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COMPARATIVE EFFICIENCY OF PESTICIDES AND SOME PREDATORS TO CONTROL SPIDER MITES:
II- BIOLOGICAL AND BEHAVIORAL CHARACTERISTICS OF PREDATORS *Stethorus gilvifrons*, A*mblyseius gossipi* AND *Phytoseiulus macropili* ANd THEIR HOST TWO SPOTTED SPIDER MITE, *Tetranychus urticae* UNDER SOME CHEMICALS TREATMENTS.

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ABSTRACT

The effect of sub lethal doses of six compounds, three acaricides (abamectin, ethion and chorfenapyr),one pyrethroid (cyhalothrin),one mineral oil (Nat-1) and one plant extract (*Allium sativum*)on some biological and behavioral characteristics of the two spotted spider mite,*Tetranychus urticae* and adult female of predators *Stethorus gilvifrons*, A*mblyseius gossipi,* and *Phytoseiulus macropilis* was examined. The results indicated that Cyhalothrin was the most effective compound tested on egg deposition, which is beneficial for some IPM programs away from predators' employments. *A. sativum* extract has the least effect on egg deposition that confers a chance to produce eggs enough for predation including egg mite, the preferable stage, for some predators. Ethion, chlorfenapyr and abamectin are considered ideal from the biological point of view since they decreased egg deposition to a suitable level and the character is needed for any integrated mite management program. Nat-1 is the best compound that has a moderate effect on egg deposition of spider mite which gave these compound special importance in integrated mite management. Nat-1 and *A.sativum* extract exhibited the least effective ovicidal action. The ovicidal effect of Chlorfenapyr and abamectin were about the same against the egg stage of spider mite. Cyhalothrin and ethion were highly toxic compounds that caused the highest decrease in egg hatchability. Cyhalothrin and abamectin were the most effective on prey egg consumption, predator egg production and predator's egg hatchability of three predators. Ethion and chlorfenapyr occupy the next position in prey egg consumption, predator egg deposition and predator's egg hatchability of three predators. Nat-1 and *A. sativum* extract were the least effective compound in prey egg consumption, predator egg deposition and predator's egg hatchability of three predators. Also, Nat-1 and *A.sativum* extract were the safest compounds that allowed the predator's egg to hatch producing the next stages necessary to the biological agent to minimize prey populations.

INTRODUCTION

A. gossipi is an important phytoseiid mite on various crops (Croft and McGroarty, 1977) and it is a key predator for managing spider mites (Specht, 1968).*P.macropilis* was released by several authors to control this pest on many plants (Osborne and petitt, 1985). Also, *S.gilvifrons* is one of the faster development rates and has high oviposition and predation rates (Sabelis, 1981). These species are specialized predators of the two-spotted spider mite, reproduce more quickly than the spider mites and feed on all stages of the two-spotted spider mites. The possibility of controlling phytophagous mites by a combination of biological and chemical methods had proved a less costly and more permanent method of control than had pesticides alone (Croft, 1978; Hislop and Prokopy, 1981; Opit *et al*., 2009 and Wang *et al*., 2009).Clearly, if chemical and biological methods are successfully integrated then the impact of pesticides used to control key pests and disease, must be minimize on beneficial arthropods. Successful control depends upon three principle aspects of the predator's biology: firstly the rate of prey consumption, secondly the relative rates of predator and prey egg production, and thirdly the relative rates of development through the life cycle. The host plant of spider mite is of important value in deciding the very useful for the relation between the two types of mites and is influenced by plant characteristics. Thus when this relation is translated to pronounces and valuable results, it will be of important value in process of integrated pest management. These all above factors are closely related since, for example, egg production by the predator is directly influenced by prey consumption. Low levels of pesticides, which do not cause mortality, can influence the success of a predator as a result of behavioral modification. Due to the different chemicals that may use against phytophagous mites and different biological control agents that may be combined with pesticideal control that lead to minimize the environmental pollution. There is a renewed interest in the use of integration between chemicals of different mode of action in combination with the use of perdatary mites in tetranychid mite control. The present study was carried out to examine the effect of sub lethal doses of six compounds, three acaricides (abamectin,ethion and chorfenapyr),one pyrethroid (cyhalothrin),one mineral oil (Nat- 1) and one plant extract (*Allium sativum*)on some biological and behavioral characteristics of the two spotted spider mite,*Tetranychus urticae* and adult female of predators *Stethorus gilvifrons* ,*mblyseius gossipi,* and *Phytoseiulus macropilis*, fecundity and hatchability of eggs for prey, feeding behavior, fecundity and hatchability for the three predators.

MATERIALS AND METHODS

Prey culture:

The two-spotted spider mite, *Tetranychus urticae* (Koch) (Acarina: Tetranychidae), reared according to Dittrich (1962). *Tetranychus urticae* colonies were obtained from castor bean plants from Kafr El-Sheikh governorate and reared under laboratory conditions on castor bean, *Ricinus communis* (L) plants to be away from any contamination with pesticides before starting the experiments. 4-6 seeds of castor beans were planted in each pot and the growing seedlings were infested by clean culture of red mites. Mites were transferred from old to young plants by cutting heavily infested leaves into small sections which were then placed on new plants. Adult female of red spider mites were collected from stock cultures and allowed to oviposite overnight into castor been leaves. The females were then removed and the leaves infested with eggs were placed on clean plants.

Groups of plants bearing eggs laid within 24 hours period were transferred to small cages. Adult females of uniform age were collected from the cultures for experimental use. The prey culture was kept at 25 ± 2°C under 16 hours photoperiod to encourage plant growth, and 70 ± 5 R.H. The provision of 16/days length ensured that mites would not enter diapause. An artists brush (No.0) was used to transfer mites from plant to another.

Predators culture:

Three Predators used in this study are A*mblyseius gossipi, Phytoseiulus macropili* and *Stethorus gilvifrons* (Acarina: Photoseiidae), were collected and reared on pollen grains of castor bean oil(*Ricinus communis (L)* plants as described by Overmeer *et al.* (1982)

Chemicals used:

Six compounds were used. The chemical names for the tested compounds are:

1-Abamectin (1.8 % E.C **)**:A mixture containing a minimum of 80% avermectin B_1a (5-0-demethy1 avermectin A_1a) and a maximum of 20% avermectinB_1b[5-0demethy1-25-de-(1-methy1-propy1)-25-(1-methylethy1) avermectin A,a].

2-Ethion(50 % E.C **)**: 0,0,0,0- tetraethy1 s,s-methylene bis (phosphorodi-thioate).

