

COMPARATIVE TOXICITIES OF THREE INSECTICIDES ON EGGS HATCHABILITY OF *Pectinophora gossypiella* (SAUNDERS) AND *Earias insulana* (BOISD.) AND THEIR SIDE EFFECTS ON WASPS OF *Trichogramma* SPP. (HYMENOPTERA: TRICHOGRAMMATIDAE), UNDER LABORATORY CONDITIONS

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ABSTRACT

Studies on the toxicity of some new insecticides against *Pectinophora gossypiella* (Saunders) and *Earias insulana* (Boisd.) eggs were carried out under laboratory conditions. Field Recommended concentrations (FRCs) of three insecticides viz., Trebon (Etofenprox 30% EC), Cygron (Alpha-Cypermethrin 7% + Flufenoxuron 3% EC), and Raner (Methoxyfenozide 24 SC %) were tested against both eggs of PBW & SBW. Also, persistent toxicity of the tested insecticides was determined against the most susceptible life stage (adult) of three wasps of egg Parasitoid *Trichogramma* spp., *Trichogramma evanescens*, *Trichogrammatoidea bactrae* and *Trichogramma brassicae*. Results regarding the harmful effects of the insecticides on eggs hatchability of PBW revealed that Trebon caused the highest percentage of mortality (95.52%) followed by Cygron treatment (93.39%), while Raner caused the less percentage of egg mortality (22.35%). There were insignificant differences between mortality percentages caused by insecticides (Trebon & Cygron) and which obtained by *Trichogramma evanescens* (90.61%). In case of SBW, Trebon caused the highest percentage of mortality (78.7%) followed by Cygron (67.5%) and Raner was the least effective (32.82%) whereas, eggs mortality caused by *Trichogramma* spp. ranged between (65.72 - 75.1%) with no differences than those caused by Trebon & Cygron as in case of PBW. On the other hand, Trebon and Cygron showed a strong impact on the tested parasitoids, in contrast Raner was the least one on the tested parasitoids. Regardless of used insecticides, *T. evanescens* achieved the highest percentage of parasitism (46.53%) compared to 28.82 & 20.31% for *T. bactrae* and *T. brassicae*, respectively, whereas, percentage of adult emergence did not differ significantly between the three species of *Trichogramma*.

On the basis of this study, it could be concluded that Trebon and Cygron proved highly toxic to the tested pests and showed a strong impact on the tested parasitoids and could not therefore be used in combination with *Trichogramma* releases, whereas, Raner, is considerably mildly toxic for the pests and less harm for the bio-control agents.

Keywords: Insecticides, egg parasitoids, *Trichogramma* spp., PBW, *Pectinophora gossypiella*, SBW, *Earias insulana*.

INTRODUCTION

The pink bollworm, *Pectinophora gossypiella* and spiny bollworm *Earias insulana* are considered the most injurious cotton pests. The larvae feed on flower buds, flowers, bolls and the seeds within to developing seeds, and cause damage by reducing the yield and staple length. Chemical control using synthetic insecticides is the primary method to manage those pests, but

it has serious drawbacks, including wildlife losses, destruction of natural enemies, crop pollination problems and the development of pesticide resistance in pests (David Pimentel, 2005).

One major purpose of Integrated Pest Management (IPM) strategies is to unify the safe and sustainable use of chemical and biological control methods. Therefore, the side-effects of pesticides on bio control agents should be carefully evaluated for induction in IPM programs (Stark *et al.*, 2007). The management of insect pests can be optimized by methods of control not antagonistic to the beneficial organisms (Degrande *et al.* 2002& Devotto *et al.* 2008). Trichogrammatid egg parasitoids are considered to be the most useful biological control agents for inundative releases against lepidopterous pests (Singh and Jalali 1994). Therefore, it is imperative to assess its compatibility with chemical control for induction in integrated pest management programs. Wasps of the genus *Trichogramma* have several advantages as biological control agents, including relative ease of rearing and fact that they kill their host in the egg stage before it causes feeding damage (Bigler, 1984). Releases of *Trichogramma* are successfully used on large scale on corn, cotton, sugarcane, fruit tree and vegetable crops in more than 50 countries (Smith 1996 and Antoon *et al.* 2006). In Egypt, *T. evanescens* has been used successfully since 1984 as a biocontrol agent against different insect pests; the sugar-cane borer, *Chilo agamenon* on sugar-cane and rice, the olive pest *Prays oleae*, the peach bud borer, *Anarsia lineatella* on peach and apricot, the grape-fruit worm, *Lopezia botrana* and the date fruit worms, *Ephestia* spp. on date palms (Abbas, 2004). Augmentative releases of *Trichogramma* can be affected by the use of broad-spectrum insecticides in or near release plots (King *et al.* 1984). In India, Tuhani *et al.* (1987) found that application of *Trichogramma brasiliense* in combination with chemical insecticides gave good control of pink bollworm.

