Toxicity of Some Recommended Insecticides in Sugarcane and Cotton Fields to *Trichogramma evanescens* West

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Abstract: The potential effects of five different insecticides; kz oil 95% EC, malathion 57% EC, challenger 36% SC, admiral 10% EC and spintor 24% SC, which are used in sugarcane and cotton fields, on some bioaspects of the egg parasitoid *Trichogramma evanescens* West have been studied. KZ oil 95% EC inhibited emergence of *T. evanescens* when the recommended concentration or less were used. Malathion 57% EC at concentrations of 0.44, 0.88, 1.75 and 2.5 ml/L (recommended rate) decreased emergence of adult parasitoids to 65.8, 52.3, 24.4 and 16.4 %, respectively, while it reached in the control treatment 73.8%. Malathion did not only shorten longevity of emerged adult parasitoids, but also decreased the fecundity of emerged female parasitoids. Challenger 36 % SC decreased percentage of emerged parasitoids and shorten their longevity to an average of 0.6 ± 0.42 day when the recommended concentration was tested. Admiral 10% EC at concentrations of 0.063, 0.125, 0.25 and 0.5 ml/L (recommended rate) had no effect on emergence, longevity of adult parasitoids or on fecundity of emerged parasitoid females. In contrary, spintor 24% SC had a drastic effect on emergence and longevity of *T. evanescens* even when it is used at the lowest concentration. This harsh effect makes its use in crop fields released with the parasitoid questionable.

Keywords: *Trichogramma evanescens*, Spintor 24% SC, Admiral 10% EC, Malathion 57% EC, Challenger 36% SC, KZ oil 95% EC.

INTRODUCTION

A successful program for controlling the lesser sugar cane borer *Chilo agamemnon* Bles. has been applied since about 15 years in sugar cane fields by utilization of the egg parasitoid *Trichogramma evanescens* West. (Abbas *et al.*, 1989 and El-Heneidy *et al.*, 1990). This program has been funded by Sugar Crops Council and carried out in Biological Control Res. Depart., Plant Protection Res. Institute, Ministry of Agriculture in cooperation with Egyptian Company for Sugar and Distillation. Now, about 289.000 fed. (93.2 %) of sugar cane fields are released yearly with the egg parasitoid *T. evanescens* West. (Abbas *et al.*, 1990 and Anonymous, 2005). In the last five years, the red-striped soft scale insect *Pulvinaria tenuivalvata* (Newstead) (Hemiptera : Coccidae) has become a major pest of sugar cane plants in Egypt (El-Serwy, 2001 and Watson and Foldi, 2001). It attacks leaves and causing a great reduction in yield. In spite of wide application of insecticides in Middle and Upper Egypt to control the red-striped soft scale insect, its population increased annually and spread in most sugar cane fields. The difficult task was how we can control the lesser sugar cane borer by releasing of the egg parasitoid *T. evanescens* and in the same growing season we are forced to use chemical insecticides intensively to stop spreading of the red-striped soft scale insect and control it.

There are also attempts to use the egg parasitoid *T. evanescens* to control the pink bollworm *Pectinophora gossypiella* (Saund) and the spiny bollworm *Earias insulana* Boisd in cotton fields in Egypt. It is essential to reduce limit residues in the environment and harvested crops, and avoids potential problems of pest resurgence and pesticide resistance. Judicious application of chemical products to minimize the risk of adverse effects is integral with the principles of IPM. Therefore, it is become necessary to evaluate their toxicity to non target insects. An ideal insecticide should be toxic to pests but not to predators and parasitoids (Ishaaya and Caside, 1981). The main objective in integrated pest management (IPM) is increasing the role of biological control components under this system. This may be accomplished by maximizing the effects of naturally occurring beneficial species or by augmentative release of specific predators or parasitoids. In any IPM system the possible side effects of all the crop protection products used should be taken into account. Insecticides as a group are ranked as the most toxic against natural enemies.

