & 4 indicated that all the predator release time and method affected pest populations. *T. urticae* reductions were generally less than 60 % during the first three weeks after different release dates. However, it increased gradually to reach about 90 % within the sixth or seventh inspection (6-7 weeks from the predator release). This finding agreed with those obtained by Decou (1994) and Heikal *et al.* (1999). Higher *T. urticae* reductions were obtained when leaflets were harbouring the predator alone than when mixed with "vermiculite" or "sawdust". Thus, these additives might diminish the predator dispersal to recipient plants. However, mixing one of these materials with leaflets harbouring the predatory individuals might be essential when predator collecting and releasing occurred during hot months or when stored 1-2 days before release.

The predator individuals began to appear on the sampled leaflets from the first post-count (a week after release) in all plots with noticeable higher densities in plots with leaflets free of "vermiculite" or "sawdust." *P. macropilis* reached a maximum of 150 individuals/30 leaflets on January 17, 2000 in plots with predator release free of "vermiculite" or "sawdust" compared with 110 individuals per 30 leaflets on February 28 in plots with predator release mixed with "sawdust," Table 3.

The predator individuals moved to the intermediate non-release plots, 4 weeks after the predator release occurred, where a maximum of 53 predators/30 leaflets were recorded. Many predators were also recorded in the check plots started from January 4 (5 weeks after the predator release undertaken) in spite of using non-release strawberry plots as buffer plants. The predator population reached a peak of 51 individuals/30 leaflets in the check plots by March 27, Table 2. The predator migration to the non-release intermediate and check plots occurred when the latters became highly infested with the two-spotted spider mites. Thus, this data might indicate the high dispersal potential of *P. macropilis* and its importance as a biological control agent. Similar results were obtained by Heikal and Mowafi (1998).

In the late season release of the predatory mite, *P. macropilis* (on February, 14), the *T. urticae* populations were slightly higher in the pre-count than those recorded in the early season release. They were 304 and 500 individuals/30 leaflets in the release

and non-release plots, respectively, Table 5. The strawberry foliages were generally smaller and the leaflets seemed to be damaged as a result of the previous mite infestation. The *T. urticae* populations increased in the check plots throughout the first four post-counts, yet they remained at nearly similar densities in the release plots. Then, the pest population rapidly diminished in both the check and release plots.

The pest population reductions was generally less than 70 % in the release plots until the fifth post- count, then, it increased to reach more than 90 % in the seventh inspection (seven weeks from the predator release), Table 5. This usually coincided with the end of strawberry flowering and fruiting period.

Individuals of the predatory mite, *P. macropilis* began to appear in the release plots from the first post-count with 12 moving stages/30 leaflets and rapidly increased to reach its maximum number (152 moving stages/30 leaflets) on March 13, 2000. On the other hand, the predator individuals started to appear in check plots two weeks from the predator release and increased rapidly to reach highest density (148 moving stages/30 leaflets) on March 21, where it reduced the *T. urticae* population in the control plots.

Examining associated weeds and adjacent strawberry and cucumber plantations, many individuals of *P. macropilis* were found to be migrated from the release strawberry plots, Table 6. Shortage of suitable prey density in the release plots and its occurrence in these adjacent plantations encouraged the predator dispersal. These findings agreed with those obtained by Heikal & Mowafi (1998). Besides, the predators occurrence on the adjacent plants might indicate the ability of this predator species to be established under the Egyptian conditions. On the other hand, population of the two-spotted spider mite in the far away strawberry field was found to be at high levels during January, February and March, 2000 (the flowering and fruiting period) inspite of using the recommended acaricides (Vertimec 1.8 % EC or Chalenger 36 % SC at rate of 40 cc/100 liter of water, or Comite 73 % EC at a rate of 130 cc/100 liter of water).

Finally, the foregoing results proved the possibility of controlling the two-spotted spider mite *T. urticae* in strawberry fields by applying one release of the predatory mite, *P. macropilis*, early in the season when the pest population is low to provide the predator a chance to play its role successfully.