The present laboratory study was conducted to investigate three objectives: the first to study the impact of three insecticides on hatchability of *P. gossypiella* and *E. insulana* eggs to determine the percentage of eggs mortality and compare it with that obtained by egg parasitoids *Trichogramma* ssp. The second to determine the side-effect of the three tested insecticides on the susceptible life stage (adults) of three *Trichogramma* species by exposing the adults to the different treatments, and inspect females' longevity, percentage of parasitism and adults' emergence. The third target was to compare the three species of *Trichogramma* and constricting whichever less effected to insecticides treatments to investigate the possibility of using these insecticides in sequence with *Trichogramma*.

MATERIALS AND METHODS

The present experiments were carried out in Bollworms Department (Trichogrammatid Laboratory), Plant protection Research Institute, ARC, Dokki, Giza, Egypt.

Insecticides used:

All tests were conducted with fresh solutions of three commercial insecticides prepared in distilled water; the field recommended concentration

for each insecticide was used. The trade, common names and recommended field applications rates are summarized in Table (1).

Rearing of *P. gossypiella* and *E. insulana*:

Newly hatched larvae of *P. gossypiella* and *Earias insulana* were obtained from a colony maintained in the Bollworms Department Laboratory, Plant Protection Research Institute, Ministry of Agriculture, Dokki, Giza for several generations at (27 ± 1°C & 75 ± 5% RH) . Larvae were reared on a modified artificial diet as described previously by Abd El-Hafez *et al.* (1982).

Table (1): Technical specifications of the experimental insecticides.

Trade name	Common name	Formulations	Active components	Dosage*
Trebon	Etofenprox	30% EC	2-(4-ethoxyphenyl)-2-methylpropyl 3-phenoxybenzyl ether.	250 cm ³ /feddan
Cygon	Alpha-Cypermethrin-Flufenoxuron	10% EC	Alpha-cypermethrin7%: Aracemat comprising (S)- α -cyano-3-phenoxybenzyl (1R, 3R)-3-(2,2-dichloro vinyl)-2,2-dimethylcyclopropanecarboxylate and (R)- α -cyano -3-phenoxybenzyl (1S, 3S)-3-(2,2-dichloro vinyl)-2,2-dimethylcyclopropanecarboxylate. Flufenoxuron3%: 1-(4-(2-chloro- α , α -trifluoro-p-tolyl oxy)-2-flucrophenyl-3-(2,6-difluorobenzoyl)urea	250 cm ³ /feddan
Raner	Methoxyfenozide	24 SC%	N-tert-butyl-N1-(3-methoxy-o-toluoyl)-3,5-xylolhydrazide)	37.5 cm ³ /100L water

*Recommended dose/feddan in 400 Liter water.

For obtaining eggs of *P. gossypiella* and *E. insulana*:

Ten pairs of freshly emerged moths were confined a glass chimney cage, inside which a piece of cotton wool previously soaked in 10 % sugar solution was suspended to be renewed every 48 hours for moths' nutrition. The top and bottom of each cage were covered with screening mesh kept in position by rubber bands for stimulating egg-laying response in the females. Eggs were deposited through the screening mesh on a piece of paper placed upper and under the cage in open Petri-dishes. In case of SBW muslin strips were held inside the chimney for eggs deposition. Cages were maintained at (27±1 °C & 75 ±5 % R. H.) and were examined daily for collecting the pieces of papers and muslin strips that contain fresh eggs.

Obtaining eggs of factitious host, Angoumois grain moth:

The eggs of Angoumois grain moth *Sitotroga cerealella* was used as a rearing host for *Trichogramma*, and was obtained from the rearing laboratory

of Angoumois grain moth in Plant protection Research Institute, ARC, Dokki, Giza, Egypt.

Rearing of *Trichogramma*:

The parasitoids *Trichogramma* were reared on Angoumois grain moth *S. cerealella* eggs; eggs were glued to cards and exposed to *Trichogramma* adults (1 parasitoid: 10 host eggs) in glass jars (1-liter capacity). Egg cards were renewed daily to avoid super-parasitism.