3-Cyhalothrin (5% E.C**):**A reaction product comprising equal quantities of (S) -2- cyano-3 ~ phenoxybenzy1 (z)-(1R3R)3- (2-chloro-3,3,3-trifluoropropeny1) -2,2 ~ dimethyl cyclopropane carboxylate and (R) -a-cyno-phenoxybenzyl (Z) - (1S, 3S) -3- (2 ~ chloro-3,3,3-trifluropropenyl) - 2,2- dimethyl cyclopropane- carboxylate.

4-Chlorfenapyr (36 % S.C**) :** 4-Bromo-2- (chlorophenyl) (ethoxymethyl)-5-(trifluoromethyl)- 1H- pyrrole -3- carbonitrile ; 4- Bromo -2 - (4-chlorophenyl) – 1- (ethoxymethyl) -5- (trifluoromethyl) pyrrole -3- carbonitrile.

5- Mineral oils : Nat 1 (96 % E.C) was provided by Central Agricultural Pesticides Laboratory-Natural oil was applied at rate of 1L / fedan.

6-Plant extract (*Allium sativum*): An amount of 80.0gm of clean seeds were added to 300 ml acetone and methanol (1:1.The extract was filtered and evaporated and 300ml acetone were added to go out the pure substance. Triton X 100 was used as an emulsifier, at rate of 0.1%

Experimental techniques:

1. Effect of chemical residues on *T. urticae* egg deposition and egg-hatching.

The residual effect of each tested compounds at LC_{25} level on adult prey mites was evaluated according to Kerratum *et al*. (1994).

2. Effect of chemical residues on egg consumption, egg laying and hatchability by the predators:

The method which was adopted by Keratum *et al*. (1994) was used to evaluate the effect of tested compounds residues on egg consumption, egg laying and hatchability by predatory mites: A*mblyseius gossipi, Phytoseiulus macropili* and *Stethorus gilvifrons*.

RESULTS AND DISCUSSION

Effect of compound's residues on egg deposition by the adult females of *T.urticae*:

The effect of sub lethal concentrations of the tested compounds (LC_{25}) on egg deposited by the adult female mites of *T.urticae* was studied. Five adult female mites were allowed to oviposite on different compounds-treated plants for a period of 5 days. Each treatment was replicated four times. The data shown in table (1) indicated that ethion and cyhalothrin caused the highest reduction in egg deposition comparable to the control treatment through the first day (84.1 and 82.2%) reduction while abamectin, chlorfenapyr,Nat-1 and *A.sativum* extract caused a moderate reduction (50.5,45.8,45.8 and 28.0% reduction) and indicated about the same effect on egg deposition of adult female mites. One of the important bases of the integrated pest management is the studying of the different effects of the different chemicals or biological agents on mite egg deposition and different responses of the eggs to these agents. The same information must be available about the predatory mite. This information are of great importance for the entomologist to reach the different relations of certain importance, between the phytophagous mites and predatory one and their responses to each other, from one side, and to the chemical or biological agent from another one. Also, there were significant differences between their effects on egg deposition comparable to the control treatment through the first day. Through the second day of oviposition cyhalothrin and ethion showed of the highest effect on the fecundity of mite (68.75% reduction of each), while abamectin, chlorfenapyr, Nat-1and *A.sativum* extract had abut the same effect on mite egg deposition (51.8, 48.2, 36.6 and 25.0 reduction), but they were significantly different from the control treatment through the second 24 hrs.

Through the third day of egg deposition, cyhalothrin was still of the highest effect on egg deposition of spider mite *T.urticae* (59.2% reduction), followed by ethion,(55.8% reduction ,chlorfenapyr (51.7%reduction),and abamectin (49.2%reduction),while Nat-1 and *A.sativum* extract were of about similar effects on egg deposition(29.2 and 21.7% reduction).The accumulated eggs deposited by the adult females of mite *T.urticae* through the first to fifth day exhibited about the same trend. From the mean number of eggs deposited by adult female mites *T.urticae* on some plants treated by different compounds table (1), results suggested that cyhalothrin was the most effective compound on egg deposition followed by ethion ,chlorfenapyr and abamectin. While, Nat-1 and *Allium sativum* extract had a moderate effect on that character and were about similarly effective in reducing mite fecundity. In general the effect of different compounds can be arranged descendingly as follows: cyhalothrin > ethion > Chlorfenapyr. > abamectin > Nat-1 > *A.sativum* extract > control. Several studies were carried out on the effect of different compounds on mite biology indicated that these compounds always showed positive effect on egg deposition of the prey.

Stafford and Fukushima (1970) indicated that oviposition of *T.pacificus* decreased with increasing concentration of the acaricide, fungicide benomyl.

Nakashima and Croft (1974) suggested that the reduction in egg deposition in predaceous mite *A.fallacis* fed on benomyl treated prey may be due to inhibition of mitoses by a breakdown product of the pesticide known to affect cell division in fungi where benomyl is of fungicidal effect. Direct interference with the division and growth of egg cells may be responsible for the suppression of egg laying in two-spotted spider mite exposed to the antibiotic cyclohiximidine (Harries, 1961 and 1963). Dittrich *et al*. (1974) found that egg lying in successive generations was increased if *T.urticae* was exposed to residues of carbaryl or DDT. They suggested that these effects may result from" hormotigoses "that is the stimulation of biochemical processes by small quantities of stressful chemical which, in these cases, the pesticide". The results of the present study probably have a similar explanation. The oviposition in mites is known to be related to feeding and the antifeeding properties of some pesticides especially the pyrethroids that will indirectly affect egg laying. Fenvalerate deposit reduced oviposition in *T.urticae* due to the antifeeding properties of pyrethroid residues (Keratum, 1993). The obtained results are also in agreement with that recorded by Ayyappath *et al*. (1997), Hosny *et al*. (1998) and Derbalah (1999). They showed that fecundity was highly reduced by bromopropylate followed by fenpyroximate and dicofol and no significant differences among them in their effects were observed. It is interesting to note that the results of sterilizing effect which had shown by Hosny *et al*. (1977) on *T.cinnabrinus* is apparent in the present results.Sterilization means one or both of two aspects, few eggs and/or less hatchability. Tedion treated discs showed fewer oviposition than showed on untreated discs (4.6 and 6.5 eggs/day/female), respectively. Temporary or partial sterilization for adult mites exposed to pyrethroids treated discs could be responsible for low number of eggs laid/female/day in spite of their intermediate effect on egg hatchability. So the same two effects could be characterized by a sterilizing effect. The same conclusion was showed by Spadafora and Lindquist (1973) who indicated that benomyl at 0.03% a.i. depressed egg hatchability of *T.urticae* (Koch), they found that viability was reduced by direct application to the eggs through ingestion of treated plant tissue by gravid females. On the other hand, Singer *et al*. (1988) suggested that oviposition preference and larval performance may be correlated within populations and may vary among individuals such that females prefer the plant species on which their larvae should have the greatest chance of surviving during their first 10 days of growth. Saadoon (2006) indicated that the two tested compounds (Challenger and Vapcomic) decreased the average number of deposited eggs per female from 51.8 to 12.6 and 3.6 eggs laid/female for Challenger and vapcomic respectively. Ismail (2007) indicated that chlorfluazuron, cypermethrin and Supermasrona were the most effective compounds on egg deposition of the adult female mites *T.urticae* and caused the highest reduction in egg deposition comparable to the control treatment. Also,Hosny *et al*,(2009)indicated that cyhalothrin is the most effective compound tested on egg deposition,while black cumin extract has the least effect on egg deposition.Chlorfenapyr and