The maintenance of biological components has proven difficult in practice where pesticide must be applied, and the beneficial species are often more sensitive than target species (Croft and Brown 1975). Classical biological control (i.e. the introduction of a predator or parasitoid for the control of a particular pest spices) and inundation control (i.e. repeated mass release of a control agent) programs impose high requirements on the selectivity of chemical control agents to be combined within them. Therefore, the present work was initiated with the aim of studying the effects of some recommended insecticides, which used in sugar cane and in cotton fields, on some bio-aspects of the egg parasitoid *T. evanescens* and of selecting insecticides with less effects on the parasitoid *T. evanescens* for better implementation of control programs of the pests, *C. agamemnon, P. tenuivalvata* and *Pectinophora gossypiella.*

MATERIALS AND METHODS

Tested insecticides

The tested insecticides are belonging to five different chemical groups. They were selected on the basis of their use commercially in the control of different insects in sugar cane and cotton fields (Table 1). The toxicity of insecticides which belong to the new chemical groups were compared with the conventional insecticides to egg parasitoid *T. evanescens* (release stage) was tested. The tested insecticides were used at recommended rates (R) by the Egyptian Ministry of Agriculture and its dilutions; 1/2, 1/4 and 1/8.

Table (1): Tested insecticides

Trade name	Common name	Chemical group	R*/100L water	Pest	Crop
1- K.Z. oil 95% EC	Petroleum oil	Mineral oil	1.5 L	Red-striped soft scale insect	Sugar cane
2-Malathion 57% EC	Malathion	Organophos-phorous	250 ml	Red-striped soft scale insect	Sugar cane
3- Challenger 36%SC	Chlorfenapyr	Arylpyrrol	45 ml	-Red spider mite -Cotton leaf worm	-Cotton -Sugar beet
4- Admiral 10% EC	Pyriproxyfen	Insect growth regulator	50 ml	Red-striped soft scale insect	Sugar cane
5- Spintor 24% SC	Spinosad	Biotic insecticides	12.5 ml	-Cotton boll worms -Batches and new hatching of cotton leaf worms	Cotton

*R = Recommended rate of application /100 L water

Laboratory rearing of the host insect *Sitotroga cerealella* and the egg parasitoid *T. evanescens*

A colony of the parasitoid, obtained from the Biological Control Dep., Plant Protection Research Institute, was established from *Sitotroga cerealella* parasitized eggs. The adult wasps which emerged from the parasitized host eggs were maintained at 25°C in plastic jars, 1 day old *S. cerealella* eggs glued on pieces of thick paper were exposed to the wasps for 24 h, and then the parasitized eggs were incubated at 25°C until the parasitoid reaches the pupal stage and the eggs turns to black or emergence of adult wasps of the next generation.

S. cerealella eggs which used as a host to rear *T. evanescens,* was obtained from a laboratory colony maintained at the Biological Control Dep., Plant Protection Research Institute using the method described by Hassan, (1994).

Application of *S. cerealella* eggs before parasitizing

The tested insecticides are recommended to control insect pests in sugar cane and cotton fields, especially for controlling the soft scale insect *P. tenuivalvata* (Newstead), the cotton leafworm *Spodoptera littoralis* (Boisd) and the bollworm *Pectinophora gossypiella* (Saunders).

S. cerealella eggs glued on thick paper were cut in small pieces, each one has about 100 eggs. Commercial formulations of the selected insecticides were diluted in water and then every piece was dipped in each insecticide solution for 5 sec. The controls were treated with water. Each treatment was performed 3 times. After drying, the treated host eggs were exposed to the adult parasitoid wasps of *T. evanescens*. The treated host eggs were put in plastic tubes and kept in the incubator at 25°C till emergence. The number of the emerged wasps was counted daily, separated in a new clean plastic tubes and the total number of emerged wasps was recorded.

Application of parasitized *S. cerealella* eggs

S. cerealella eggs glued on thick paper were exposed to the adult parasitoid wasps for 24 h, then kept in the incubator at 25°C. After 3 days, the thick paper with the parasitized eggs were cut in small pieces, each one has about 100 eggs. The pieces were treated with the recommended rate of application and their dilution (1/2, 1/4 and 1/8) of the selected insecticides. Every piece was dipped in each insecticide solution for 5 sec.

The same experiment was conducted with parasitized eggs after 7 days and that's when the parasitoid reaches the pupal stage and the eggs turns to black. The thick paper with the parasitized eggs were cut in small pieces, each one has about 100 parasitized eggs. Commercial formulations of the selected insecticides were diluted in water and then every piece was dipped in various concentrations of every insecticide solution for 5 sec. After drying, the treated host eggs were put in plastic tubes and kept in the incubator at 25°C till emergence. The controls were treated with water. Each treatment was performed 3 times. The number of the emerged wasps was counted daily, separated in a new clean plastic tubes and the total number of emerged wasps was recorded.