Experimental techniques:

1- Mortality percentage in *P. gossypiella* and *E. insulana* eggs exposed to insecticides and *Trichogramma*:

Field recommended concentrations (FRCs) of the insecticides *viz*, Trebon, Cygron and Raner were tested initially against *P. gossypiella* and *E. insulana* eggs < 24 hour old in laboratory and ten tested cards (200 eggs/card) of PBW and/or SBW were dipped for 15 seconds in solution of recommended dose of each insecticide while, ten cards were treated with water as untreated check (control). The treated cards were left to dry naturally for approximately one hour at room temperature. After drying, the treated cards were kept individually in glass vials (3x10 cm) capped with cotton stoppers and maintained in an incubator at (27±1° C and 75± 5% R.H.) until egg hatchability. Another ten cards (200 eggs/ card) / insect species were introduced individually in glass vials to five mated females of each *Trichogramma* species and incubated under the same conditions until hatchability. The numbers of hatched larvae and dead eggs for all cards treated with insecticides and/or those treated with *Trichogramma* species were inspected.

2- Effect of exposing adult wasps of *Trichogramma* spp. to various insecticides:

The adults (susceptible life stage) of *Trichogramma evanescens*, *T. bactrae* and *T. brassicae* were exposed to the field recommended concentrations of the aforementioned three insecticides. Free-Choice and Non-choice Tests were conducted to evaluate the acceptance of the adults' females to the less toxic insecticides.

Free Choice experiment: Fresh *Sitotroga cerealella* egg cards treated with the recommended field concentration of each tested insecticides and untreated cards were introduced all together to *Trichogramma* adult females, in the same Petri-dish sealed with parafilm to prevent adult wasps from escaping out. After the parasitized eggs turned black each treated egg card was transferred to separate tube sealed with parafilm to determine the numbers of parasitized eggs, number of emerged wasps resulted from each treated eggs with the tested insecticides.

Non-choice experiment: Fresh *S. cerealella* egg cards less than 24 h old (each contained about 150 eggs) were treated with the recommended field concentration of each tested insecticide. Treated eggs for each tested insecticide was placed separately in Petri-dish and exposed to newly emerged *T. evanescens*, *T. bactrae* and *T. brassicae* females (5 females/ Petri-dish), then sealed with parafilm . Fresh eggs treated with water only exposed to newly emerged *Trichogramma* spp. were used to serve as a control.

3- Residual effect of the tested insecticides to *Trichogramma* females

This experiment was conducted in three steps;

Exposing *Trichogramma* females to treated Petri-dishes:

Ten Petri-dishes were treated with a film /each tested insecticide and left them at room temperature until dry. Five mated females of each parasite were introduced/ Petri-dish and given fresh untreated card of *S. cerealella* eggs (300 eggs/ plat). Petri-dishes were sealed with parafilm. The experiment was tested after 2 hours, 24 hours and after 8 days to determine the females' longevity and to measure the number of parasitized host eggs.

Exposing *Trichogramma* females to fresh treated host eggs:

Five mated females from each *Trichogramma* species were exposed to a fresh dry treated host eggs; i.e. cards with 300 fresh *S. cerealella* eggs each were dipped in the tested concentrations for five seconds, removed and left on a filter paper to dry, and then introduced to *Trichogramma* females in clean Petri-dish.

Exposing *Trichogramma* females to six days residues:

To study if the insecticides residues were still effective on host eggs after six days or not, *S. cerealella* egg cards were treated with the field recommended concentrations of the tested insecticides, then maintained at 10 °C after drying and offered after six days to *Trichogramma* females. Each treated card was placed individually in Petri-dish (5 cm diameter) containing five adult females (<24 h old) of *Trichogramma* spp. The control group was dipped in distilled water only. The treatments were checked after two hours hence daily to determine the adults' longevities, and after ten days to determine the rate of parasitism and adults' emergence. Each treatment was replicated ten times for each tested insecticide and the control.

Statistical analysis

Analysis of variance (ANOVA) was conducted on collected data using Costat (1990) computer program software. Means were compared by Duncan's multiple range test to separate the means (Snedecor & Cochran 1980).

