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Effect of some acaricides on the biology of *Stethorus gilvifrons* Mulsant (Coleoptera: Coccinellidae) as predator of *Tetranychus urticae* Koch.

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ABSTRACT

The present work were determined to evaluate the latent effect of three acaricides Ortus Super®5%EC, Vertimec® 1.8% EC and Delmite®7.5% SC on the biological aspects of the coccinellid predator, *Stethorus gilvifrons* Mulsant as predator of the tow spotted mite, *Tetranychus urticae* Koch at laboratory conditions (30±1°C and 70±5% RH.). All experimented acaricides were affected on the biology of *S. gilvifrons*. Vertimec® was the most effective on *T. urticae* and associated predator, S. *gilvifrons* than Ortus Super® and Delmite®. Using Delmite® proved to be the safest amongst other acaricides on this predator.

Key words: Acaricides, *Stethours gilvifrons* (Mulsant), *Tetranychus urticae* Koch, biological aspects.

1. INTRODUCTION:

Tetranychus urticae Koch (Acari: Tetranychidae) has been considered as a pest of wide varieties of major crops. *T. urticae* causes many injuries in tomatoes such as reducing yield and quality by impeding plant rowth. Tomato yields were lost as a result of outbreak of infestation with *T. urticae* that caused drying and death of the plants (Abo- El Ella, 1993). High population density of spider mites was recorded on tomatoes and caused injury to the plants at Fayoum Governorate (Rizk et al., 2002).

The adult and larval stages of predators belonging to Coccinellidae play an important role in regulating pest populations. In Egypt, little information are available about the role of ladybird beetle, *Stethorus gilvifrons* Mulsant (Coleoptera: Coccinellidae) as a predator of *T. urticae* although it was recorded associated with this mite on castor bean (.El Adawy et al, 2000) and tomato (Abdel Gayed, 2004) and (Abou El-Ela, 2014).

Therefore, this study reported here to evaluate the effectiveness of some recommended acaricides, e.g. Ortus Super®5% EC, Vertimec®1.8% EC and Delmite® 7.5% SC on the biological aspects of *S. gilvifrons* at laboratory conditions.

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2. MATERIALS AND METHODS:

The present work aimed to evaluate the latent effects of Ortus Super®, Vertimec® and Delmite® on the biological aspects of the predator *S. gilvifrons* when treated with the LC_{50} of these acaricides previously determined on the spider mite *T. urticae* adults under lab. conditions (30±1°C and 70± 5% RH.). (Daniel, 1976, Fiaboe et al., 2007 and Poorani, 2017)

S. gilvifrons, one of the predominant predators associated with *T. urticae*, on tomato plants in Fayoum Governorate, was chosen for the laboratory experiments.

Table 1. The acaricides were used in this study:

Trade name	Common name	Rate of field application
Ortus Super® 5% EC	Fenpyroximate	50 cm^3/ 100 Liter water
Vertimec® 1.8 % EC	Abamectin	40 cm^3/ 100 Liter water
Delmite® 7.5% SC	Sulfur	1 Liter/200 Liter water

1- Stock cultures

A) *T. urticae*

A separate stock culture was prepared under lab. condition. Infested leaves of tomato were collected from Fayoum province. The newly emerged adults were collected and introduced on sweet potato plants grown in plastic pots under wooden cages covered with muslin to avoid cross contamination. Immature individuals were used for preparing small cultures in Petri dishes provided with sweet potato leaves; its ridges dipped in thin layer of agar 0.6% to prevent escape the mites. (Abd-Elgayed, 2004).

B) *S. gilvifrons*

Different stages of this predator was collected from tomato leaves naturally infested with *T. urticae* and introduced in chimney glasses contained sweet potato leaves infested with *T. urticae*. From such cultures, progressive cultures were prepared.

2. Toxicity experiments:

From each of the chosen acaricides, serial concentrations were used to draw the dosage-mortality regression line (5, 10, 20 &40 cm^3 for Ortus Super®, 2.5, 5, 10 &20 cm^3 for Vertimec® and 50, 100, 200 &400 cm^3 for Delmite®).