The effect of the tested insecticides on the longevity of the emerged wasps was evaluated by counting the numbers of the live and dead wasps in every treatment daily till death all of them. The fecundity was evaluated by allowing pairs of the emerged wasps (1-day old) to mate and oviposit in about 100 host eggs for 24 h., then the eggs were renewed every 24 h. and so on till the death of all wasps. After 7 days the parasitized eggs, which are characteristic with their black color, were counted. Deterrent index was calculated according to

Lundgren (1975) i.e. Deterrent index = (B-A) 100/ (A+B), where A and B are the number of eggs laid in the treatment and control, respectively.

RESULTS AND DISCUSSION

Parasitizing of *T. evanescens* on treated host eggs

Results in Table (2) indicate that the parasitoid wasps were differed in acceptation the treated eggs with different insecticides as hosts for parasitization. The recorded percentages of parasitism differ greatly between tested insecticides. It ranged between 2.7 and 59.1 % in the average, while it ranged between 62.3 % and 77.4 % in the control treatments. The lowest mean percentage of parasitism (2.7 %) was of eggs treated with the mineral oil kz 95 % EC before process of parasitization, followed by 24.4 % in case of the conventional insecticide malathion 57% EC. In contrary, the insect growth regulator compound admiral 10% EC gave a slight decrease in parasitization 7.4%. The percent reduction in parasitism of *T. evanescens* wasps after application the host eggs of *S. cerealella* with admiral 10% EC, challenger 36% SC, spintor 24% SC, malathion 57% EC and kz oil 95% EC was 7.4, 22.6, 38.7, 66.9 and 96.5%, respectively.

In general, the same trend in the effect of tested insecticides at their recommended rates on parasitism was also found on the emergence of *T. evanescens* wasps. No parasitoid wasps were emerged from host eggs treated with kz oil 95 % EC comparing with 88.8% of parasitoid wasps succeeded to emerge from eggs of control treatment. In general, the mean percentages of emergence of *T. evanescens* in treatments of malathion 57% EC, spintor 24% SC, challenger 36% SC and admiral 10% EC was 14.3, 15.5 , 34.7 and 87.6% comparing with 93.2, 87.3, 89.4 and 91.9% in control treatments, respectively. All candidate insecticides affected the emergence of *T. evanescens*. They can be classified into three groups according to their percent reduction in emergence. kz oil (100%), malathion (84.7%) and spintor (82.3%) demonstrated the highest reduction percentages to emergence of *T. evanescens* wasps. The second group contains the insecticide challenger only, which gave moderate reduction effect (61.2%) on the emergence of *T. evanescens* wasps. Admiral 10% EC was representative the the third group, which caused 4.7% reduction only in emergence.

The obtained results indicate that, application of fields with the recommended concentrations of the tested insecticides before releasing of the egg parasitoid *T. evanescens* as biological control agent, affect drastically both percentages of parasitism and emergence.

The results indicated that kz oil 95% EC was the most toxic one, while admiral 10% EC was the least toxic. Although the insecticides spintor 24% SC belong to the biotic insecticides group and are isolated from the actinomycete *Saccharopolyspora spinosa* but it caused reduction in parasitization and emergence reach to 38.7 and 82.3%, respectively.

Table (2): Effect of tested insecticides at the recommended rate of application on parasitism and percentage of emergence of *T. evanescens* from treated host eggs before parasitization.