RESULTS AND DISCUSSION

1- Mortality percentage in *P. gossypiella* and *E. insulana* eggs exposed to insecticides and *Trichogramma*:

The obtained result in Table (2) showed that Trebon treatment caused the highest percentage of mortality in *P. gossypiella* eggs followed by Cyron treatment, and there were insignificant differences in mortality percentages of *P. gossypiella* eggs in both and those occurred by *T. evanescens* and *T. brassicae*. The percentage of mortality caused with these four treatments was 95.52, 93.39, 90.61 and 91.01%, respectively. *T. bactrae* caused a moderate mortality for *P. gossypiella* eggs (78.76%). Whereas, Raner had a relatively slight effect on *P. gossypiella* eggs, as it caused slightly percentage of mortality (22.35%). There were significant differences between all treatments and untreated one.

Table (2): Eggs mortalities of *P. gossypiella* and *E. insulana* caused by insecticides and *Trichogramma* spp.

Treatments	<i>P. gossypiella</i>		<i>E. insulana</i>	
	%Mortality (Mean± SD)*	Range	%Mortality (Mean± SD)*	Range
Trebon	95.52±1.85 ^a	91.61-97.9	78.70±7.99 ^a	70.05-91.67
Cyron	93.39±2.85 ^a	88.65-97.78	67.50±11.92 ^{bc}	41.18-85.71
Raner	22.35±6.94 ^c	11.11-32.61	32.82±9.44 ^d	22.22-49.02
<i>T. evanescens</i>	90.61±8.45 ^a	76.36-98.61	75.10±8.44 ^{cd}	58.049-84.38
<i>T. bactrae</i>	78.76±7.94 ^b	66.33-86.83	65.72±6.33 ^c	58.62-75.44
<i>T. brassicae</i>	91.01±4.45 ^a	86.92-100	70.77±8.29 ^{abc}	54.72-81.25
Untreated	9.54±3.2 ^d	4-12	15.18±5.45 ^e	8-26
F value	477.562		68.096	
LSD (0.05%)	4.673		7.677	

*Means in the same column with the same letter are not significantly different (P=0.05).

On the other hand, treatment with Trebon and *T. evanescens* led to the maximal percentage of mortality in *E. insulana* eggs (78.70% & 75.1%, respectively). There were moderate and insignificant differences between mortality caused by Cyron and *T. bactrae* (67.50% & 65.72%). Raner had the least effect on the percentage of *E. insulana* eggs mortality (32.82%) (Table 2). The result of Raner treatment was in agreement with those obtained by Rajendran and Hanifa (1997) who found that the incidence of *Chilo sacchariphagus* and the emergence of *Trichogramma chilonis* Ishii in sugar cane field were not affected by the insecticidal treatments.

2- Effect of exposing adults *Trichogramma* to various insecticides treatments:

Free-Choice and Non-choice Tests:

Effect on the percentage of parasitism:

Data presented in Table (3) indicated that in free-choice test *S. cerealella* eggs treated with insecticides were significantly less frequently parasitized by *T. evanescens* (3.79, 12.95 & 38.25% for Trebon, Cyron and Raner, respectively) compared to (65.96%) in the untreated eggs. Whereas, females of *T. bactrae* presented in free-choice prevented to parasitize treated eggs with Trebon and Cyron (zero percentage of parasitism) and parasitized a small percentage of treated eggs with Raner (7.53%) compared to high percentage of parasitism in untreated ones (72.99%). Exposing *T. brassicae* females in free choice with treated and untreated eggs cleared that they preferred untreated ones and parasitized 57.65%, whereas, it parasitized impotent percentages at treated *S. cerealella* eggs with Trebon, Cyron and Raner (3.81, 4.76 & 4.52%, respectively).

On the other hand, in case of non-choice test when females of *T. evanescens* offered fresh eggs treated with Trebon, Cyron and Raner, females obligate to parasitize slightly more eggs. The percentages of parasitism were 15.4, 33.37 & 62.075, respectively, but still declined compared to untreated one (78.85%). Also, *T. bactrae* imposed to parasitize small number of treated eggs, as the percentages of parasitism were 5.34, 5.2, and 10.71% when fresh *S. cerealella* eggs treated with Trebon, Cyron and Raner were introduced, respectively, compared with higher parasitism in

untreated eggs (92.22%). Otherwise, exposing *T. brassicae* females to treated eggs had a significant great impact on parasitism as the percentage of parasitism reduced sharply from 69.66 in untreated eggs to 4.91, 5.31 & 4.72% in the respective insecticides. Singh and Varma (1986) found that, when *T. brasiliensis* adults were released on treated host (*Corcyra cephalonica* eggs). Phosalone, monocrotophos and fenvalerate inhibited parasitism by 26-64%. Phosalone and fenvalerate are relatively safe for the above-mentioned natural enemies and can provide selectivity in an integrated control programs for cotton bollworms. Also, Osama and Mohamed (2012) found that *S. cerealella* fresh eggs exposed to low concentrations of glyphosate had a high parasitism viability (85.5%) and higher percentage of *T. evanescens* adult emergence (91.14%) that was closely similar to the untreated 89.88% and 95.59%, respectively.