Nat-1 are the best compounds that have a moderate effect on egg deposition of spider mite which give these compounds special importance in integrated mite management.

Table (1): Effect of different compound's residues on egg deposition of *T.urticae*

Compounds	No of eggs deposited /5 adults					General Mean
	1st day	2nd day	3rd day	4th day	5th day	
Control	a 26.75±1.258	a 28±1.141	a 30±.816	a 34±1.414	a 36±.8165	a 30.95±1.062
Abamectin	d 13.25±1.258	d 13.5±1.00	d 15.25±1.258	c 18.25±.50	cd 20.75±.957	d 16.20±0.994
Ethion	f 4.25± .957	e 8.75±.50	e 13.25±.9574	d 17±1.4142	c 21±.1.414	e 12.85±1.048
Cyhalothrin	e 4.75± .50	e 8.75±.9574	f 12.25±0.50	e 15.75±0.50	e 18.75±0.5	f 12.05±0.591
Chlorfenapyr	c 14.5±1.290	d 14.5±1.290	de 14.5±1.290	de 16.75±1.25	d 19.75±0.957	de 16±1.215
Nat 1	c 14.5±.577	c 17.75±0.97	c 21.25±0.97	bc 24.5±1.290	bc 29±0.816	c 21.4±0.922
Allium Sativum	b 19.25±0.50	b 21.0±0.816	b 23.50±0.577	b 25.75±0.957	b 29.25±0.957	b 23.75±0.761
LSD0.05	0.94	1.06	0.90	1.23	0.90	___________

Effect of compound's residues on eggs hatchability of the two- spotted spider mite *T.urticae* :

This experiment was carried out to determine the toxic effect of the tested compounds at LC_{25} level on mite eggs of *T.urticae*. In other, words to determine the ovicidal action of these compounds on the egg stage. As mentioned before in materials and methods, the chemical treatments were applied for the small plants before egg laying of the prey mite. Then five adult female mites were placed on each plant for 24 hours, and then they were removed. Hatchability was counted 72 hours after egg laying for five successive days. Each treatment was replicated four times. The data were shown in Table (2) indicated that all compounds caused decrease egg hatchability comparable to the control treatment in the first day, with percent of unhatching eggs between 67 and 100%.Ethion, cyhalothrin and chlorfenapyr were the highest toxic compounds which decreased egg-hatchability of *T.urticae* followed by abamectin. While Nat-1 and *A.sativum* have a moderate effect on egg hatchability. Through the second day most of the compounds caused an obvious decrease in egg hatchability expect Nat-1 and *A.sativum* extract that were the least effective on egg hatchability.

The same results were found in the next day (third day) except Nat-1 and *A.sativum* which were the least effective on egg hatchability. In the other days (fourth and fifth days)cyhalothrin ,ethion,abamectin and chlorfenapyr were highly toxic compounds, while Nat-1 and *A.sativum* extract were the least effective on egg hatchability .In general , the effect of different compounds (Table 2) can be arranged descendingly as follows: Cyhalothrin > ethion > chlorfenapyr > abamectin > Nat-1 > *A.sativum* >control. .

Dimetry *et al*. (1990) indicated that spraying females with the LC_{25} for beta-Amyrin caused a significant reduction in viability of eggs resulting from

T.urticae.Gamieh and Saadoon (1998) reported that egg viability of *T.cucurbitacearum* was adversely affected by all tested compounds, vertimec (abamectin) was more harmful. Hosny *et al*. 1998) indicated that egg hatchability of *T.urticae* was decreased with increasing period of egg deposition on the same disc. Some investigators found similar results to that of the present experiment. El-Banhawy and Reda (1988) found that the susceptibility of *T.urticae* egg increased progressively with increasing age for synthetic pyrethroids (cypermethrin 500 ppm and pyridaphenthion 10 ppm) while abamectin was effective only on older eggs. EL-Atrouzy *et al*. (1989) indicated that a correlation was existed between hatchability and egg age in the cascade-treated eggs.

Table (2): Effects of different compound's residues on hatchability of spider mite *T.urticae*:

Compounds	Unhatched eggs at indicated day					Mean	Hatchability %
	1st day	2nd day	3rd day	4th day	5th day		
Control	f 13.75±0.95	f 9.75±1.9	f 6.75±0.96	f 4.75±1.15	e 1.00±0.5	g 7.2±1.0	71.2
Abamectin	c 22.5±3.0	c 17.00±2.16	c 15.5±1.3	c 12.00±1.8	bc 9.5±1.0	d 15.3±1.85	38.8
Ethion	b 25.0±0.00	b 21.75±0.96	ab 18.00±1.4	a 16.0±1.4	a 12.5±0.58	b 18.65+0.87	25.4
Cyhalothrin	b 25.0±0.0	a 23.75±0.96	a 18.75±0.96	b 15.75±0.5	b 13.5±1.73	a 19.35±0.83	22.6
Chlorfenapyr	b 25.0±0.0	bc 21.5±2.9	b 16.25±0.96	d 10.75±1.7	c 9.25±0.96	c 16.55±1.3	33.8
Nat 1	e 16.75±1.7	d 15.5±1.3	e 9.0±1.6	e 6.75±0.96	d 4.25±0.5	e 10.45±1.21	58.2
Allium sativum	d 17.75±0.96	e 14.5±1.2	d 9.25±0.5	g 3.25±0.5	f 0.25±0.5	f 9.0±0.73	64.0
LSD0.05	1.9	3.3	1.4	1.58	0.86	___	___

