

**BIOLOGICAL CONTROL OF *TETRANYCHUS URTICAE* KOCH  
IN STRAWBERRIES OPEN FIELDS AND GREENHOUSES  
BY RELEASING *PHYTOSEIULUS MACROPILIS* (BANKS)  
(ACARI : TETRANYCHIDAE & PHYTOSEIIDAE)**

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**Abstract**

Biological control of *Tetranychus urticae* Koch (Acari : Tetranychidae) on strawberries was investigated in open fields in three Egyptian Governorates by releasing the predatory mite, *Phytoseiulus macropilis* (Banks) (Acari : Phytoseiidae), at a rate of about 5 individuals/ bit. (i.e. 100000 predators/feddan). More experiments were carried out in Ismailia Governorate for releasing the predator to control the *T. urticae* population in plastic greenhouses and also release the predator in an open field with the rate of about 3 individuals/bit (i.e. 60000 individuals/ feddan). The percent reduction of *T. urticae* population reached more than 90 % after six weeks from release at Ismailia Governorate, while reached this level early in the fifth week at Qualubia and Sharkia Governorates. This was probably due to the low pest population at the time of release. The *T. urticae* reduction in the greenhouses reached more than 90 % in the sixth or seventh week of release. However, the pest and predator densities showed a tendency to increase in the greenhouses than those in open fields which could be attributed to the warmer temperature inside the greenhouse. The minimal release of the predator could maintain the pest population under relatively low level, yet the two-spotted spider mite outbreaks areas (hot spots) were occasionally observed in the released areas where additional predator release should be done. Results indicated the possibility of controlling the two-spotted spider mite, *T. urticae* on strawberries in open fields and plastic greenhouses by releasing the predatory mite, *P. macropilis* with the rate of about 5 predators/bit.

**INTRODUCTION**

Preliminary studies during 1998 at Qualubia Governorate indicated that the two-spotted spider mite, *Tetranychus urticae* Koch could be controlled on strawberry in Egypt by several releases of the predatory mite *Phytoseiulus macropilis* (Banks) (Heikal *et al.*, 2000). Additional studies during 1999-2000 showed that pest control could be effectively obtained by a single release of *P. macropilis* applied early in the strawberry

growing season (during mid-Nov. - mid-Dec.) at the rate of about 5 predator individuals/bit. At this time, the pest should be at a low density of less than 5 individuals/leaflet (Heikal & Ibrahim, 2001). In the same year, Heikal described the base of two preliminary methods for mass production of the predatory mite, *P. macropilis* during different year seasons.

Studies were carried out at three locations to evaluate biological control of *T. urticae* on strawberry in open field and three net plastic greenhouses using *P. macropilis*.

## MATERIALS AND METHODS

**Predator's source :** Populations of *P. macropilis* were obtained from mass rearing of the predator on *T. urticae* on bean plants in a net plastic greenhouse (25 x 6.5 m) at the Agricultural Research Station, Ismailia Governorate. Production of *P. macropilis* was basically according to the method described by Heikal (2001) and Heikal & Ibrahim (2002).

**Predator's manipulation :** The predator prey ratios were monitored twice weekly in the predator's greenhouse to keep it in suitable levels during production period (about one motile stage of the predator/ten motile stages of the prey). However, during the release time, these ratios were reduced to be one predator to 0-2 prey individuals (Heikal & Ibrahim, 2001). Bean leaflets harbouring high density of the predator individuals and few numbers of *T. urticae* were collected in paper bags in the early morning of the release day and transferred in ice chests to the release locations.

**Predator's release :** Two strawberry fields of about 5 feddans each and three greenhouses in Ismailia and two other fields of about 0.5 feddan each in Qualubia and Sharkia Governorates, were also selected for this study. Application areas did not receive any pesticide treatments.

*P. macropilis* was released at the rate of about 5 individuals/bit (about 100000 individuals/feddan) in the selected open fields or greenhouses, and with a rate of about 3 predators/bit (about 60000 individuals/feddan) in one selected open field at Ismailia Governorate, additional release of the predator (with a low predator density) occasionally applied to ensure the predator establishment at any hot spot developed later on.

Randomized samples of 30 leaflets per field or greenhouse were picked up just before release where mite populations were counted as pre-counts. This procedure was repeated at weekly or biweekly intervals as post-counts. Samples were also obtained from the adjacent non-released fields or greenhouses as control and counts of both predator and pest were estimated in the fields using a special magnified hand lens (*i.e.* 20X).

Counts of *T. urticae* on released plots and non-released plots were compared. Henderson and Tilton equation (1955) was applied to calculate percent reduction of *T. urticae* populations.

