BIOLOGICAL CONTROL OF THE TWO-SPOTTED SPIDER MITE AND THE EUROPEAN RED MITE USING THE PREDATORY INSECT, *STETHORUS GILVIFRONS* MULSANT (COCCINELLIDAE, COLEOPTERA) ON APPLE SEEDLINGS

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Abstract

The two-spotted spider mite *Tetranychus urticae* Koch and European red mite *Panonychus ulmi* (Koch) (Family: Tetranychidae) are considered the important two species mite pests attacking apple trees causing serious damage of leaves and fruits. To enhance the exportation and reduce the applications of pesticides. We concern in this study to use the coccinellid insect *Stethorus gilvifrons* Mulsant as biocontrol agent for controlling this dangerous mite pests on apple seedlings. The predatory insect was reared on the two-spotted mite, *Tetranychus urticae* Koch and released at three levels 5, 10 and 15 adult predator per apple seedling at level infestation 4.23, 4.03 and 4.26 mite per leaf, respectively, while, the untreated one 4.96 individuals/leaf as a control. After releasing the predatory insect the mite pest, *T. urticae* population generally declined gradually and reduction percent in the population of mite pests after 110 days of releasing reached 75.69, 89.1 and 92.9%, respectively.

While the predator insect was released at the same levels 5, 10 and 15 adult predator per apple seedling to control *P. ulmi* with level infestation 2.33, 2.96 and 3.26 individuals per leaf apple seedlings, respectively. While the untreated one 3.66 individuals/leaf. The percentage redaction in the population of *P. ulmi* after 110 days after release the predatory insect reached 63.39, 73.57 and 78.33%, respectively.

INTRODUCTION

Apple trees belonging to deciduous fruit trees thus they are subjected to be attacked by many serious pests where the two-spotted spider mite, *Tetranychus urticae* Koch and the European red mite *Panonychus ulmi* (Koch) may causes considerable damages for the production quality and quantity.

This study aimed to utilizing the predatory insect *Stethorus gilvifrons* Mulsant in controlling the previous mite pests to avoid the residual effects of using pesticides.

Many successful trails have been applied using coccinellid insect as a biocontrol agents against different tetranychid mite pests infesting different orchard trees, ornamental plants and vegetable crops, Scriven and Fleschner (1960) described the mass production of *Stothorus* sp.by rearing it on tetranychide prey on orange under

controlled conditions. The adult can fly activity and aggregate on mite colonies and eat the whole mite, their preference for large motile prey has been observed by Michelbacher (1959), Bravenboer (1967), Pavdova (1975), Danial (1976), Georgis *et al.* (1978), Jiang *et al* (1982), McMurtry (1986), Tuovinen (1992), Tian *et al.* (1995), Ebrahim (2001) and Amer (2003).

MATERIALS AND METHODS

Design of experiment

These experiment was carried out using eighty seedlings divided into four groups each one of twenty seedlings, as four treatments, three levels of release 5,10 and 15 and control.

Mass rearing of predator

Bean plant *Phaseoulus vulgaris* L. used as host plant. Bean seeds were planted in plastic trays (40x40x12cm) with the rate of 20 seeds per trays. These trays were used in rearing the predatory insect who used as nucleation of the predator for releasing in the green house of mass rearing. Small greenhouse divided to three isolated parts: a) rearing of clean bean plants, b) clean plants at the stage of 12 leaves were artificially infested with *T. urticae*, c) one week later, five females of predator insect *Stethorus gilvifrons* Mulsant transferred to each bean plant, we follow up the relation between the predator and the prey inside the greenhouse, when it need for prey we were supported it with more prey. About one month when the rate of predator increased to reach 15-25 individuals/ leaflet. The predatory insect was picked in small paper bags with few prey on bean leaves and transferred inside ice box. Abo-Donia, (1994) and El-Sayed (1994).

Predators release

When the number of predator increased for suitable number to collect and release. The leaves of the beans peering the predator and small number of prey were picked in paper bag and transmitted to the seedling in ice box and the predator released on the seedling with three levels 5,10 and 15 per seedling. Random samples 30 leaflet were collected every ten days from each treatments and inspected aid stereomicroscope. First samples collected just before release and the next collected every 10 days. The number of prey and predator were recorded to the end of experiment and the reduction percent was calculated according to Henderson and Tilton equation (1955).