No doubt that the compounds that have an ovicidal effect may act to prevent the embryo formation or if this embryo has already formed in the next day after egg treatment, the compound may be toxic to the development nymph inside the egg membrane before hatching. Practically in nature where egg stage of mites receives direct pesticide spray or as residue in the field one can not expect an importance for egg-age variations. The scientific importance of this point is just to select the suitable selective compound that differentiate between different egg stages of mite that exposed for it's sprays in integrated mite programs. Park *et al*. (1995) found that abamectin significantly affect the hatchability of one day old eggs of *T.urticae* at (0.06 - 0.6) ppm. Four days old eggs were much more susceptible to abamectin than one day old eggs. Abamectin at selective sublethal concentration (i.e., 0.012 - 0.06 ppm) could be of value in adjusting predator/prey ratios in the integrated management of *T.urticae*. Wu *et al*. (1997) found that no effect against eggs was observed after the adult females were treated with abamectin at the LC_{50} level. Abd EL- Samad (1998) found that one day old eggs treated with Biofly caused 90% mortality during immature stages.Gamieh and Saadoon (1998) found that vertimec (abamectin), Neorn (bromopropylate), Ortus (fenpyroximate),Sanmite (pyridaben) at LC_{25} level adversely affected the egg viability of *T.urticae*. However abamectin was more harmful (51% reduction in hatchability than other tested compounds). Derbalah (1999) found that Biofly was highly toxic to eggs of 24 and 48 hrs., while Kotb (2000) found that it was more toxic to mite *T.urticae* eggs of 3 days old than of one day old. The hydrocarbon oils are known to be used as insecticides, herbicides and as emulsifiable carries of oil soluble pesticides. In such cases the oils assist the main toxicant to penetrate since it is absorbed in and thereby softens and disrupts the waxy layer in leaves, insect cuticle or fungal spore walls and mite egg wall. The nature of physical toxicity of the hydrocarbon oils make them safe compounds from the environmental point of view, they are of low chemical reactivity, so relatively they could be used at concentrations much higher than those which would been chemically toxic. Gamieh *et al*. (2000)found that hatchability of mite eggs of *T.cucurbitacearum* treated with LC_{50} mineral oils increased as the eggs got older, being 45.43, 57.83 and 70.69% with KZ-oil and 50.51, 44.21 and 69.47 % with Supermasrona oil for one, two and three days old eggs, respectively. Amer *et al*. (2001) found that KZ-oil was more toxic to *T.urticae* during the egg stage than to adult female. Saadoon (2006) indicated that hatchability of mites *T.cucurbitacearum* eggs decreased being 57.62% with Challenger and 76.47% with Vapcomic .Total mortalities of mite immature were (61.66% and 45.17%) in Challenger and Vapcomic respectively. On the other hand, the duration of immature stages and total life cycle of this mite were prolonged when adult females were treated with LC_{50} of two tested compounds compared with untreated ones. Ismail (2007) indicated that cypermethrin was highly toxic compound that caused the highest decrease in egg hatchability on leaf discs against egg stage of *T.urticae* but etoxazole and worm wood extract were the least effective as ovicides . Hosny *et al*., (2009) indicated that cyhalothrin was highly toxic compound that caused the drastic drop in egg hatchability, while ethion and abamectin were about of the same ovicidal effect against the egg stage of spider mite.Nat-1 and black cumin extract exhibited the least effective ovicidal action of spider mite *T.urticae*.

Effect of compound's residues on the biology of the Predators:

Effect of compound's residues on the biology of the predatory mite *Amblyseius gossipi* :

Effect of compound's residues on feeding capacity:

This technique was used to test the effect of tested compound's residues on egg consumption by the predatory mite *A.gossipi*. The chemical treatments were applied for the plants before egg laying of the prey mite. The discs were dipped in LC_{25} concentration ofeach tested compound, then left to dry. 10 adult females *T.urticae* of known age were transferred to each disc to oviposite for 24 hours. Then adult females were removed and the oviposited eggs were counted with equal number of eggs of prey mite *T.urticae* on each disc. One adult female of predator mite was transferred to each treated disc. Each treatment was replicated four times. The number of prey eggs eaten was recorded after 24 and 48 hours. The data of this study shown in Table (3) indicated that most of tested compound's residues caused a decrease in prey egg consumption comparable to the control treatment through the egg meal of the first day. Cyhalothrin and abamectin caused the highest decrease in prey egg consumption by the predator, followed by ethion, there was significant difference between the chlorfenapyr and Nat-1 effects while *Allium sativum* extract has the least effect. Through the second day it was indicated that cyhalothrin and abamectin were the most effective chemicals that caused a decreased in prey egg consumption comparable to control treatment ,followed by ethion and chlorfenapyr that caused a moderate effect ,while Nat-1 and *A.sativum* extract have the least effect ,but still significant comparing control treatment. It is apparent from the calculated average number of eggs consumed by one adult predator through the first and second days, that cyhalothrin and abamectin were the most effective compounds that reduced the prey egg consumption (4.87eggs/adult/day) for cyhalothrin and 6.6 eggs/adult/day for abamectin comparable to control of 18.1 eggs/adult/day, followed by ethion (7.5 eggs/adult/day) and chlorfenapyr (8.12 eggs/adult/day).While *A.sativum* extract and Nat-1 were the less harmful compounds in this respect but not similar to control treatment (9.75 eggs/adult/day and 9.12 eggs/adult/day) respectively. In spite of the egg stage of spider mite is the main food of the predator *A.gossipi*, the leaf surface may have negative or positive chemical stimuli that determine or evaluate the contact process. Renwich and Redke (1988) stated that visual stimuli may play a role in landing process on plant leaves. This step may also decide, for a certain extent, the rate of egg consumption of the prey mite by the predator.

Effect of compound's residues on oviposition capacity:

The studies that investigate the correlation between egg consumption and egg production indicated a positive correlation under normal condition (0.883).The deposited eggs by the adult females predator under the effect of the tested compound's residues were studied through two successive days. The data in Table (3) indicated that the predator's eggs deposited under the chemical effect through the first and second days were less than that deposited under normal conditions (untreated). The average number of predator egg production through two successive days indicated that abamectin and cyhalothrin were the dangerous chemicals which caused a decrease in eggs deposited by adult females of predatory mite comparable to control (0.5 and 0.5 eggs/day) respectively comparable to control treatment of 3.5 eggs/day, followed by ethion and chlorfenapyr which have a moderate effect (1.75and 1.75 eggs/day) respectively, while Nat-1 and *Allium.sativum* extract have a little effect on egg deposition by predatory mite comparable to other tested compounds (2.37 and 2.62 eggs/day) respectively and was significantly different from control.