Sweet potato leaves were dipped in each of the tested concentrations for 5 seconds and left to dry in shade. For each concentration, twenty adults of *T. urticae* were introduced to Petri dishes containing treated leaves on a thin layer of agar 0.6%. All treatments were replicated five times. The alive adults were counted after 24 hrs. for the chosen acaricide. Percentages of mortality were calculated and corrected for natural mortality by using Abbott's formula **(Abbott, 1925)** and the dosage-mortality regression lines (toxicity lines) were drawn **(Finney, 1952).**

3. Latent effect:

From the toxicity lines on *T. urticae*, median lethal concentrations (LC_{50}) was calculated and used to evaluate the latent effect on the predator *S. gilvifrons* .Leaves of sweet potato were treated at the LC_{50} level (water used as control) by using dipping technique for 5 seconds, then airy dried. Twenty of newly emerged adults of the predator were transferred to the leaves and kept in a glass chimney cages. Five replicates were conducted for each treatment. The alive adults were confined for 24 hrs. after treatment. The survivor were transferred to clean glass cages and fed on *T. urticae* nymphs. Such cages were inspected daily to record the preying capacity, deposited eggs and longevity of adults.

Some of the deposited eggs incubated to record the incubation period and hatchability. The successive immatures provided with *T. urticae* in order to record preying capacity, duration of the different

stages, mortality percentages. New LSD test was used for statistical analysis of data according to the methods given by **Senedecor and Cochran (1980).**

3. RESULTS AND DISCUSSION:

S. gilvifrons is a coleopterous predator collected from tomato plants associated with spider mite, *T. urticae*. On the other hand Ortus Super®, Vertimec® and Delmite® were recommended pesticides to control the spider mite , therefore the latent effect of these pesticides were evaluated to determine their side effects on *S. gilvifrons* at laboratory conditions (30±1°C and 70±5% RH) by using the LC_{50} values for *T. urticae.* Data showed that Vertimec® is more effective against *T. urticae* than Ortus Super® and Delmite®. The results obtained could be discussed as follows:

1-Adults:

a- Preoviposition period:

Data in table (2) indicated that treatments with Ortus Super® and Vertimec® significantly shortened these periods to 3.60 and 3.70 days, respectively. This period increased when the predators was fed on nymphs of *T. urticae* untreated to recorded 6.20 days. Preoviposition period of female treated with Delmite® ranged 2-6 days with an average of 4.40 days.

b- Oviposition period:

The longest period was recorded for female treated with Delmite® (22.9 days) and reduced significantly in other treatments to recorded 13.2, 5.2 and 19.2 days for Ortus Super®, Vertimec® and control, respectively (Table 2).

c- Postoviposition period:

At Ortus Super® treatment this period shortened to 1.5 days with significant differences with other treatments, on the other hand, no significant observed between Vertimec® and control to recorded 4.2 and 4.1 days, respectively (Table 2).

d- Adult longevity:

The results recorded that Ortus Super® and Vertimec® could be effective on the longevity of adults which significantly reduced compared to Delmite® and control , the females longevity were 21.2, 12.9, 32.8 and 28.6 days for Ortus Super®, Vertimec®, Delmite® and control , respectively. For males, the same trend was observed, the longevity was 14.1, 7.9, 25.2 and 25.2 days for the above mentioned treatments, respectively (Table 2).

e- Fecundity:

The weekly deposited eggs / female and mean number of eggs/ female/ day of oviposition period were affected obviously and significantly by exposure to Ortus Super® or Vertimec®, while in case of Delmite® treatment, the total deposited eggs (64.4/ female with a rate of 2.85 eggs / female / day) outnumbered those obtained at control (49.33 egg / females with the rate of 2.7 egg / female / day). The lowest obtained eggs number (12.6 egg/female and 2.6 eggs / female / day) was recorded at Vertimec®, increased insignificantly to 21.0 eggs / female and 4.7 eggs /female/ day at Ortus Super® treatment. (Table, 2)

f- Preying capacity:

The highest total and daily consumed prey were 722.3 and 23.0 nymphs of *T. urticae* were determined for the control treatment. Such numbers reduced either slightly to 560.81 and 17.9 nymphs for Delmite® or drastically to (210.1 and 9.82 for Ortus Super®) and (124.6 and 7.21 nymphs for Vertimec®), respectively (Table 2).