## RESULTS AND DISCUSSION

**Open field experiments :** When the predatory mite, *P. macropilis* was released at the rate of about 5 individuals/bit in the strawberry open field at Ismailia, the *T. urticae* populations were generally low in the pre-counts. They were 86 and 71 moving stages/30 leaflets in released and non-released areas, respectively, Table 1. After releasing the predator, the *T. urticae* populations generally declined gradually and reached 1/30 leaflets after about 8 weeks from the predator release. Then, the pest population remained at its low level until the last inspection in April 24. Therefore, the pest populations were reduced during the critical flowering and fruiting periods. This agreed with that of Decou (1994) who observed (in strawberry fields under biological control of *P. persimilis*) stronger plant growth and healthier and denser foliage, possibly due to the absence of chemical treatments. On the other hand, the pest population gradually increased in the control area (non-released) which reached its highest level (635 individuals/30 leaflets) at the end of January, 2002 where the grower was obliged to apply the recommended acaricide (Ortus 5 % SC at the rate of 50 cc/100 L of water) to reduce the *T. urticae* population in the control area. .

Percentages of leaflets infested with the two-spotted spider mite in the pre-count were 70 and 50 % in both the released and non-released areas, respectively. They gradually decreased after the predator release to reach the lowest levels after eight and nine weeks from the predator release.

Reductions of the two-spotted spider mite population were weekly estimated in the first post-counts and then at one-week intervals. *T. urticae* reduction reached more than 70 % after the third week of predator release. This might be due to the relatively low population of the mite pest at that time of predator release. Then, reduction gradually increased to reach 94 % at the sixth week of release. This finding agreed with those obtained by Decou (1994) and Heikal & Ibrahim (2001).

Individuals of the predatory mite, *P. macropilis* were recovered on sampled leaflets in the release area from the first post-count indicating the establishment of the predator. Similar finding was obtained by Heikal *et al.* (2000) and Heikal & Ibrahim (2001).

Similar trends were obtained when the predator was released in strawberry fields at Qualubia and Sharkia Governorates. The pest reduction reached more than 70 % at the first and second post-counts at Qualubia and Sharkia Governorates, respectively, Tables 2 & 3. About 90 % pest reduction was recorded at the fifth week of release at both of Qualubia and Sharkia Governorates. Here again, the low population of *T. urticae* at the time of predator release encouraged quick reduction of this pest.

The predator individuals also began to appear on the sampled leaflets after one week from the predator release. A comparatively high predator populations were recorded in these two locations, where maximum of 49 and 65 predators/30 leaflets were recorded at Qualubia and Sharkia Governorates, respectively. Small areas of spider mite outbreaks were observed near the sites adjacent to the untreated eggplant, squash or cucumber plantations (which are known to be more susceptible to the two-spotted spider mite infestation). Hence, a supplementary predator release was applied in these hot areas to reduce the pest population.

When the predatory mite, *P. macropilis* was released with a low rate in an open strawberry field (about 3 individuals/bit), the pest population increased gradually in the released and non-released areas, however, these increases were comparatively higher in the non-released area, where the pest population reached 187 and 1367 moving stages/30 leaflets in the two areas, respectively, on February 6, Table 4. The maximum count of the predator occurred on March 20 where 40 predators/30 leaflets were recorded. The minimum release of this predator could maintain the pest population under

Table 1. Release of *P. macropilis* in an open strawberry field to control *T. urticae* at Ismailia Governorate.

Sampling date	Released area			Non-released area			Reduction of <i>T. urticae</i> (%)
	No./30 leaflets		%	No./30 leaflets		%	
	<i>T. urticae</i>	<i>P. macropilis</i>	Infested leaflets	<i>T. urticae</i>	<i>P. macropilis</i>	Infested leaflets	
Dec. 5, 2001 (Pre-count, date of release)	86	-	70	71	-	50	-
Dec. 12 (1st post-count)	72	16	60	80	0	55	26
Dec. 19	60	4	67	106	0	67	53
Dec. 25	63	16	45	192	0	83	73
Jan. 2, 2002	57	11	30	238	0	100	80
Jan. 9	109	2	55	392	0	100	77
Jan. 16	27	1	20	381	0	75	94
Jan. 23	15	13	24	522	0	91	98
Jan. 30*	1	1	3	635	0	100	100
Feb. 13	0	2	0	175	0	37	100
Feb. 27	17	11	33	146	0	75	-
Mar. 20	15	4	15	50	2	30	-
Apr. 7	21	0	13	188	0	55	-
Apr. 24	62	0	37	341	0	80	-

\* Date of treatment with the acaricide Ortus 5 % SC with the rate of 50 cc/100 L of water in non-release area.

Table 4. Release of *P. macropilis* with a low rate in an open strawberry field to control *T. urticae* at Ismailia Governorate.

Sampling date	Released area			Non-released area			Reduction of <i>T. urticae</i> (%)
	No./30 leaflets		% Infested leaflets	No./30 leaflets		% Infested leaflets	
	<i>T. urticae</i>	<i>P. macropilis</i>		<i>T. urticae</i>	<i>P. macropilis</i>		
Jan. 2, 2002 (Pre-count, date of release)	174	-	60	212	-	73	-
Jan. 9 (1st post-count)	65	3	50	284	0	77	34
Jan. 16	52	2	35	411	0	87	36
Jan. 23*	113	2	57	558	0	100	42
Jan. 30	190	10	57	905	0	100	40
Feb. 6*	187	5	42	1367	0	100	61
Feb. 13*	131	6	27	818	0	96	54
Feb. 27**	196	14	66	810	0	100	31
Mar. 20	37	40	35	315	0	70	66
Apr. 7	17	32	23	333	0	66	-
Apr. 24	6	22	20	415	0	70	-

\* Date of an additional release of the predator in the release area.