It is well known that there is a positive correlation between the prey egg consumption and predator oviposition. This relation may take the linear appearance if it was free from any disruptive factors. The presence of chemicals on leaf discs which is considered a disruptive factor may be coincide with the unsuitable structures of the host plant leaves to increase the above mentioned disruption leading to disturbed relation between egg consumption and predator egg deposition.

Effect of compound's residues on the numbers of eggs hatched:

Hatchability of eggs laid by predatory mite A*. gossipi* was recorded 4 and 5 days after egg laying. The hatchability of predator eggs was shown in Table (3) and exhibited that the most safe compounds were *Allium sativum* extract and Nat-1 (53.8 and 42.5 %) that allowed the predator's eggs to hatch to produce the next stages necessary to complete the biological agent to minimize prey populations. The data in Table (3) also indicate that cyhalothrin, abamectin and chlorfenapyr were the most toxic and deleterious compounds on hatching of eggs produced by the predator mite (8.8, 22.5 and 21.3 %) comparable to control treatment (97.5%). Ethion was of moderate effect on predator's egg hatchability (34 %).

Effect of compound's residues on the biology of predatory mite *Phytoseiulus macropilis*: Effect of compound's residues on feeding

The data of this study shown in Table (4) indicated that most of the tested compound's residues caused a decrease in prey egg consumption comparable to the control treatment through the egg meal of the first day. Cyhalothrin and abamectin caused the highest decrease in prey egg consumption by the predator, followed by ethion and there was significant difference between their effects. Chlorfenapyr caused a moderate effect, while Nat-1 and *A.sativum* extract have the least effect, but not similar to control treatment. Through the second day it was indicated that cyhalothrin and abamectin were the most effective chemicals that caused a decrease in prey egg consumption comparable to control treatment, followed by ethion. Chlorfenapyr caused a moderate effect, while Nat-1 and *A.sativum* extract have the least effect, but not similar to control treatment. It is apparent from the calculated average number of eggs consumed by one adult predator through the first and second days, that cyhalothrin and abamectin were the most deleterious compounds that reduced the prey egg consumption (2.75 eggs/adult/day) for cyhalothrin and (3.5 eggs/adult/day) for abamectin comparable to control of 11.25 eggs/adult/day, followed by ethion and chlorfenapyr (5.12eggs/adult/day) and (6.12 eggs/adult/day) respectively.

Effect of compound's residues on oviposition capacity:

The data in Table (4) indicated that the predator's egg deposited under the chemical effect through the first and second days were less than that deposited under normal conditions (untreated). The average number of predator egg production through two successive days indicate that abamectin and cyhalothrin were the most toxic chemicals which caused a decrease in egg deposited by adult females of predatory mite comparable to control (1.0 and 1.25 eggs/female/day)respectively comparable to control treatment (3.75 eggs/ female/day),followed by ethion and chlorfenapyr which have a moderate effect (2.0 and 2.47 eggs/ female/day) respectively, while Nat-1 and *A.sativum* extract have a little effect on egg deposition by the predator comparable to other tested compounds (2.75 and 3.35 eggs/ female /day) and were significantly different from control. The correlation between the prey egg consumption and predator oviposition was calculated. The correlation coefficients of positive value (0.947).

3-4

Effect of compound residues on number of eggs hatched:

The hatchability of predator eggs was shown in table (4) and exhibited that the most safe compounds were *A.sativum* extract and Nat-1 (61.3 and 48.8 %) that allowed the predator's eggs to hatch to produce the next stages necessary to complete the biological agent to minimize prey populations.The data in table (4) also indicated that cyhalothrin and abamectin were the most toxic compounds on hatching of eggs produced by the predator mite (10 and 22.5 %) comparable to control treatment of 97.5 %, followed by ethion and chlorfenapyr which were of moderate effect on predator's egg hatchability (30.8 and 37.5 %) and were about of the same in their effects in this respect.

P. macropilis was successfully introduced throughout the world for two-spotted spider mite control for many years. It is a voracious predator which typically reduces two-spotted spider mite to extremely low levels and then rapidly disperses to locate new colonies. It does not appear to have many alternate food sources as its numbers decline rapidly once high levels of two-spotted mite have been controlled .*P. macropilis*, a predaceous mite, is one of the integrated pest management programs for control of spider mites. This species is a specialized predator of spider mites. In fact, *P.macropilis* feeds, reproduces and completes development on mites (family: Tetranychidae), although it also feeds on young trips and can be cannibalistic when spider mite prey is unavailable (Sabelis, 1981).

Effect of compound's residues on the biology of the predatory insect; Stethorus *gilvifrons*.

Effect of compound's residues on feeding capacity

The data of this study shown in Table (5) indicated that most of tested compounds residues caused a decrease in prey egg consumption comparable to the control treatment. Through the egg meal of the first day cyhalothrin and abamectin caused the highest decrease in pry egg consumption by the predator ,followed by ethion and chlorfenapyr and there was significant difference between their effects .While Nat-1 and *A.sativum* extract have the least effect ,but not similar to control treatment. Through the second day it was indicated that cyhalothrin and abamectin were the most effective chemicals that caused a decrease in pry egg consumption comparable to control treatment, followed by ethion and chlorfenapyr. While Nat-1 and *A.sativum* extract have the least effect. It is apparent from the calculated average number of eggs consumed by one adult predator through the first and second days, that cyhalothrin and abamectin were the most toxic compounds that reduced the prey egg consumption (25.0 eggs / adult / day) for cyhalothrin and (28.0 eggs / adult /day) for abamectin comparable to control of 66.75 eggs/adult/day, followed by ethion and chlorfenapyr (35.75 egg / adult / day) and (38.62 eggs / adult / day) respectively.

Effect of compound's residues on oviposition

The data in Table (5) indicated that the predator's egg deposited under the chemical effect through the first and second days were less than that deposited under normal conditions (untreated). The average number of predator egg production through two successive days indicate that abamectin and cyhalothrin were the most dangerous chemicals which caused a decrease in egg deposited by adult females of the predatory insect comparable to control (2.1 and 2.12 eggs/day) respectively comparable to control treatment of (7.5eggs/day),followed by ethion and chlorfenapyr which have a moderate effect (3.5 and 4.0 eggs/day) respectively, while Nat-1 and *A.sativum* extract have a little effect on egg deposition by the predator comparable to other tested compounds (5.125 and 6.125 eggs/day) and were significantly different from control.

Effect of compound's residues on number of eggs hatched

The hatchability of predator eggs was shown in Table (5) and exhibited that the most safe compounds were *A.sativum* extract and Nat-1 (62.5 and 48.75 %) that allowed the predator's eggs to hatch to produce the next stages necessary to complete the biological agent to minimize prey populations. The data in Table (5) also indicated that abamectin and cyhalothrin were the most toxic compounds on hatching of eggs produced by the predator insect (12.5 and 16.3 %) comparable to control treatment of 97.5 %, followed by ethion and chlorfenapyr which were of moderate effect on predator's egg hatchability (26.3 and 37.5 %) and were about of the same in their effects in this respect.