The longest duration of oviposition period and adult longevity associated with the highest fecundity (with high prey consumption) were recorded at Delmite® treatment, slightly reduced significantly at control, however with the highest prey consumption. While at other treatments, drastic and significant reductions were obtained to record their lowest at Vertimec® associated with the lowest prey consumption.

2-Immature stages:

Duration of incubation periods were not evidently influenced by the kind of treatments 1.84 and 1.80 at Delmite® and control prolonged insignificantly to 2.10 and 2.11 days at Ortus Super® and Vertimec®, respectively associated with the highest mortalities (32.21 and 25.22%), the shortest incubation period 1.80 days associated with the lowest mortality (2.1 %) were recorded at untreated treatment (control). (Table 3).

Total immature stages which obtained from untreated females developed fasters and required the shortest period to complete development (11.84 days), while treatments with Ortus Super®, Vertimec® and Delmite® retarded the growth, to recorded 12.30, 12.32 and 12.96 days, respectively to complete development. Treatments with Vertimec® and Ortus Super® suffered the highest rates of mortality (65.60 and 44.25%, respectively). The lowest mortality rate (39.14%) was recorded with Delmite®, while this rate was 19.0 % for control.

Table 2. Latent effect of some acaricides on *S. gilvifrons* adults reared on *T. urticae* nymphs under lab. condations.

Treatment*	Period of (in day)			Adult longevity		Weekly deposited eggs / female				Total deposited egg / female	Mean No. of egg / female / day
	Pre oviposition	Oviposition	Post Oviposition	Female	Male	1st	2nd	3rd	4th		
Ortus Super® 5%EC	3.6 ± 0.21 2-4	13.2 ± 0.72 11-16	1.5 ± 0.23 0-3	21.2 ± 0.72 13-23	14.1 ± 0.22 12-14	12.9 ± 0.61 11-17	6.70 ± 0.76 5-14	1.20 ± 0.52 0-6		21.00 ± 1.22 19-29	4.7 ± 0.15 1.2-1.4
				210.1(9.82)**							
Vertimec® 1.8% EC	3.7 ± 0.33 3-5	5.2 ± 0.25 2-7	4.2 ± 0.20 0-6	12.9 ± 0.94 7-10	7.9 ± 0.85 4-12	12.9 ± 0.40 9-13	1.20 ± 0.41 0-2			12.6 ± 1.20 9-24	2.66 ± 0.43 1.5-5.0
				124.6(7.21)**							
Delmite® 7.5% SC	4.40 ± 0.37 2-6	22.9 ± 0.71 19-25	5.5 ± 0.86 4-10	32.8 ± 0.76 29-36	25.2 ± 1.04 20-28	23.3 ± 2.20 20-30	19.10 ± 3.56 4-32	15.30 ± 2.78 9-20	4.00 ± 1.25 2-6	64.40 ± 8.09 36-102	2.85 ± 0.37 1.9-3.9
				560.8(17.9)**							
Control	6.2 ± 0.33 5-7	19.2 ± 0.33 18-22	4.1 ± 0.51 3-7	28.6 ± 1.20 26-35	25.2 ± 1.50 22-33	16.2 ± 2.53 10-22	19.9 ± 2.86 11-35	8.8 ± 1.52 8-12	0.63 ± 0.60 0-5	49.33 ± 4.1 33-70	2.7 ± 0.21 1.2-4.2
				722.3(23.0)**							
New L.S.D.	0.82	2.66	1.75	3.22	3.92					14.62	0.88

N.B.* such pesticides used at LC_{50} which determined for *T. urticae* adults.