\*\* Date of treated with the acaricide Ortus 5 % SC with the rate of 50 cc/100 L of water in release area.

relatively low levels, yet, spider mite outbreak areas (hot spots) were frequently noticed in the released area. Therefore, the release of low density of the predator may result in less effective suppression of the pest population than do the release with 5 predators/bit. Hence, an additional predator release should be required -in the host spots- to increase the predator efficiency.

**Greenhouses experiments :** The predatory mite, *P. macropilis* was released at Ismailia Governorate on strawberry plantations cultivated under three plastic greenhouses. The two-spotted spider mite populations were generally moderate in the pre-count. It averaged 136, 128, 144 and 48 individuals/30 leaflets in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and control greenhouses, respectively, Table 5. The *T. urticae* populations slightly increased in the release and non-release greenhouses which continued until January 16 (fifth week from the predator release). Then, the pest population generally decreased gradually in the three releases greenhouses to reach their lowest density from February 13 (8 weeks from the predator release) till April 24. On the other hand, the *T. urticae* densities increased gradually in the control greenhouse and attained its highest level (1967 individuals/30 leaflets) on February 13, where the grower found at necessary to apply the recommended acaricide to reduce the pest population in the control greenhouse.

The *T. urticae* reductions reached about 60 % in the fourth post-count (four weeks from the predator release). Then, it increased rapidly to reach more than 90 % reduction in the sixth or seventh post-count.

The predator individuals began to be noticed in low numbers in the release greenhouses from the first post-count and rapidly increased in next post-counts to attain their highest densities (227 individuals/30 leaflets) in the third post-count in the first greenhouse and in the sixth post-count in the second and third greenhouses (421 and 379 individuals/30 leaflets in the second and third greenhouses, respectively). Prasad (1974) reported that a maximum population of *P. macropilis* was found when the prey population was at a peak level.

It is worth to mention that the pest population was higher in green-houses than in open fields; this could be attributed to the relatively warmer temperature in the greenhouses. Thus, it could be advisable to encourage releasing the predator individuals in the greenhouses two to three weeks earlier than in open fields when the pest

density is at its very low level. This agreed with that obtained finding by Hamlen & Poole (1980) and Hamlen & Lindquist (1981).

Thus, the foregoing results indicated the possibility of controlling the two-spotted spider mite, *T. urticae* on strawberries in both open fields and plastic greenhouses by releasing the predatory mite, *P. macropilis*. Additional predator release might be necessary in plastic greenhouses in winter, but being more suitable in open fields to increase the predator efficiency or when the low release of the predator is applied.



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**المكافحة البيولوجية للعنكبوت الأحمر *Tetranychus urticae*  
على الفراولة في الحقل والصوبة بإطلاق المفترس الأكاروسى  
*Phytoseiulus macropilis***

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أجريت مكافحة بيولوجية للعنكبوت الأحمر *Tetranychus urticae* Koch على نباتات الفراولة المنزرعة في حقول مفتوحة بالاسماعيلية والشرقية والقليوبية أو في صوب بلاستيك فى الاسماعيلية بإطلاق المفترس الأكاروسى *Phytoseiulus macropilis* (Banks) بمعدل حوالى ٥ أفراد/جورة (٦٠٠٠٠ فرد/فدان) كذلك بمعدل حوالى ٢ أفراد/جورة (حوالى ٦٠٠٠٠ مفترس/فدان) فى الحقل بالاسماعيلية. وقد وصل الخفض فى تعداد العنكبوت الأحمر أكثر من ٩٠٪ فى الأسبوع السادس فى محافظة الإسماعيلية، بينما وصل النقص إلى هذا المستوى مبكراً فى الأسبوع الثالث أو الرابع فى كل من محافظتى القليوبية والشرقية، على التوالى. وقد وصل النقص فى الصوب إلى أكثر من ٩٠٪ فى الأسبوع السادس أو السابع من الإطلاق. وعلى أى حال، فقد أظهرت كثافة العنكبوت الأحمر أنه يله للزيادة فى الصوب عن الحقول المفتوحة والذي قد يرجع لزيادة درجات الحرارة داخل الصوب. وقد أمكن للإطلاق المنخفض للمفترس أن يحافظ على تعداد الآفة تحت مستوى منخفض نسبياً. إلا أنه لوحظ أحيانا زيادة فى تعداد العنكبوت الأحمر فى بعض المساحات الصغيرة حيث تم إطلاق إضافى للمفترس فى هذه المساحات. وقد دلت النتائج فى هذا البحث على إمكانية مكافحة العنكبوت الأحمر على الفراولة المنزرعة بالحقول المفتوحة والصوب البلاستيك بإطلاق المفترس الأكاروسى *P. macropilis* بمعدل حوالى ٥ أفراد/جورة.