The obtained results were in agreement with that recorded by many investigators. Discussing the foregoing results, it could be noticed that successful biological control depends upon several factors concerning the predator's biology. One of these important factors is the rate of prey consumption. Certainly low concentration level of chemicals such as LC_{25} for adult mites which do not cause enough mortality can affect other responses such as functional response, and this is why the prey egg consumption was recorded under chemical treatments. The decrease in feeding capacity by *S.gilvifrons* exposed to chemicals contaminated eggs on leaf discs could arise a non toxic influence of a change in the nature of the surface on which predator fed. It is interesting to know that the deposited eggs were not in a relation with the eaten ones. The existence of relationship between feeding and oviposition and mite activity and connection between the levels of these elements and the nature of the surface on which mites were placed suggest that disturbances in all these patterns of behavior could be triggered by the effects of sensory detection of the chemical on the surface. Mite activity can be influenced by the nature of the substrate of the surface (Blommers *et al*. 1977 and Everson, 1979 and 1980). The activity pattern of *S.glivifrons* which was not measured in the present study may be responsible for the non correlated relation between feeding and oviposition in the predatory. The presence of chemicals in low levels, on the leaf surface may be irritant enough to make the adult females predator in contact with the contaminated prey eggs accordingly the consumed eggs seemed to be almost at the same level of untreated control. The suffering adult females are expected to stop oviposition in spite of the stored food (prey eggs eaten) that was enough for oviposition process in a normal number of eggs. The relationship between the number of eggs eaten and laid by *A.fallacis* was found by Barritt (1984) linear, and when she calculated an expected value for egg production using Giboney's regression equation (1981) she found a good agreement between observed and expected oviposition when feeding was affected by bupirimate.

Sabelis (1981) suggested that adult female predator lay a constant number of eggs and that if the rate of oviposition was rapid, the oviposition period would be short, conversely if eggs were laid slowly the predator will, continue to oviposit for a longer time until it deposits full complement. Hosny and Keratum (1995) found decreased feeding and oviposition in *A.fallacis* when deltamethrin was used on prey *T.urticae*. Abou- Awad and El-Benhawy (1985) found an increased mortality of *A.gossipi* as a daily consumption of Osman *et a.,* (1979) studied some biological aspects of predatory mite *A.gossipi* (El-Badry) affected by different acaricides Curacron and dicofol with two concentrations (LC50 and LC_{25}). The egg laying capacity and percentage hatch had decreased but larval and nymphal duration increased. Kim and Paik (1996b) found that fenpyroximate did not affect the hatchability of *A.womersleyi* eggs or the developmental time of immature predators. Survival of immature predators significantly decreased with increasing fenpyroximate concentration. On the other hand, the hydrocarbon oils used in the present study were of moderate effect concerning the egg consumption and egg production and predator egg hatchability. The obtained results are in agreement with these recorded by many investigators, and they showed high effect of biological nature of chemical on predatory mite. Abou-Awad and El- Banhawy (1985) found that residues of the synthetic pyrethroids (cypermethrin, flucythrinate, fenvalerate and cyfluthrin) even at a nontoxic level to predaceous mite *A.gossipi* interrupted oviposition of prey *T.urticae* treated with cypermethrin caused an increased mortality at high prey density.Keratum (1989) reported that chemically treated surface with deltamethrin,*A.fallacis* showed decreased feeding and oviposition compared with control. Also, Ford *et al*. (1989) found that there was a reduction in the predator's oviposition. Zhang and Sanderson (1990) found that abamectin did not affect the hatch of eggs of *Phytoseiulus persimilis* at 1-16 ppm using leaf disc-dip technique. Keratum and Hosny (1994) found the effect of sub-lethal concentration of cypermethrin (EC) on the feeding and oviposition of the predatory mite *P.persimilis* using a modified leaf disc technique caused significant reduction in feeding and oviposition. Also they found that very low concentration of cypermethrin and deltamethrin caused marked reduction in feeding with a further more gradual decline with higher concentration. There was a highly significant linear relationship between feeding and egg laying. It is concluded that female predators were dipped in a 0.6 – 0.12 ppm solution, their reproduction was not affected, but at 6 ppm it decreased by 35%. Also Kim and Paik (1996a) found that reproduction was not significantly reduced of adult females as at 6.25 – 50 ppm fenpyroximate did not affect the hatchability of *A.womerselyi* eggs. Hosny *et al*. (2003a) found that cypermethrin was one of the most effective compounds on prey consumption by the predator *A.gossipi*, while Biofly was one of the safest compounds that allowed the predator to consume the contaminated prey eggs.Also Hosny *et al*. (2003b) indicated that abamectin was one of the safest compounds that allow the predator *A.gossipi* to consume contaminated eggs and slightly affected predator egg production. Ismail *et al*. (2006) indicated that the pyrethroid compound cypermethrin and the acaricide compound abamectin were the most effective that decreased prey egg consumption, decreased predator egg production and caused high decrease in egg hatchability of the predator *A.gossipi*. Ismail (2007) indicated that abamectin and cypermethrin were the most effective chemicals that caused a decrease in prey egg consumption of the predator *Stethorus gilvifrons* comparable to the control treatment, while etoxazole had the least effect. The auther found that Cypermethrin was the most effective chemical which caused a decrease in egg deposited by the predator, while etoxazole and worm wood extract were the safest compounds that allowed the predator's egg to hatch producing the next stages necessary as biological agent that minimize prey populations.Hosny *et al*.(2009) indicated that cyhalothrin and abamectin are the most effective on prey egg consumption, predator egg production, while ethion occupies the next position in prey egg consumption. All compounds have exhibited different effects on predator's eggs hatchability of the predatory mite *A.fallacis.*They also found that cyhalothrin and abamectin were highly toxic to predator's egg that caused high decrease in egg hatchability comparable to the control treatment .All compounds different effects on predator's egg hatchability of the predatory mite *P.persimilis*.Cyhalothrin and abamectin were highly toxic to predator's egg that caused high decrease in egg hatchability comparable to the control treatment of predatory mite *P.persimilis*.