** Total consumed prey by couple and data between parentheses represent daily consumed prey.

According to results shown in Table (3), different tested pesticides did not exhibit significant variations among pupal durations. However, pupae resulted from larvae treated with Vertimec® required the shortest time (1.40 days) to complete development, while the longest period (2.28 days) was obtained for pupae resulted from larvae belonging to control. Pupae resulted from larvae treated with Ortus Super® and Delmite® had intermediate periods (1.71 and 1.80 days, respectively) .All pupae emerged to adult stage for the treatments of Ortus Super®, Delmite® and control. Effects of acaricides on the total duration of immature stages were insignificant compared to control.

Daily consumed prey by larvae increased gradually as the progressive larval instars. The highest prey consumption was observed for Delmite® (98.5 preys with rate of 7.4 nymphs/ day) followed by Ortus Super® (45.36 preys with rate of 3.01 nymphs/ day) and Vertimec® (33.72 preys with rate of 2.5 nymphs/ day), while the untreated individuals consumed less number of *T. urticae* (33.7 preys with rate of 2.8 nymphs/ day). All above mentioned results indicated that adult's coccinellid predator; *S. gilvifrons* was highly affected by Vertimec® and Ortus Super®. The longest duration of oviposition period and adult longevity associated with the highest fecundity (with high prey consumption) were recorded at Delmite® treatment, reduced slightly and significantly at control, however with the highest prey consumption.

Table 3. Latent effect of some acaricides on duration (in days) of immature stages of *S. gilvifrons* reared on *T. urticae* nymphs under lab. condations.

Treatment	Eggs	Larvae				Pupae	Total
		1st	2nd	3rd	4th		
OrtusSuper® 5%EC	2.10 ± 0.18 1-3	1.73 ± 0.12 1-2	1.63 ± 0.16 1-2	1.52 ± 0.14 2-3	2.15 ± 0.22 4-6	1.71 ± 0.20 1-2	12.30 ± 0.33 10-13
	**	4.36(2.22)	8.22(3.86)	13.27(7.29)	21.25(9.52)		45.36(3.01)
***	(25.22)	(24.00)	(1.22)	(7.22)	(0.0)	(0.00)	(44.25)
Vertimec® 1.8% EC	2.11 ± 0.22 1-4	2.10 ± 0.32 2-3	1.7 ± 0.22 1-2	1.80 ± 0.20 1-2	2.3 ± 0.36 1-3	1.4 ± 0.28 1-2	12.32 ± 0.17 10-13
	**	4.0 (1.72)	6.0 (2.75)	8.7 (4.66)	1.2 (5.87)		33.72(2.5)
***	(32.21)	(26.12)	(0.00)	(0.00)	(0.00)	(0.00)	(65.66)
Delmite® 7.5% SC	1.84 ± 0.19 1-3	2.50 ± 0.17 2-4	2.13 ± 0.15 2-3	2.11 ± 0.15 2-3	2.80 ± 0.14 2-5	1.80 ± 0.12 1-2	12.96 ± 0.22 12-16
	**	10.5(4.11)	17.8(8.22)	28.5(12.7)	42.2(13.83)		98.5 (7.4)
***	(23.71)	(6.24)	(6.23)	(0.00)	(0.00)	(7.12)	(39.14)
Control	1.80 ± 0.08 1-3	1.98 ± 0.08 1-3	2.08 ± 0.12 2-3	2.08 ± 0.11 2-3	2.08 ± 0.12 1-3	2.28 ± 0.21 1-3	11.84 ± 0.21 10-14
	**	5.1(2.6)	7.9(3.8)	10.4(5.1)	12.1(5.6)		33.7(2.8)
***	(2.1)	(5.6)	(2.33)	(1.2)	(7.2)	(0.00)	(19.00)
NewL.S.D.	0.55	0.81	0.43	0.42	0.83	0.90	1.21

N. B. * Such pesticides used at LC_{50} which determined for *T. urticae* adults.

** Shows the total consumed prey /life (average of daily consumption).

*** Data in parenthesis represent mortality percentage.

On the other hand, the total duration of immature stages (12.96 days) associated with the lowest mortality (39.14%) and the highest ability for predates (98.5 preys) were obtained at Delmite®. Such records reduced insignificantly at other treatments to reach the lowest duration (11.48) days and the lowest prey consumption (33.7) at control.