RESULTS AND DISCUSSION

1- Biological control of *Tetranychus urticae* Koch using the predatory insect *Stethorus gilvifrons* Mulsant (Coccinellidae, Coleoptera) on apple seedling in 2005

The predacious coccinellid insect *Stethorus gilvifrons* Mulsant was released in April 29th, 2005 at three level 5, 10 and 15 adult predators per apple seedling high infesting with the two-spotted spider mite *Tetranychus urticae* Koch.

First level of release

Data in Table (1) cleared that the predatory insect *S. gilvifrons* which released at 5 predators per seedling in April 29th, 2005 with number of motile stages of the *T. urticae* 127 and 149 individuals/ 30 leaves in released and unreleased treatments, respectively. The population of *T. urticae* gradually decreased in number after releasing the predatory insect while gradually increased in control treatment. The reduction percentages of *T. urticae* gradually increased recording 54.8, 75.0, 79.7 and 84.4% in May 9th, May 19th, May 29th and June 8th, after that the reduction gradually decreased recording 82.4, 81.5, 79.9, 77.7, 76.7, 71.1 and 69.4% in June 18th June, 28th , July 8th , July 18th , July 28th, Aug. 7th and Aug. 17th at number of predatory insect as 26, 19, 13, 14, 9, 8 and 6 individuals, respectively.

The average reduction percent of *T. urticae* after release the predator insect at rate (5 predators/ seedling) was 75.69% after 110 days of release.

Statistical analysis data as shown in Table (1) indicated that there was positive correlation between temperature and population density of predacious insect (0.46) and non-significant negative correlation between population density of predatory insect and relative humidity (-0.64).

Second level of release

When the predatory insect *S. gilvifrons* was released at rate of 10 adult predators/ seedling. Obtained data in Table (1) demonstrated infestation of two-spotted spider mite *T. urticae* generally was in moderate, so, pre-count, recorded 121 and 149 individuals/ 30 leaves in released and control treatment, then population density of *T. urticae* decreased gradually recording reduction percent 60.8% after ten days of release and then the population of mite pest gradually then decreased in released seedling to the end of the mite experiment recording 16 individuals/ 30 leaves at August 17th while it was 1150 individuals/ 30 leaves in control treatment, and the reduction percent in the mite pest population reached 98.2 at the end of experiment with averaged 89.1% (Table 1).

Statistical analysis data as shown in Table (1) indicated that highly significant positive correlation between temperature and population density of predacious insect

(0.98***) and significant positive correlation between population density of predatory insect and relative humidity (0.72*).

Third level of release

The predatory insect *S. gilvifrons* released at 15 predators/ seedling for controlling *T. urticae* in April 29th , 2005 at level infestation of 128 individuals/ 30 leaves and 149 individuals in control. The population of *T. urticae* gradually decreased after releasing the predatory insect. The reduction percentages of mite pest increased gradually as the following, 68.1, 84.1, 90.6, 93.9, 95.6, 97.3, 97.4, 97.8, 98.3, 99.1 and 99.7% in May 9th , May 19th , May 29th , June 8th , June 18th , June 28th, July 8th , July 18th , July 28th , Aug. 7th and Aug. 17th at number of predatory were 6, 11, 15, 17, 21, 27, 33, 39, 42, 26 and 12 individuals per 30 leaves at average temperature were 20.9, 23.4, 24.6, 25.1, 26.1, 27, 26.7, 27.36, 28.04, 28.2

Table 1. Biological control of *Tetranychus urticae* Koch using the predatory insect *Stethorus gilvifrons* Mulsant on apple seedling in 2005.