Table (3): Effect of exposing adults *Trichogramma* spp. to various insecticides in Free-Choice and Non-choice Tests.

Treatment (Recommended dose)	Free-choice*		No-Choice*	
	Parasitism %	Emergence %	Parasitism %	Emergence %
<i>T. evanescens</i>				
Trebon	3.79±3.88 c	62.08±6.54 *	15.40±11.49 ^u	57.54±18.03 c
Cygron	12.95±8.11 c	70.17±12.36 c	33.37±8.33 c	71.12±8.47 ^b
Raner	38.25±17.07 b	79.88±10.71 b	62.07±8.12 b	83.00±8.69 a
Untreated	65.96±10.52 ^a	92.01±4.11 ^a	78.85±7.16 ^a	89.58±9.76 ^a
F value	61.707	16.471	83.278	11.753
LSD	9.983	8.236	8.325	10.705
<i>T. bactrae</i>				
Trebon	0.00±0.00 b	-	5.34±5.61 b	69.31±11.33 c
Cygron	0.00±0.00 b	-	5.20±4.68 b	75.28±6.30 bc
Raner	7.53±18.43 b	71.43±1.0 b	10.71±9.41 b	79.78±7.91 b
Untreated	72.99±16.12 a	88.27±7.82 a	92.22±3.45 a	91.96±6.84 a
F value	10.829	743.55	488.05	11.308
LSD	10.853	4.277	5.523	7.477
<i>T. brassicae</i>				
Trebon	3.81±5.07 b	50.00±0.00 c	4.91±3.44 b	79.62±11.54 b
Cygron	4.76±6.98 b	68.06±6.37 b	5.31±3.49 b	68.69±16.53 c
Raner	4.52±4.36 b	67.92±13.15 b	4.72±5.99 b	74.11±7.04 bc
Untreated	57.65±6.54 a	94.29±3.42 a	69.66±2.95 a	97.33±1.15 a
F value	59.594	64.143	545.501	10.664
LSD	9.272	5.832	3.809	10.09

*Means in the same column with the same letter are not significantly different (P=0.05).

Effect on percentage of emergence:

Similar trend was recorded for the adult emergence in both free-choice and non-choice tests. Table (3) showed obvious and significant decrease in the percentage of parasitoids progeny emerged from treated host eggs compared with untreated one, except for the percentage of emergence obtained from *T. evanescens* treated with Raner in no-choice tests which decreased insignificantly from 89.58 in control to 83.0% in Raner treatment. These results are in agreement with Rajendran and Hanifa (1997) who found that application of 2000 ppm. of endosulfan and monocrotophos decreased the emergence of *T. chilonis*

to(43.2-50.3 %) and(34.1 -42.1% %), respectively compared with untreated control plots (78.2 and 85.8%). The obtained results of Raner treatment were in agreement with those obtained by Tipping and Burbutis (1983) who found that field-weathered carbaryl and methomyl residues did not reduce parasitoid emergence. Also, Singh and Varma (1986) found that Phosalone, monocrotophos and fenvalerate did not affect the emergence of parasitoid adults and with Gnanadhas Preetha *et al* (2010), who found that, Imidacloprid 17.8 SL (at the recommended dose) did not cause any adverse effects on the adult emergence of *T. chilonis* and parasitization (90.67 and 85.32%, respectively).