Insecticides	Treated host eggs before parasitization		Parasitism (%)		Red. (%)	Emergence (%)		Red. (%)
	N0. of eggs	Control	Mean	Control		Mean	Control	
KZ oil 95% EC	328	115	2.7	77.4	96.5	0.0	88.8	100
Malathion 57% EC	360	121	24.4	73.6	66.9	14.3	93.2	84.7
Challenger 36% SC	342	114	48.2	62.3	22.6	34.7	89.4	61.2
Admiral 10% EC	336	116	59.1	63.8	7.4	87.6	91.9	4.7
Spintor 24% SC	349	100	38.6	63.0	38.7	15.5	87.3	82.3

Toxicity of tested insecticides to *T. evanescens* when treated the 3-days parasitized host eggs

The obtained results (Table 3) show that the mean percentages of successful parasitization were 44.1, 45.3, 47.6, 47.8 and 49.3% for kzoil 95% EC, Spintor 24% SC, malathion, admiral 10% EC and challenger 36 % SC, respectively, comparing with 62.2, 54.3, 53.9, 52.3 and 56,9%, in control treatments. The corresponding values of percent reduction in parasitism were 29.1, 16.6, 10.2, 9.0 and 13.4%, respectively.

The harsh effect of the used recommended concentrations of the tested insecticides was clear on percentages of adult wasps of *T. evanescens* emerged from treated host eggs. No parasitoids emerged in case of kz oil 95 % EC treatment compared to 89.2% of control treatment. In case of malathion 57% EC and spintor 24% SC, the percent emergence were 15.9 and 17.2% comparing with 90.5 and 91.2% in the control treatments, respectively. The percent emergence of *T. evanescens* from treated host eggs in challenger 36% SC treatment was 36.4%, while in the control treatment was 91.9 %. The highest percentage of parasitoids emergence was recorded from eggs treated with the recommended concentration of admiral 10 % EC, which reached to 86.9 % comparing with 99.0% in control treatment. Admiral has little effect on *T. evanescens* emergence when it was applied the host eggs after 3 days of parasitization.

The cumulative effect of candidate insecticides on emergence of *T. evanescens* from treated host eggs was differed with each insecticide. The percent reduction in emergence ranged between 12.2 and 100%. Accordingly the tested insecticides at the recommended doses can be classified into four groups. The first group contains the oil kz, which gave complete reduction in emergence of *T. evanescens*. There are no differences in the percent reduction of emergence between the organophosphours insecticide malathion (82.4%) and the natural compound spintor (81.1%). The both insecticides belong to the second group. The third group contains the insecticide compound challenger, which gave moderate effect on the emergence with percent reduction 60.4%. The last group contains only the insect growth regulator compound admiral, which was the safest insecticide to *T. evanescens*.

The low population of the egg parasitoid *T. evanescens* in the field as a result of low percentages of emergence after application of such insecticides means unsuccessful biological control. Abbas *et al.*, (1989 and 1990) mentioned that the lesser sugar cane borer *C. agamemnon* Bles. can be successfully controlled by releasing at least 20.000 *T. evanescens* wasps in sugar cane fields. Therefore occurring of high population of parasitoid wasps in the field is of great importance.

Toxicity of tested insecticides to *T. evanescens* when treated the 7-days parasitized host eggs.

KZ oil 95% EC

The results in Table (4) show that the emergence of the adult *T. evanescens* wasps was totally inhibited when the parasitized host eggs were treated with the concentration of 7.5 and 15 ml/ L. The decreasing concentration of kz oil to 3.75 and 1.9 ml/L caused 5.9 and 6.4% emergence, respectively, compared to 71.9% in the control treatment.

Table (3): Effect of tested insecticides at the recommended rate of application on parasitism and percentage of emergence of *T. evanescens* from treated host eggs after 3 days of parasitization.

Insecticides	Treated host eggs before parasitization		Parasitism (%)		Red. (%)	Emergence (%)		Red. (%)
	N0. of eggs	Control	Mean	Control		Mean	Control	
KZ oil 95% EC	333	119	44.1	62.2	29.1	0.0	89.2	100
Malathion 57% EC	418	100	47.6	53.0	10.2	15.9	90.5	82.4
Challenger 36% SC	328	109	49.3	56.9	13.4	36.4	91.9	60.4
Admiral 10% EC	334	113	47.8	52.3	9.0	86.9	99.0	12.2
Spintor 24% SC	349	105	45.3	54.3	16.6	17.2	91.2	81.1

Table (4): Effect of kz oil 95% EC at the recommended rate of application (R) and their dilutions on different biological aspects of *T. evanescens* when treated the 7-days parasitized host eggs.