Table 5. Effect of late release of *P. macropilis* on strawberry to control *T. urticae*.

Sampling date	Plot*	Infested leaflets (%)	No. mites/30 leaflets		Reduction of *T. urticae* (%)
			T.urticae	*P. macropilis*	
Feb. 14, 2000 Pre-count, date of release	I	100	304	-	-
	J	100	500	-	-
Feb., 21 (1*st* post-count)	I	80	277	12	17
	J	100	546	0	-
Feb., 28	I	80	296	18	45
	J	87	887	30	-
March, 6	I	73	437	60	25
	J	93	964	38	-
March, 13	I	80	254	152	23
	J	100	546	45	-
March, 21	I	33	43	108	70
	J	73	236	148	-
March, 27	I	33	33	39	71
	J	53	89	141	-
April, 10	I	0	0	10	100
	J	33	39	34	-
April, 24	I	10	6	5	81
	J	37	52	5	-

* Plot I : Bean leaflets harbouring predaors alone

J : No release (check 2)

Table 6. Inspection of associated weeds, the adjacent strawberry and cucumber and faraway strawberry plantations.

Inspection date	No. mites/30 leaflets or leaves							
	Strawberry		Cucumber		Faraway strawberry*		Associated weeds**	
	T.urticae	*P. macropilis*	*T.urticae*	*P. macropilis*	*T.urticae*	*P. macropilis*	*T.urticae*	*P. macropilis*
Jan. 31, 2000	-	-	-	-	1378	0	-	-
Feb., 14	917	5	-	-	1256	0	-	-
March, 13	390	23	322	25	1075	0	13	3
April, 17	116	3	250	21	366	0	43	9
May, 17	65	9	189	15	257	0	34	7

* About 2 kms far-treated with the recommended acaricides

** Mainly Mexican tea.

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إطلاق المفترس *PHYTOSEIULUS MACROPILIS* لمكافحة العنكبوت الأحمر *TETRANYCHUS URTICAE* على الفراولة بمحافظة الاسماعيلية بمصر

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تم إطلاق المفترس الأكاروسى *phytoseiulus Macropilis* (Banks) على نباتات فراولة منزرعة بمنطقة سيرابيوم بالاسماعيلية لمكافحة العنكبوت الأحمر *Tetranychus urticae* Koch واستخدمت إطلاقة واحدة للمفترس بمعدل ٥ أفراد/جورة فى عدة مواعيد مختلفة : فى بداية الموسم (٢٩ نوفمبر، ٧ و١٤ ديسمبر ١٩٩٩) وموعد متأخر فى نهاية الموسم (١٤ فبراير ٢٠٠٠). وقد أثبتت مواعيد الإطلاق المبكر فعاليته بدرجة كبيرة لمكافحة أكاروس العنكبوت الأحمر بالمقارنة بالإطلاقة المتأخرة. وقد وصل النقص فى تعداد العنكبوت الأحمر فى الإطلاق المبكر ٦٠-٩٠ ٪ بعد ٣-٧ أسابيع من إطلاق المفترس. وطبقاً لذلك فقد إنخفض تعداد الآفة كثيراً خلال فترة تزهير وتكوين ثمار الفراولة والتى يمكن أن يكون لها تأثير إيجابى على محصول الفراولة.

وقد تحركت أفراد المفترس من أحواض الإطلاق إلى أحواض المقارنة والأحواض البينية التى لم يتم بها إطلاق المفترس ونباتات الخيار والفراولة المجاورة والحشائش المصاحبة للفراولة، وذلك عند توفر أعداد من العنكبوت الأحمر على هذه الزراعات. وهذا يدل على إمكانية هذا المفترس أن يستقر تحت ظروف البيئة المصرية على الحشائش المصاحبة والزراعات المجاورة لنباتات الإطلاق.