3- Residual effect of the tested insecticides to the *Trichogramma* females: Effect on the percentage of parasitism:

Table (4) cleared an obvious and significant reduction in the percentage of parasitism in all Petri-dishes' treatments compared to untreated ones. Cygron was the most sever insecticide on *T. evanescens* and *T. bactrae*, as it caused the less percentage of parasitism (12.35 and 16.16%) for the two parasitoids, respectively. Also there were insignificant differences between the three insecticides used in case of *T. brassicae* in this treatment.. Also, the same trend occurred when exposing females of *Trichogramma* to the fresh insecticides residues sprayed on host eggs. Whereas, when the treated *S. cerealella* eggs held at 10 °C for 6 days and offered to females of *Trichogramma*, the percentage of *T. evanescens* parasitism increased obviously from 16.88, 36.66& 49.61 to 27.11, 39.47& 53.66% and from 4.25, 5.57& 10.1% to 22.99, 40.58& 48.77% in case of *T. bactrae* and from 4.02, 5.59& 5.29% to 23.89, 22.01& 46.2% in case of *T. brassicae* in fresh insecticides and 6 days residues, respectively.

Tipping and Burbutis (1983) stated that carbaryl residues reduced parasitism rates up to 21 days post spray. Parasitism increased over time at the lower dosage rate of methomyl.

Effect on females' longevities:

Table (4) revealed that longevity of *Trichogramma* spp. females presented with fresh insecticide treated *Sitotroga cerealella* eggs decreased significantly compared with those in untreated ones. Whereas, when the treated host eggs held for 6 days at 10°C, and introduced to *Trichogramma*, females' longevities increased slightly than the fresh treated host eggs were introduced. Arunava Samanta *et al.* (1997) found that *T. chilonis* parasitoids could be safely released 3, 4 and 5 days after crop has been sprayed with alpha-cypermethrin, methomyl and quialphos, respectively. Also, Suh *et al.* (2000) stated that based on LC50 values, spinosad and prophenofos were the most toxic compounds to female *T. exiguum* adults, followed by lambda cyhalothrin, cypermethrin, and thiodicarb. Insecticides field- weathered for 4 to 6 days on cotton leaves showed no activity against female *T. exiguum* adults.

Table (4): Residual effect of the tested insecticides to the *Trichogramma* spp. Adults

Treatments	Glass plate test		Fresh insecticide residue sprayed on host eggs		6 day insecticide residue sprayed on host eggs	
	parasitism rate (eggs/female)*	Longevity±SD (days)	parasitism rate (eggs/female)	Longevity±SD (days)	parasitism rate (eggs/female)	Longevity±SD (days)
<i>T. evanescens</i>						
Trebon	20.22±3.3 ^D	0.39±0.07 ^D	16.82±4.68 ^D	0.49±0.29 ^D	27.77±4.24 ^D	1.5±1.25 ^D
Cygron	12.35±4.35 ^C	0.45±0.50 ^D	36.66±4.47 ^C	0.59±0.39 ^D	39.47±3.56 ^C	1.89±1.05 ^D
Raner	17.6±4.17 ^D	0.69±0.47 ^D	49.61±4.53 ^D	0.79±0.40 ^D	53.61±4.71 ^D	2.00±0.87 ^D
Control	93.72±3.88 ^A	4.6±1.17 ^A	80.51±4.68 ^A	4.6±1.1 ^A	82.06±4.71 ^A	4.6±1.17 ^A
LSD	3.472	0.763	4.159	0.662	3.795	0.895
<i>T. batrae</i>						
Trebon	21.8±4.93 ^D	0.39±0.27 ^D	4.25±3.27 ^C	1.3±0.48 ^D	22.99±4.48 ^D	1.4±0.70 ^D
Cygron	16.16±5.06 ^C	0.54±0.50 ^D	5.57±3.79 ^D	1.33±0.48 ^D	40.58±4.29 ^C	1.4b±0.52 ^D
Raner	19.85±4.29 ^{DC}	0.85±0.34 ^D	10.1±3.73 ^D	1.5±0.71 ^D	48.77±4.92b	1.5±0.71 ^D
Control	78.01±4.80 ^A	3.7±1.25 ^A	70.28±3.35 ^A	3.2±1.32 ^A	72.62±4.84 ^A	3.2±1.32 ^A
LSD	4.530	0.764	3.384		4.240	0.784
<i>T. brassicae</i>						
Trebon	5.33±4.99 ^D	0.47±0.45 ^D	4.02±3.37 ^D	0.59±0.38 ^C	23.89±5.29 ^C	1.5±0.71 ^D
Cygron	4.66±4.18 ^D	0.55±0.35 ^D	5.59±3.55 ^D	1.1±0.32 ^D	22.01±4.95 ^C	1.4±0.70 ^D
Raner	4.93±3.5 ^D	0.75±0.72 ^D	5.29±3.6 ^b	1.5±0.71 ^D	46.20±4.75 ^D	1.6±0.70 ^D
Control	74.27±7.43 ^A	3.22±0.97 ^A	71.94±3.32 ^A	4.44±0.88 ^A	74.68±3.72 ^A	4.4±0.89 ^A
LSD	4.067	0.651	3.154	0.573	4.276	0.678

*Means in the same column with the same letter are not significantly different (P=0.05).