Results agree with Harris and Valearce (1955), they observed that all organophosphorus compounds were high toxicity on Coccinellidae. Also Charles et al., (1985) and James et al., (2001), indicated that the organophosphorus compounds killed all individuals of *Stethorus bifidus* Biddinger. Hill (1968) observed that Vertimec® was very toxic to *Stethorus.* Daniel, (1976) investigated the biology of *S. keralicus* Kapur reared on the mite *Raoiella indica* Hirst (a pest of palms) on areca in February-March, when the temperature varied from 26 to 34°C and the relative humidity from 64 - 85%. Development from egg to adult occupied 12-14 days. adults and larvae fed on all stages of the mite. Abdel Gayed (2004) recorded that Vertimec® appeared the highest persistent under natural conditions and the most eradication for pests and predators, followed by Actellic®, while Biofly appeared the lowest toxic.

The bionomics of *Stethorus tridens* Gordon fed on *Tetranychus evansi* Baker &Pritchard were studied in the laboratory. The number of prey consumed by *S. tridens* increased with increasing instar levels and the total mean number consumed during immature development was 184.1 ± 18.02 *T. evansi* nymphs per individual. For adult male and adult female, the daily consumption was 41.3 ± 0.80 and 67.8 ± 1.69 nymphs, respectively. At 27°C, the sex ratio, expressed as the proportion of females, was 0.54 and the mean preoviposition, oviposition and postoviposition periods were 10.3 ± 0.67, 31.2 ± 4.74 and 30.2 ± 5.24 days, respectively. The oviposition rate was 4.0 ± 0.16 eggs/female/day with a female mean longevity of 71.6 ± 6.19 days and an intrinsic rate of natural increase of 0.104 (Fiaboe et al.,2007)

Taghizadeh et al., (2008) in India studied development of *S. gilvifrons*, a predator of two spotted spider mite (*T.urticae*), under laboratory conditions at constant temperatures of 15, 20, 25, 28, 30, 35 and 40°C. No development occurred at 40°C. The total development time at temperatures tested was 56.47, 31.19, 18.53, 17.54, 12.49, and 9.27 days, respectively.

Abou El-Ela, A. A. (2014) investigated five acaricides, Challenger®, Ortus®, Delmite®, Vertimec® and Bioca® for controlling *T. urticae* and their effects on the predatory insects, mites and spiders at Fayoum Governorate on cotton seedling during the seasons of 2007 and 2008. The application of these pesticides induced 83.247%, 84.11%, 76.34%, 56.29% and 59.57% reduction during the 2007 season changed to 84.78%, 84.94%, 77.31%, 55.58% and 58.68% reduction during 2008, respectively.

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تأثير بعض المبيدات الاكاروسية علي بيولوجية المفترس*Stethorus gilvifrons* المتغذي علي أكاروس العنكبوت الأحمر*Tetranychus urticae*

الملخص العربي:

أُجريت هذه الدراسة بمعمل الأكارولوجي بكلية الزراعة جامعة القاهرة، لتقدير التأثير المتأخر لثلاثة مبيدات أكاروسية وهم (أورتس سوبر– فرتيميك– والدلميت) علي بيولوجية المفترس*Stethorus gilvifrons* المتغذي علي حوريات أكاروس العنكبوت الأحمر*Tetranychus urticae* وذلك علي درجة حرارة 30±1°م ورطوبة نسبية 70± 5%، وقد أظهرت النتائج أن مبيد الفرتيميك هو الأكثر تأثيراً علي المفترس وأكاروس العنكبوت الأحمر، مقارنة بمبيد أورتس سوبر والدلميت، كما ثبّت أن مبيد دلميت هو الأكثر أماناً علي هذا المفترس عن المبيدات الاخري المستخدمة محل الدراسة.