The success of any integrated pest management depends on the judicious use of chemicals applied to control key pests and diseases. The importance of avoiding adverse effects on predatory species was reflected by the fact that chemicals which might be used on certain crops must be subjected to routine screening to assess their toxicity to beneficial arthropods to select the safer compounds. The rate of development of resistance to insecticides in the predaceous mites would be another important evaluation, which must be taken in consideration in IPM programmers .The world safe must be understood relative to the subject under discussion. The safe compound (chemical or biological) means; according to authers look for the present study has the following features:

1- Moderate toxicity to the prey egg stage.
2- Selective toxicity that keep the predator alive necessary for biological control.
3- Keep the predator appetite normal enough to consume prey eggs (the preferable stage for adult predator mite).
4- Allow the predator to translate the egg consumption to egg production to keep the predator populations in numbers enough to play their role in integrated pest management program.
5- Keep the predator egg viability at its maximum rate.

5

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الفعالية النسبية لبعض المبيدات وبعض المفترسات لمكافحة العنكبوت الاحمر:

2- تاثيرالمعـاملات الكيماويــة المختلفــة علــى الخصــائص الســلوكية والبيولوجيــة للعنكبـوت الاحمـر وللمفترسـات أمبليسـيس جوسـيباي، فيتوسـيلس مـاكروبلس واستيثروس جلفيفرونس

عبد العزيز حسن حسنى، عطية يوسف قريطم و ناهد السيد حسن
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التأثيرالمميـت لسـتة مركبـات مختلفـة ، ثلاثـة مبيـدات أكاروسـية (أبـامكتين واثيـون وكلورفينابير) ومبيد بيرثرويد (سيهالوثرين) وأحد الزيوت المعدنية (نـات واحد) ومستخلص نبـاتى (الثوم) على بعض الخصائص السلوكية والبيولوجية للعنكبوت الاحمر والانـاث البالغة للمفترسات أمبليسيس جوسيباي، فيتوسيلس مـاكروبلس واستيثروس0 اظهرت النتـائج ان المركب سيهالوثرين أكثر تأثيراً على وضع البيض للأكـاروس النبـاتى والذى يجعله نافعاً فى برامج المعالجة المتكاملة بينما كان مستخلص الثوم اقل تأثير على وضع البيض وهذه فرصة لانتاج البيض الكـافى للافتراس خاصـة وانـه الطـور المفضـل لـبعض المفترسـات. المبيدات اثيـون و كلورفينـابير وابـامكتين يمكـن أخذهما فى الاعتبار عند نقطة المكافحة الحيوية نظراً لخفضهما معدل وضـع البـيض للعنكبـوت الاحمر لمستوى مناسب. الزيت المعدنى (نات 1) احسن مركب متوسط التـاثيرعلى وضع البيض للعنكبوت الاحمر وهذا يعطيه الاهمية فى برامج المعالجة المتكاملة **0** الزيت المعدنى والمستخلص النباتى كانا لهما اقل تـاثير كمبيدات بيض للأكـاروس النبـاتى بينمـا مبيد ابـامكتين وكلورفينابيركانـا لهمـا نفـس التـأثير كمبيـدات بـيض للأكـاروس النبـاتى. المبيـدان سـيهالوثرين واثيـون كانـا أعلـى المركبات سمية والتى سببت انخفاض عالى فى عملية فقس البيض للعنكبوت الاحمر.

كـان المبيد سيهالوثرين والمبيد أبـامكتين أكثر المركبـات تـاثيرا فـى خفض معدل استهلاك بيض الفريسة وعملية إنتاج البيض وعملية فقس البيض للمفترسات الثلاثة كما احتل المبيدان إثيـون وكلورفينابير الموضـع التـالى فـى التـأثير علـى معدل استهلاك بيض الفريسة وعملية إنتـاج البيض وعملية فقس البيض للمفترسات الثلاثة. الزيت المعدنى والمستخلص النباتى كانا لهما اقل تأثير علـى معدل استهلاك بيض الفريسة وعملية إنتاج البيض وعملية فقس البيض للمفترسات الثلاثة وكانا أكثر المركبات أماناً و سمحت لبيض المفترس فى الفقس لإنتـاج الأطـوار التاليـة الضـرورية فـى عمليـة المكافحة البيولوجية لخفض معدل الفريسة.

قام بتحكيم البحث

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Table (3): Effect of different compound's residues on number of *T. urticae* eggs consumed, number of eggs laid and number of eggs hatched by the predatory mite *A. gossipi*.

Compounds	No. of consumed eggs/adult/ day		** Average	No Deposited eggs/adult/ daythrough		** Average	No Predator eggs un hatching at		Average	Hatchability %
	1st day	2nd day		1st day	2nd day		1st day	2nd day		
Control	18.75 ± 0.5^{a}	17.50 ± 0.5^{a}	18.1 ± 0.5^{a}	3.5 ± 0.57^{a}	3.5 ± 0.577^{a}	3.5 ± 0.577^{a}	0.25 ± 0.50^{f}	0.25 ± 0.5^{f}	0.25 ± 0.5^{f}	97.5
Abamectin	7.0 ± 0.816^{e}	6.25 ± 0.5^{e}	6.6 ± 0.65^{e}	0.5 ± 0.577^{e}	0.5 ± 0.577^{e}	0.5 ± 0.577^{e}	7.75 ± 0.5^{b}	7.75 ± 0.957^{b}	7.75 ± 0.72^{bc}	22..5
Ethion	8.0 ± 0.816^{d}	7.0 ± 0.816^{d}	7.5 ± 0.816^{d}	1.75 ± 0.50^{d}	1.75 ± 0.50^{d}	1.75 ± 0.50^{cd}	$7.0\pm.816^{c}$	6.2 ± 0.50^{c}	6.6 ± 0.65^{c}	34
Cyhalothrin	5.25 ± 0.50^{f}	4.5 ± 0.577^{f}	4.87 ± 0.53^{f}	0.5 ± 0.57^{e}	0.5 ± 0.57^{e}	0.50 ± 0.57^{e}	9.75 ± 0.5^{a}	8.5 ± 0.577^{a}	9.12 ± 0.53^{a}	8.8
Chlorfenapyr	8.0 ± 0.816^{d}	8.25 ± 0.50^{c}	8.12 ± 0.65^{c}	1.75 ± 0.5^{c}	1.75 ± 0.5^{d}	1.75 ± 0.5^{c}	7.5 ± 0.577^{bc}	8.25 ± 0.5^{ab}	7.87 ± 0.53^{b}	21.3
Nat 1	8.75 ± 0.5^{c}	9.5 ± 0.57^{bc}	9.12 ± 0.5^{bc}	2.5 ± 0.577^{b}	2.25 ± 0.50^{c}	2.37 ± 0.37^{bc}	5.75 ± 0.50^{d}	5.75 ± 0.5^{d}	5.75 ± 0.5^{d}	42.5
Allium Sativum	10.5 ± 0.57^{b}	9.0 ± 0.016^{c}	9.75 ± 0.29^{b}	2.5 ± 0.577^{b}	2.75 ± 0.50^{b}	2.62 ± 0.53^{b}	4.5 ± 0.577^{e}	4.75 ± 0.957^{e}	4.62 ± 0.76^{e}	53.8
LSD0.05	0.440	0.405	0.42	0.310	0.286	0.298	0.333	0.452	0.392	__

****Correlation between average consumed eggs and deposited eggs to the predatory mite *A. gossipi*(0.883)**

Table (4): Effect of different compound's residues on number of *T. urticae* eggs consumed, number of eggs laid and number of eggs hatched by the predatory mite *Phytoseiulus macropilis*.