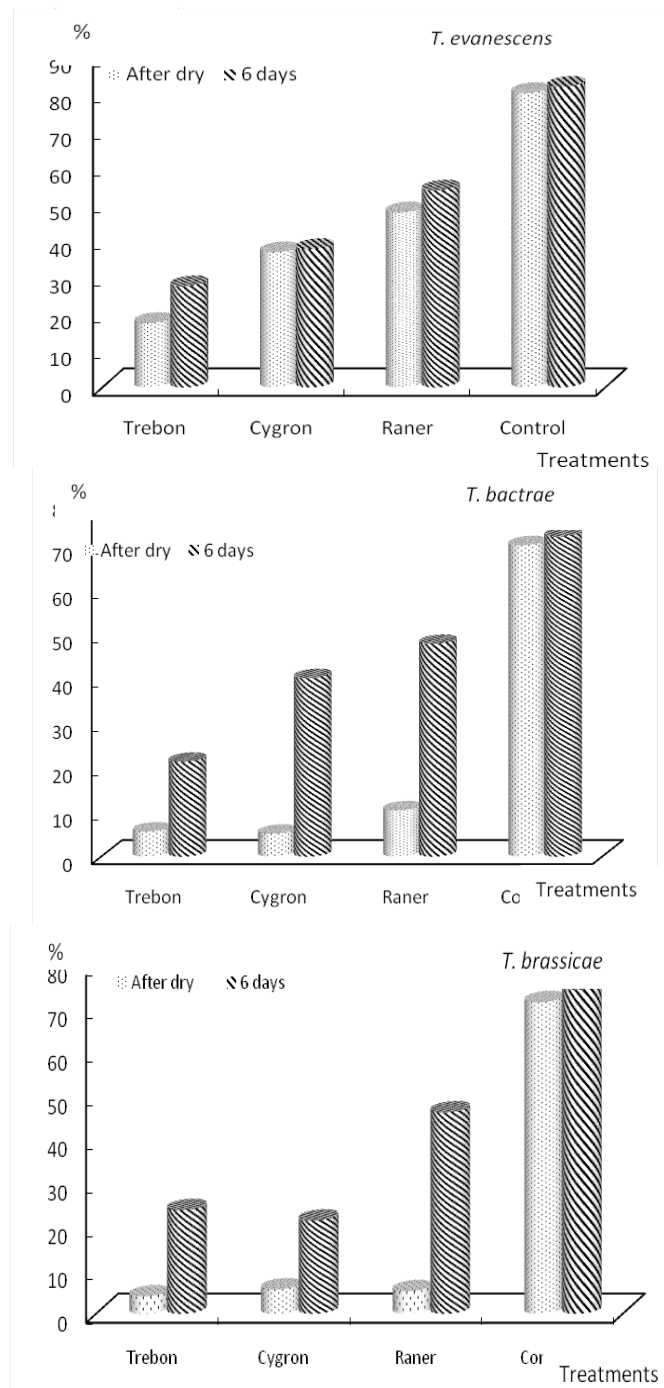


Fig (1): Residual effect of the tested insecticides to the *Trichogramma* females.

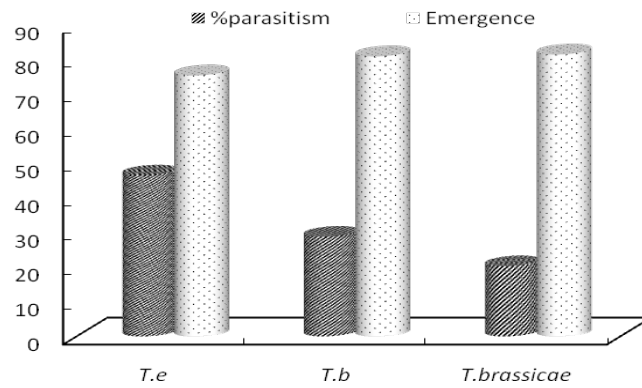


Fig (2): Efficiency of tested insecticides against *Trichogramma* spp.