Biological aspects	Side effects of recommended rate of application and their dilutions of KZ oil comparing with control treatment				
	R (15 ml/L)	R/2 (7.5ml/L)	R/4 (3.75ml/L)	R/8 (1.9 ml/L)	Control
No. of treated parasitized eggs	368	375	359	359	377
Emergence (%)	0	0	5.9	6.4	71.9
Longevity range (Days)	0	0	0.5-3	0.5-3	2-4
Longevity average(Days)	0	0	1.3±0.91	1.2±0.85	2.3±0.54

The longevity range of *T. evanescens* was between 0.5 and 3 days with an average of 1.3 ± 0.91 using the concentration of 3.75 ml/L. At the concentration 1.875 ml/L, the longevity average was 1.2 ± 0.85 days, lying between 0.5 and 3 days. In the control treatments the longevity of the parasitoid individuals ranged between 2 and 4 days with an average of 2.3 ± 0.54. Due to the short longevity of emerged parasitoids host eggs and the highly toxicity of kz oil to *T. evanescens*, it was not possible to investigate the effect on fecundity. It can be stated that, kz oil 95 % EC inhibits emergence of *T. evanescens* from treated parasitized host eggs and shorten their longevity even when it's used at the quarter and eighth of recommended rate of application.

Malathion 57% EC

Data in Table (5) indicate that a low percentage of emergence (16.4%) had been recorded, when the parasitized h... eggs were treated, 7 days after parasitization, with malathion at concentration of 2.5 ml/l (recommended rate). With decreasing the concentration to half, quarter and eighth of recommended rate, the percentage of emergences was increased to 24.4, 52.3% and 65.8%, respectively, comparing with 73.8 % in the control treatment. There was a positive correlation between the different concentrations of malathion and the percentage of emergences.

Longevity of *T. evanescens* individuals ranged between 2 and 4 days with an average of 2.4 ± 0.63 when the tested concentration was 2.5 ml/L (recommended rate). At the half, quarter and eighth of recommended rate of application for malathion, the longevity average recorded 2.67 ± 0.83, 2.69 ± 0.82 and 3.0 ± 0.88, respectively. The longevity range in all treatments was between 2 and 4 days. In the control treatment the longevity of parasitoid individuals ranged between 2 and 5 days with an average of 3.0 ± 0.86.

The numbers of parasitoid females were 8, 14, 24 and 53 in the treatments of 2.5, 1.75, 0.88 and 0.44 m/L, respectively, comparing with 68 in control treatment. So, the numbers of deposited eggs per females were compatible with the numbers of parasitoid females. The number of deposited eggs per female was 6 eggs when the recommended rate of application was used; it increased to 19, 37 and 38 eggs/female when the concentrations of half, quarter and eighth of recommended rate were used. It was reached 41eggs/female in the control treatment. The deterrent indices decreased gradually with reducing the used concentration, which were 74.5, 36.7, 5.1 and 3.8, % using the recommended rate of application and their dilutions; half, quarter and eighth, respectively. The obtained results show that, Malathion 57% EC at the tested concentrations decreased percentage of emergence of adult parasitoids, shorten their longevity and decreased fecundity of females. These effects of Malathion 57 % EC have to be taken into consideration when it used in fields released with *T. evanescens*. The present results are supported by Dutt and Somchoudhury (1986), who noticed a high mortality (99.63%) of *Trichogramma perkinsi* adults and immature stages (larvae and pupae) when they tested malathion against it at concentrations of 0.01, 0.02, 0.05 and 0.1 %.

Table (5): Effect of malathion 57% EC at the recommended rate of application (R) and their dilutions on different biological aspects of *T. evanescens* when treated the 7-days parasitized host eggs.

Biological aspects	Side effects of recommended rate of application and their dilutions of malathion comparing with control treatment				
	R (2.5ml/L)	R/2 (1.75ml/L)	R/4 (0.88ml/L)	R/8 (0.44ml/L)	Control
No. of treated parasitized eggs	446	430	423	450	446
Emergence (%)	16.4	24.4	52.3	65.8	73.8
Longevity range (Days)	2-4	2-4	2-4	2-4	2-5
Longevity average(Days)	2.4±0.63	2.67±0.83	2.69±0.82	3.0±0.88	3.0±0.86
No. of parasitoid females	8	14	24	53	68
No. of deposited eggs	49	265	890	2014	2792
No. of eggs/female	6	19	37	38	41
Deterrent index (%)	74.5	36.7	5.1	3.8	---

Challenger 36% SC

Results in Table (6) indicate that the percentage of emergence recorded 37.1%, when the parasitized host eggs were treated with the recommended concentration (0.45 ml/L). With decreasing the concentration to 0.225, 0.113 and 0.056 ml/L it slightly increased to 38.3, 39.9 and 45.9%, respectively, compared to 56.2% in the control treatment. It was found that there are no differences between the recommended rate of application for challenger and their dilutions (half and quarter) in the toxicity to emergence adults.