Compounds	No. of consumed eggs/adult/ day		** Average	No Deposited eggs/adult/ daythrough		** Average	No Predator eggs un hatching at		Average	Hatchability %
	1st day	2nd day		1st day	2nd day		1st day	2nd day		
Control	10.75 ± 0.5^{a}	11.75 ± 0.5^{a}	11.25 ± 0.5^{a}	3.5 ± 0.57^{a}	4.0 ± 0.81^{a}	3.75 ± 0.69^{a}	0.25 ± 0.50^{g}	0.25 ± 0.5^{f}	0.25 ± 0.5^{g}	97.5
Abamectin	3.75 ± 0.5^{f}	3.25 ± 0.5^{f}	3.5 ± 0.5^{f}	0.5 ± 0.577^{f}	1.5 ± 0.57^{f}	1.0 ± 0.577^{f}	7.5 ± 0.57^{b}	8.0 ± 0.816^{b}	7.75 ± 0.69^{b}	22..5
Ethion	4.75 ± 0.5^{e}	5.5 ± 0.57^{e}	5.12 ± 0.5^{e}	1.75 ± 0.5^{d}	2.25 ± 0.5^{e}	2.0 ± 0.50^{d}	7.25 ± 0.95^{c}	6.75 ± 0.95^{c}	7.0 ± 0.95^{c}	30.0
Cyhalothrin	2.75 ± 0.5^{g}	2.75 ± 0.5^{g}	2.75 ± 0.5^{g}	1.0 ± 0.86^{e}	1.5 ± 0.57^{f}	1.25 ± 0.71^{e}	9.25 ± 0.95^{a}	9.0 ± 0.816^{a}	9.12 ± 0.88^{a}	8.8
Chlorfenapyr	5.5 ± 0.57^{d}	6.75 ± 0.5^{d}	6.12 ± 0.53^{d}	2.25 ± 0.5^{cd}	2.7 ± 0.5^{d}	2.47 ± 0.5^{c}	6.25 ± 0.5^{d}	6.25 ± 0.57^{cd}	6.25 ± 0.53^{d}	37.5
Nat 1	8.0 ± 0.81^{c}	8.0 ± 0.81^{c}	8.0 ± 0.81^{c}	2.75 ± 0.5^{c}	2.75 ± 0.50^{c}	2.75 ± 0.50^{c}	5.0 ± 0.816^{e}	5.25 ± 0.95^{d}	5.12 ± 0.88^{e}	48.8
Allium Sativum	9.5 ± 0.577^{b}	9.0 ± 0.816^{b}	9.25 ± 0.71^{b}	3.5 ± 0.57^{b}	3.2 ± 0.50^{b}	3.35 ± 0.53^{b}	3.75 ± 0.577^{f}	4.00 ± 0.816^{e}	3.87 ± 0.696^{f}	61.3
LSD0.05	0.333	0.381	0.357	0.345	0.333	0.339	0.516	0.631	0.573	________

****Correlation between average consumed eggs and Deposited eggs to the predatory mite *P. macropilis* (0.947) prey *T.urticae* treated with the pyrethroid cypermethrin or cyfluthrin.**

Table (5): Effect of different compound's residues on number of *T. urticae* eggs consumed, number of eggs laid and number of eggs hatched by the predatory insect *Stethorus gilvifrons*.

Compounds	No. of consumed eggs/adult/ day		** Average	No Deposited eggs/adult/ dathrough		** Average	No Predator eggs un hatching at		Average	Hatchability %
	1st day	2nd day		1st day	2nd day		1st day	2nd day		
Control	66.75±1.25^{a}	66.75±1.5^{a}	66.75±1.37^{a}	7.5±0.57 ^{a}	7.5±1.00^{a}	7.5±0.785 ^{a}	0.25±0.50^{g}	0.25±0.5 ^{g}	0.25±0.5 ^{f}	97.5
Abamectin	27.75±.95^{f}	28.25±0.5^{e}	28±0.725 ^{f}	2±0.816^{e}	2.2±0.5^{g}	2.1±0.658^{f}	8.75±0.5 ^{b}	8.75±0.5^{a}	8.75±0.5^{a}	12..5
Ethion	36±0.816^{e}	35.5±0.5^{d}	35.75±0.6^{e}	3.5±1.0^{de}	3.5±1.0^{e}	3.5.0±1.0^{e}	8.0±0.00 ^{c}	6.75±0.95^{c}	7.37±0.47^{b}	26.3
yhalothrin	24.5±0.5^{g}	25.5±0.5^{f}	25.0±0.5^{g}	1.5±0.57 ^{f}	2.75±0.5^{f}	2.12±0.53 ^{f}	8. 5±0.57^{a}	8.25±0.95 ^{b}	8.37±0.76^{b}	16.3
Chlorfenapyr	39±0.81^{d}	38.25±0.9^{d}	38.62±0.8^{d}	3.75±0.9^{d}	4.25±0.^{d}	4.0±0.725^{d}	6.25±0.5^{d}	6.25±0.5^{d}	6.25±0.5^{c}	37.5
Nat 1	43.75±0.95^{c}	44.25±0.9^{c}	44±0.95^{c}	4.5±0.57^{c}	5.75±0.5^{c}	5.125±0.53^{c}	5.0±0.81^{e}	5.25±0.95 ^{e}	5.125±0.8^{d}	48.75
Allium Sativum	51±0.81^{b}	50.5±0.57^{b}	50.75±0.69^{b}	5.75±0.57^{b}	6.5±0.57^{b}	6.125±0.57^{b}	3.5±0.577^{f}	4.00±0.816^{f}	3.75±0.696^{e}	62.5
LSD0.05	0.821	0.762	0.791	0.548	0.476	0.512	0.298	0.595	0.446	________

****Correlation between average consumed eggs and deposited eggs to the predatory insect *S.gilvifrons* (0.984)**