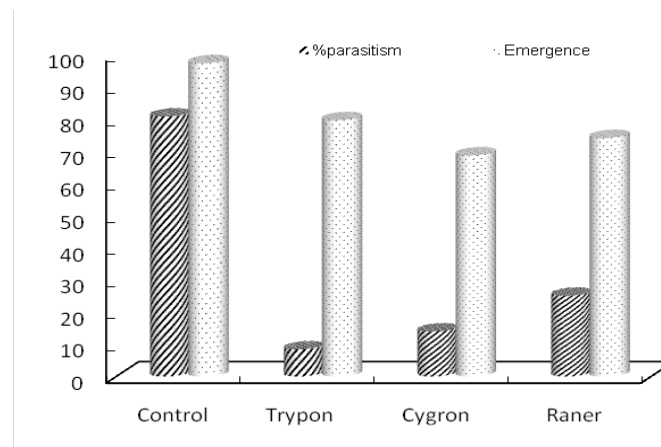


Fig (3): impact of the three tested insecticides on *Trichogramma* spp.

CONCLUSION

- 1- Trebon and Cygron could be used against *P. gossypiella* and *E. insulana* eggs as ovicidal insecticides in case of the absence of *Trichogramma*, whereas, it is unfavorable to use these insecticides in the presence of *Trichogramma*.
- 2- *Trichogramma. evanescens* was the less effected species to insecticides followed by *T. bactrae*, while, *T. brassicae* was the most effected species to insecticides.
- 3- Both Trebon and Cygron were relatively harmful to the tested parasitoids and therefore, could not be used in combination with *Trichogramma* releases, whereas, Raner was the harmless insecticide.

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السمية النسبية لثلاثة مبيدات حشرية على فقس البيض لديدان اللوز القرنفلية والشوكية وآثارها الجانبية على طفيل الترايكوجراما تحت الظروف المعملية
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تم عمل دراسة معملية لدراسة تأثير ثلاث أنواع من المبيدات المختلفة على نسبة الفقس لبيض دودتى اللوز القرنفلية والشوكية و التأثيرات الجانبية على ثلاث أنواع من طفيليات البيض (ترايكوجراما ايفانيسينس و ترايكوجراماتويدى باكترا و ترايكوجراما براسيكا) وهذه المبيدات هي تريبيون (Etofenprox 30% EC) و سيجرون (+ 7% Alpha-Cypermethrin) و رنر (Flufenoxuron 3% EC) و رنر (Methoxyfenozide 24 SC).
أوضحت النتائج أن المعاملة بالتريبيون سببت أعلى نسبة موت لبيض دودة القرنفلية (٩٥,٥٢%) تليها المعاملة بالسيجرون (٩٣,٣٩%) بينما أعطى الرنر أقل نسبة موت لبيض القرنفلية (٢٢,٣٥%). لم يوجد فرق معنوي بين نسبة الموت التي أحدثتها هذه المبيدات (التريبيون والسيجرون) وتلك التي حصل عليها باستخدام طفيل الترايكوجراما ايفانيسينس (٩٠,٦١%). وفي حالة معاملة بيض الشوكية أعطى التريبيون أعلى نسبة موت للبيض (٧٨,٧%) يليها النسبة التي سببها طفيل الترايكوجراما ايفانيسينس (٧٥,١%) بينما أعطى الرنر أقل نسبة موت للبيض. وتمت أيضا دراسة التأثيرات الجانبية التي تحدثها هذه المبيدات على الحشرات الكاملة (الطور الحساس في دورة حياة طفيليات الترايكوجراما) حيث تم تعريض الحشرات الكاملة لمعاملات مختلفة بهذه المبيدات لدراسة تأثير هذه المعاملات على طول فترة حياة الإناث و نسبة التطفل على بيض العائل وعلى نسبة خروج للطفيل من العائل. وأوضحت النتائج أن التريبيون و السيجرون كان لهما تأثير ضار على طفيليات الترايكوجراما حيث أدى إلى انخفاض نسبة التطفل وقصر طول فترة حياة الإناث مع انخفاض نسبة الخروج انخفاضاً واضحاً. وبغض النظر عن نوع المبيد المستخدم، كان طفيل الترايكوجراما ايفانيسينس أقل أنواع الطفيليات تأثراً بالمبيدات المختبرة حيث أعطى أعلى نسبة تطفل (٤٦,٥٣%) بالمقارنة ب ٢٨,٨٢ و ٢٠,٣% لترايكوجراماتويدى باكترا و ترايكوجراما براسيكا على التوالي .