The longevity of *T. evanescens* lay between 0.5 and 2 days with an average of 0.6 ± 0.42 when the recommended concentration was tested. Longevity of *T. evanescens* individuals ranged between 0.5 and 3 days with all other tested concentrations of challenger. The values of longevity average were 0.9 ± 0.70, 1.2 ± 0.85 and 1.1 ± 0.78 days using half, quarter and eighth concentrations of recommended rate. The toxic effect of challenger on longevity mean of *T. evanescens* was quite obvious even at the low concentration. There was a positive correlation between different concentrations of challenger and longevity. It's clear that challenger 36% SC shorten the longevity of *T. evanescens* to be only one day or less when any of the tested concentrations is used. Therefore, it's expected that the role of adult parasitoids in parasitizing host eggs under field conditions will be limited if Challenger 36 % SC is used. Due to the short longevity of emerged parasitoids and highly toxicity of challenger, it was not possible to investigate the effect of Challenger on fecundity of female parasitoids. The results obtained with challenger for *T. evanescens* agreed with the literature, which reports that this compound is highly toxic to the adults of *Trichogramma chilonis*, and caused a mortality of 100% after 24 h of application (Abida *et al.* 2000). Also, Hewa *et al.* (2003) found that challenger caused 100% mortality when it was directly applied to *T. brassicae* adults and 95% mortality when adults were exposed to residues of it.

Table (6): Effect of challenger 36% SC at the recommended rate of application (R) and their dilutions on different biological aspects of *T. evanescens* when treated the 7-days parasitized host eggs.

Bio-aspects	Side effects of recommended rate of application and their dilutions of challenger comparing with control treatment				
	R (0.45ml/L)	R/2 (0.225ml/L)	R/4 (0.113ml/L)	R/8 (0.056ml/L)	Control
No. of treated parasitized eggs	426	415	449	412	418
Emergence (%)	37.1	38.3	39.9	45.9	56.2
Longevity range (Days)	0.5-2	0.5-3	0.5-3	0.5-3	2-4
Longevity average (Days)	0.6±0.42	0.9±0.70	1.2±0.85	1.1±0.78	2.7±0.65

Admiral 10% EC

Data in Table (7) show that the percentage of emergence, longevity and deterrent index when the parasitized host eggs were treated after 7 days of parasitization with admiral 10% EC at the recommended rate of application and their dilutions (half, quarter and eighth). The percentage of emergence of *T. evanescens* ranged between 80.0 and 90.8 using all concentrations of admiral comparing with 88.1 in control treatment. There is a little difference in the percentage of emergence between the different concentrations of admiral and control treatment.

Table (7): Effect of admiral 10% EC at the recommended rate of application (R) and their dilutions on different biological aspects of *T. evanescens* when treated the 7-days parasitized host eggs.

Bio-aspects	Side effects of recommended rate of application and their dilutions of admiral comparing with control treatment				
	R (0.5ml/L)	R/2 (0.25ml/L)	R/4 (0.125ml/L)	R/8 (0.063ml/L)	Control
No. of treated parasitized eggs	353	345	350	346	352
Emergence (%)	89.8	80.0	88.0	90.8	88.1
Longevity range (Days)	2-6	2-5	2-5	2-6	2-6
Longevity average (Days)	3.3±0.95	3.25±0.84	3.2±0.76	3.2±0.84	3.2±1.05
No. of parasitoid females	45	64	94	72	137
No. of deposited eggs	1408	1968	2940	2227	4316
No. of eggs/female	31.3	30.8	31.3	30.9	31.5
Deterrent index	0.32	1.12	0.32	0.96	---