Sampling date	Number and redaction % of motile stages of *T. urticae*/30 leaves after release of the predatory insect.									control	Temp. °C	R.H %
	5 predators/ apple seedlings		No. of pred.	10 predators/ apple seedlings		No. of pred.	15 predators/ apple seedlings		No. of pred.			
	No.	R.%		No.	R.%		No.	R.%				
Pre-count before release April 29th	127	-	-	121	-	-	128	-	-	149	20.3	54.1
May 9th	114	54.8	3	94	60.8	5	81	68.1	6	296	20.9	51.4
May 19th	100	75	8	83	78.3	9	64	84.1	11	470	23.4	50.9
May 29th	94	79.7	17	72	83.7	16	44	90.6	15	545	24.6	50.2
June 8th	82	84.4	20	65	87	22	32	93.9	17	617	25.1	53.5
June 18th	105	82.4	26	50	91.2	23	26	95.6	21	700	26.1	52.7
June 28th	122	81.5	19	43	93.2	28	18	97.3	27	776	27.0	53.9
July 8th	155	79.9	13	32	95.6	35	20	97.4	33	905	26.7	56.1
July 18th	197	77.7	14	30	96.4	40	19	97.8	39	1040	27.36	58.8
July 28th	223	76.7	9	21	97.7	34	16	98.3	42	1125	28.04	56.5
August 7th	286	71.1	8	18	98	29	8	99.1	26	1163	28.2	58.7
August 17th	300	69.4	6	16	98.2	13	2	99.7	12	1150	27.7	61.4
Mean	161.64	75.69	13	47.64	89.1	23.09	30	92.9	22.64	744.7	25.45	54.85

No.=Number R.%=Reduction Temp.=Temperature R.H.= Relative humidity

Correlation coefficient

moving stages of the predator at level 5 predator	0.46	-0.64
moving stages of the predator at level 10 predator	0.98***	0.72*
moving stages of the predator at level 15 predator	0.95***	0.64*

Finally, level of 15 predatory insects gave an average of 92.9% reduction percent after 110 days of release, in addition to the insect predator was highly efficiency in controlling the two-spotted spider mites.

Statistical analysis data in Table (1) indicated that highly significant positive correlation between the predatory insect population and temperature (0.95***) but significant positive correlation between the predatory insect and relative humidity (0.64*) at level 15 predators/ seedling.

2-Evaluating the efficiency of different levels of release of the predatory insect *Stethorus gilvifrons* Mulsant against *Tetranychus urticae* Koch on apple seedlings

Data in Table (2) illustrated that, the predatory insect *S. gilvifrons* was released at three level 5, 10 and 15 adults of *S. gilvifrons* for controlling *T. urticae* on apple seedlings. The mean of reduction percentages in population of *T. urticae* after release were 75.69, 89.10 and 92.9% for levels 5, 10 and 15 predators/ apple seedling, respectively. There were significant different between the level of 5 predatory insect and others two levels of release 10 and 15 predators, while no significant between levels 10 and 15 predators insect. The highest reduction percent of mite pest at level 15 predatory insect/ seedling, at reduction percentage 92.9%. Thus the second level of release the predatory insect the best level because no different between the second and third levels.

3- Biological control of the European red mite *Panonychus ulmi* (Koch) using the predatory insect *Stethorus gilvifrons* Mulsant (Coccinellidae, Coleoptera) on apple seedling in 2005

Results in Table (3) indicated that, the predatory insect was released with three level (5, 10 and 15 predators/ seedling) in April 15th 2005 against *Panonychus ulmi* (Koch) on apple seedlings.

First level of release

The pre-count of population density of *P. ulmi* were 70 and 110 individuals/ 30 leaves in treated and untreated seedling, respectively at level 5 predatory insect/ seedling.

The reduction percent in population density of mite pest reached 22.6% in first post-counts in April 25th at average temperature 20.6ºC and 53.7% R.H. After that the reduction percent increased gradually reaching 83.3% in June 14th at number of predatory insect 27 individuals, on the opposite pest population increased in the control reaching 246 individuals/ 30 leaves then the reduction percent of the mite pest decreased gradually from 83 to 56.2% in Aug. 3rd at number of predatory insect 33

and 5 individuals/ 30 leaves at average temperature 26.8ºC and 53.9 to 57.2% R.H., respectively.

The average of reduction percent of *P. ulmi* after 110 days of releasing the predatory insect recorded 63.39%.

Statistical analysis in Table (3) provided that there was highly significant positive correlation between the population density of *S. gilvifrons* and Temperature (0.76**) while non significant positive correlation between the predatory insect and relative humidity (0.19).