The longevity of the parasitoid individuals lay between 2 and 6 days in all concentrations of admiral comparing with 2-6 days in control treatment, while the longevity mean ranged between 3.2 and 3.3 days comparing with 3.2 days in control treatment. Accordingly, the results confirmed that the admiral had no effect on the percentage of emergence and the longevity of *T. evanescens* even in the high concentration (rate of application). Also, it was found that admiral had no influence on the fecundity of females, which emerged from treated parasitized host eggs. The numbers of deposited eggs from 45, 64, 94, 72 and 137 females in the treatments of 0.50, 0.25, 0.125, 0.063 ml/L and control were 1408, 1968, 2940, 2227 and 4316, respectively. Based on, the numbers of eggs per females in admiral treatments, which ranged between 30.8 and 31.3, representative deterrent indices, lay between 0.32 and 1.12% only. Therefore, this compound was safer than the other tested insecticides to the *T. evanescens*.

Spintor 24% SC

Results in Table (8) show the side effects of spintor 24% SC on the emergence and longevity of *T. evanescens* adults. The biotic insecticide spintor (a secondary metabolite from the soil bacterium *Saccharopolyspora spinosa*) decreased the percentage of emergence from 76.9% in the control treatment to 16.2, 21.5, 26.5 and 28.3% using the rate of application and their dilutions (half, quarter and eighth), respectively. It's clear that Spintor 24 SC has a drastic effect on emergence of *T. evanescens* even when it's used at the lowest concentration (0.016ml/L). This harsh effect makes its use in crop fields released with *T. evanescens* questionable.

Table (8): Effect of spintor 24% SC at the recommended rate of application (R) and their dilutions on different biological aspects of *T. evanescens* when treated the 7-days parasitized host eggs.

Bio-aspects	Side effects of recommended rate of application and their dilutions of spintor comparing with control treatment				
	R (0.125ml/L)	R/2 (0.063ml/L)	R/4 (00.31ml/L)	R/8 (0.016ml/L)	Control
No. of treated parasitized eggs	346	316	343	346	338
Emergence (%)	16.2	21.5	26.5	28.3	76.9
Longevity range (Days)	0-2	0.5-2	0.5-2	0.5-3	1-4
Longevity average (Days)	0.36±0.26	0.69±0.54	0.67±0.46	0.79±0.68	1.6±0.92

The longevity of *T. evanescens* individuals ranged between 0 and 3 days with spintor treatments comparing with 1-4 days in control treatments. The longevity mean was less than one day in the treatments of spintor, accordingly, it was not possible to investigate the effect of spintor on fecundity. The obtained results make it clear that spintor 24% SC has a drastic effect on emergence of *T. evanescens* from treated parasitized host eggs and on the longevity of these parasitoids. Similar results were reported by Suil *et al.* (2000) who studied the effects of spintor 24% SC and other insecticides on development and adult survival of *Trichogramma exiguum* and found that spintor was one of the most toxic compounds. Spintor was recommended for use in IPM programs, which it was not harm to beneficial insects and has a broad spectrum of activity against many insect pests (Schoonover and Larson, 1995 and Thompson *et al.*, 2000). This natural compound needs more investigations on its effect on different groups of beneficial insects.

Any pesticide applied during the growing season has the potential to disrupt biological control. The chosen insecticides in this study were kz oil 95% EC, malathion 57% EC, challenger 36% SC, admiral 10%

SC and spintor 24% SC, which are recommended against *Chilo agamemnon* Bles, *Spodoptera littoralis* and *Pectinophora gossypiella* in fields of sugar cane and cotton. These insecticides belong to the following groups; petroleum oil, organophosphorous, arylpyrrol, insect growth regulator and bio-pesticide, respectively. The three different timings of application were conducted in this study; application of *S. cerealella* eggs before parasitization and application of *S. cerealella* eggs after 3 & 7 days of parasitization. The three different timings of application gave similarly influences on the parasitism, emergence and fecundity of *T. evanescens*. In general, the results indicated that kz oil 95% EC was the most toxic one, while admiral 10% SC was the least toxic. In the different timings of insecticides application, they were arranged according to their effect on parasitism and emergence of *T. evanescens* in the following descending order; kz oil 95% EC, malathion 57% EC, challenger 36% SC, spintor 24% SC and admiral 10% SC. These results were supported by Suil *et al*., (2000) who reported based on the LC_{50} values, spinosad and profenofos were the most toxic compounds to female of *T. exiguum* adults, followed by lambda cyhalothrin, cypermethrin and thiodicarb. Croft and Brown (1975) reported that organophosphate, carbamate and synthetic pyrethroid insecticides are generally considered highly toxic to biological control agents due to their broad spectrum activity. With one exception of this finding is the bio-pesticides spintor 24% SC, which was highly toxic to *T. evanescens* than the other insecticides that belong to the arylpyrrol and insect growth regulator.

Integrated use of natural enemies particularly *T. evanescens* for controlling the lesser sugar cane borer *Chilo agamemnon* Bles. with different insecticides against the red-striped soft scale insect *Pulvinaria tenuivalvata* (Newstead) in sugar cane fields appears not easy by the use of selective insecticides or the use of reduced concentrations of other insecticides. In fact, it is difficult and not acceptable reducing the recommended rate of insecticides in controlling different insect pests in order to decrease their side effects on natural enemies. Accordingly, the unique way in integrated use of natural enemies with different insecticides is by choosing the safer compound to these natural enemies especially there are a several recommended insecticides against each insect pest. The combination of *T. evanescens* and selective insecticides opened an unprecedented window of opportunity for an increased impact of biological control on field crops in fields. The integration of biological and chemical control tactics requires a thorough understanding of how pesticide residues affect biological control agents. There is low literature about the adverse effects of pesticides residue on *T. evanescens*. Data presented here can be used as a rough guide to the relative influence of insecticides residue on *T. evanescens* when each of the tested insecticides is sprayed on field crops at the recommended rate. Therefore, we need more information concerning the residual activity of chemicals against parasitoids. Such information would enable scheduling the safe release of natural enemies for augmentation. Collectively, these data have considerable implication for growers who are selecting insecticides for use in an integrated pest management program where *T. evanescens* is present.

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سمية بعض المبيدات الموصى بها في مزارع قصب السكر و القطن للتريكوجراما ايفانسنز *Trichogramma evanescens* West.

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درس تأثير خمس مبيدات تستخدم في مزارع قصب السكر و القطن و هي الزيت المعدني KZ oil 95% و الملاثيون (مستحلب مركز ٥٧٪) ، شالنجر (معلق مركز ٣٦٪) ، ادميرال (مستحلب مركز ١٠ ٪) و سبنتور (معلق مركز ٢٤٪) على بعض الخواص البيولوجية لطفيل البيض تريكوجراما ايفانسنز و كانت النتائج كما يلي:

في حالة إستخدام التركيز الموصى به للزيت المعدني KZ حدث تثبيط لعملية خروج الطفيل و ذلك عند استخدام التركيز الموصى به و التكيزات الأقل. و في حالة استخدام الملاثيون بالتركيزات ٠,٤٤ ، ٠,٨٨ ، ١,٧٥ ، ٢,٥ ملليتر/ لتر (الموصى به) قلت نسبة خروج الحشرات الكاملة للطفيل إلى ٦٥,٨ ، ٥٢,٤ ، ٢٤,٤ ، ١٦,٤٪ علىالتوالي بينما بلغت ٧٣,٨ ٪ في معاملة المقارنة. كما قلت فترة حياة الحشرة الكاملة و خصوبتها (عدد البيض الذي تضعه الأنثى الواحدة) ، و عند استخدام المبيد شالنجر قلت نسبة خروج الحشرات الكاملة و كذلك فترة حياتها حيث كان عمرها ٠,٤٢ ± ٠,٦ يوم عند استخدام التركيز الموصى به.

اما عند استخدام المبيد ادميرال بالتركيزات ٠,٦٣ ، ٠,١٢٥ ، ٠,٢٥ ، ٠,٥ ملليتر/ لتر (التركيز الموصى به) لم يحدث اى تأثير على نسبة خروج الحشرات الكاملة و كذلك على فترة حياتها و كفاءة الإناث في وضع البيض ، و على العكس في حالة استخدام المبيد سبنتور حدث تأثير شديد الضرر على نسبة خروج الحشرات الكاملة للطفيل و فترة حياتها حتى عند اختبار اقل تركيز و عليه يجب أخذ ذلك في الإعتبار عند استخدامه في الحقول المعاملة بالطفيل.