Table 2. The mean reduction of *Tetranychus urticae* Koch as a result of releasing the predatory insect *Stethorus gilvifrons* Mulsant.

Rate of release	*T. urticae*	Reduction	*S. gilvifrons*
5	161.64 a	75.69 b	13.00 b
10	47.64 b	89.10 a	23.09 a
15	30.00 b	92.90 a	22.64 a
F. value	17.06	36.48	7.29
P.	0.0001	0.0001	0.0042
L.S.D.0.05	51.03	4.41	6.23

Second and third level of release

The predatory insect *S. gilvifrons* was release at level of release 10 and 15 adult predators/ seedling in April 15th 2005 to control *P. ulmi* at level infestation with *P. ulmi* were 89, 98 and 110 individuals/ 30 leaves at 10 and 15 adult predators per seedling and control treatment.

The population density of *P. ulmi* gradually decreased in number after 10 days of release the reduction percentage were 24&26, 42.2&45.3, 53.9&60.1, 64.5& 71.3, 80.3& 89.3, 87.8& 92.7, 92.5& 95.5, 93.7 & 96.4 , 92.7&96, 89.8&95.6, 87.9 and 93.5%in April 25, May 5th , May 15th , June 4th , June 14th , June 24th, July 4th , July 14th, July 24th and August 3rd at number of predatory insect 9&11, 11&15, 17&22, 20&28, 24&30, 28&46, 37&50, 32&41, 21&40, 16&37and 9&34 individuals/ 30 leaves at level 10 and 15 predators/ seedling, respectively.

Finally, the average reduction percent of *P. ulmi* after 110 days of releasing the predator were 73.57 and 78.33% at level 10 and 15 individuals/ seedling, respectively.

Statistical analysis in Table (3) showed that there are highly significant positive correlation between temperature and population density of predatory insect were

(0.94***and 0.93***) while non-significant positive between the population density of predator insect and relative humidity were (0.54 and 0.52) at level 10 and 15 predatory/ seedling, respectively.

4- Evaluating the efficiency of different levels of release of the predatory insect *Stethorus gilvifrons* Mulsant against *Panonychus ulmi* (Koch)on apple seedling

Revealed data in table (3) indicated that the predatory insect *S. gilvifrons* was released at three levels 5, 10 and 15 predators insect per apple seedlings. The most effective level was 15 predator insects per seedlings. The mean reduction percent in population of *P. ulmi* were 63.39, 73.57 and 78.33% for levels 5, 10 and 15 predators, respectively. Statistical analysis cleared that there were significant differences between the level 5 predators and the others two release levels of 10 and 15 predators per seedling, also introduced that there is no significant between t 10 and 15 levels, the best level to release of the predator insect 10 predators/ seedling at reduction percent 73.57%.

Table 3. Biological control of *Panonychus ulmi* (Koch) using the predatory insect *Stethorus gilvifrons* Mulsant on apple seedling in 2005.

Sampling date	Number and redaction % of motile stages of *P. ulmi* /30 leaves after release of the predatory insect.									control	Temp. °C	R.H %
	5 predators/ apple seedlings		No. of pred.	10 predators/ apple seedlings		No. of pred.	15 predators/ apple seedlings		No. of pred.			
	No.	R.%		No.	R.%		No.	R.%				
Pre-count before release April 15th	70	-	-	89	-	-	98	-	-	110	18.7	54.7
April 25th	65	22.6	6	81	24	9	87	26	11	132	20.6	53.5
May 5th	59	39.8	8	72	42.2	11	75	45.3	15	154	19.5	52
May 15th	51	52.6	14	63	53.9	17	60	60.1	22	169	22.8	51.2
May 25th	46	61.5	18	54	64.5	20	48	71.3	28	188	24.1	51.6
June 4th	32	78.3	21	37	80.3	24	22	89.3	30	232	25.1	52.7
June 14th	28	83.3	27	26	87.8	28	17	92.7	46	264	25.9	53.1
June 24th	32	83	33	18	92.5	37	12	95.5	50	297	26.8	53.9
July 4th	45	77.5	26	16	93.7	32	10	96.4	41	315	27.0	54.7
July 14th	57	75.9	14	22	92.7	21	13	96	40	373	27.3	56.7
July 24th	88	66.6	8	34	89.8	16	16	95.6	37	415	27.2	59.2
August 3rd	120	56.2	5	42	87.9	9	25	93.5	34	431	28.3	57.2
mean	56.63	63.39	16.36	42.27	73.57	20.36	35.0	78.33	32.18	256.7	24.4	54.2

No.=Number R.%=Reduction Temp.=Temperature R.H.= Relative humidity

Correlation coefficient

moving stages of the predator at level 5 predator	0.76**	0.19
moving stages of the predator at level 10 predator	0.94***	0.54
moving stages of the predator at level 15 predator	0.93***	0.52

Table 4. The mean reduction of *Panonychus ulmi* (Koch) as a result of releasing the predatory insect *Stethorus gilvifrons* Mulsant.

Rate of release	*P. ulmi*	Reduction	*S. gilvifrons*
5	56.63 a	63.39 a	16.36 a
10	42.27 a b	73.57 b	20.36 b
15	35.00 b	78.33 b	32.18 b
F. value	3.35	17.31	30.68
P.	0.055	0.0001	0.0001
L.S.D.0.05	18.63	5.68	4.59

The above mentioned results indicated the possibility of controlling the two-spotted spider mite *T. urtice* and the European red mite *P. ulmi* by releasing the predatory insect, *S. gilvifrons* with the rate of 15 predators per seedling without any damage on leaves.

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المكافحة الحيوية للعنكبوت الأحمر العادى والأكاروس الأحمر الأوروبى باستخدام المفترس الحشرى ***Stethorus gilvifrons*** **Mulsant** على شتلات التفاح

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يعتبر العنكبوت الأحمر العادى والأكاروس الأحمر الأوروبى من الآفات الأكاروسية الهامة التى تهاجم أشجار الفاكهة متساقطة الأوراق خاصة التفاح وتسبب خسائر فادحة على الأشجار وتقلل من الإنتاج كماً ونوعاً ولذلك تم اطلاق المفترس الحشرى *Stethorus gilvifrons* Mulsant على شتلات التفاح بثلاثة مستويات ٥، ١٠، ١٥ مفترس لكل شتلة لمكافحة كل من العنكبوت الأحمر العادى والأكاروس الأحمر الأوروبى. تم اطلاق المفترس الحشرى على العنكبوت الأحمر العادى عند مستوى من الإصابة ٤,٢٣، ٤,٠٣، ٤,٢٦ أفراد للمستويات الثلاثة ومعاملة الكنترول ٤,٩٦ فرد/ ورقة.

وتشير النتائج المتحصل عليها بعد اطلاق المفترس الحشرى ب ١١٠ يوم على شتلات التفاح أدى إلى خفض فى تعداد العنكبوت الأحمر العادى وصلت إلى٧٥,٦٩، ٨٩,١، ٩٢,٩% على مستوى ٥، ١٠، ١٥ مفترس لكل شتلة على التوالى.

وكذلك تم اطلاق المفترس الحشرى على شتلات التفاح لمكافحة الأكاروس الأحمر الأوروبى عند مستوى اصابة ٢,٣٣، ٢,٩٦، ٣,٢٦ ، ٣,٦٦ فرد لكل ورقة للمستويات الثلاثة والكنترول على التوالى وكانت نسبة الخفض فى التعداد بعد الإطلاق ب١١٠ يوم ٦٣,٣٩، ٧٣,٥٧، ٧٨,٣٣% على التوالى.

من نتائج التحليل الإحصائى لاتوجد فروق معنوية فى نسبة الخفض على مستوى ١٠، ١٥ مفترس لكل شتلة وعلية يمكن استخدام هذا المفترس الحشرى بمعدل ١٠ مفترس لكل شتلة لمكافحة الآفات الأكاروسية على شتلات التفاح. وكذلك يمكن استخدام هذا المفترس الفعال على نباتات الخضر والفاكهة والزينة والمحاصيل الحقلية لمكافحة العديد من الآفات الضارة.