EFFECT OF PROFENOFOS AND DIFLUBENZURON ON *PECTINOPHORA GOSSYPIELLA* (SAUNDERS) AND ITS PARASITOID *DIBRACHYS CAVUS* (WALKER)

MERVAT A. A. KANDIL

Bollworms Research Department, Plant Protection Research Institute, Dokki, Giza, Egypt

(Received 1-7-2007)

INTRODUCTION

The pink bollworm, *Pectinophora gossypiella* (Saunders) is a serious pest of cotton in many parts of the world. Abbas *et al.* (1996), Al-Shannaf (2002) and Aioub *et al.* (2003) reported that the developmental stages of bollworms are greatly influenced with insecticidal and IGRs treatments.

The pteromalid wasp *Dibrachys cavus* (Walker) was recorded as a generalist gregarious ectoparasitoid on the diapausing larvae of *P. gossypiella* existing in cotton bolls in different countries (Chu, 1978 and Cock, 1985) and attacking many species of Lepidoptera (Zerova *et al.*, 1986 and Tkachev 1976).

Profenofos, (Curacron 72% EC) has been tested against many lepidopterous such as, *P. gossypiella, Earias insulana* and *Spodoptera littoralis* (Abbassy *et al.*, 1984; Saad *et al.*, 1984; Kassem *et al.*, 1986 and Temerak 2003).

Also, IGR's were studied against *P. gossypiella, E. insulana* and other pests by many authors as Simwat and Dhawan (1992), Rashad *et al.* (1993), Horowitz *et al.* (1992) and Perveen (2000). On the other hand, some others studied the effect of many insecticides and IGR compounds on some natural enemies such as *Bracon, Microplitis* and *Caroliechiles nigriceps* (Tillman and Mulrooney, 2000; Stapel *et al.*, 2000 and Khafagi and Hegazi, 2000).

The best way to conserve beneficial insects is to spray pesticides only when necessary. For this reason the present study aimed to investigate the relative efficiency of profenofos and diflubenzuron on the pink bollworm and following the effect on its parasitoid *D. cavus* when fed and rearing on treated host larvae.

MATERIAL AND METHODS

The experiments were carried out at Bollworms Research Department, Plant Protection Research Institute, Dokki, Giza, Egypt.

Insecticides used

Two compounds were used in this investigation belonging to two groups namely; profenofos (Curacron 72 % EC) a synthetic organphosphorus compound and diflubenzuron (Dimilin 48 % SC) an insect growth regulator.

Insects used

1- Rearing of *P. gossypiella*

The proper conditions and diet for maintaining laboratory colony of the pink bollworm (PBW) was conducted according to Rashad and Ammar (1985).

2- Rearing of the parasitoid *D. cavus*

Laboratory culture of *D. cavus* began with adults emerged from parasitized pink bollworm larvae collected from infested dry cotton bolls at Sharkia Governorate, at the end of 2004 cotton season which were kept under field conditions on roof of farmers' house. Emerged adult parasitoids were reared on fullgrown larvae of a laboratory strain of the pink bollworm.

Two hundred adults of the parasitoid were paired and confined in 0.5 glass jars (10 pairs/ jar). The jar was covered with a piece of muslin cloth kept in position by rubber bands. Small droplets of bee honey were scattered on the inner surface of each jar for feeding the parasitoid adults. Five of fullgrown larvae of *P. gossypiella* were inserted daily / jar for laying eggs and subsequent parasitization.

Bioassays

To evaluate acute toxicity of the two tested compounds, against newly hatched larvae of pink bollworm, serial aqueous dilutions of Curacron ranged from (0.25 to 0.00025ppm) were prepared. The LC20 & LC50 were estimated. While in case of Dimilin, the newly hatched larvae of pink bollworm were treated with the recommended dose (288ppm). The PBW surviving larvae after treatment with the LC20 & LC50 of Curacron and with Dimilin were reared until being fullgrown then divided into two groups. The first group was placed in the parasitoid jars to observe effect of treatment on parasitization. The second group was used to evaluate the effect of treatments on the developmental stages of the host.

Effect of Curacron and Dimilin on the biology of *P. gossypiella*

Newly hatched larvae of *P. gossypiella* were transferred double by fine camel brush into glass tubes (2x7 cm) containing treated artificial diet by the LC_{20} (0.0131 ppm) and LC_{50} (0.0558ppm) of Curacron, recommended dose of Dimilin (288ppm). Tubes were then, plugged with pieces of cotton wool. The tubes were incubated at 26 ±1°C and 70-75% R.H. in an incubator and inspected daily until pupation. Initial numbers for each treatment were (1000 larvae). Pupae were removed from all tubes and placed in clean tubes till adult emergence. Some biological aspects such as: percentage of larval mortality, larval duration, pupation percentage, pupal duration, percentage of adult emergence and sex ratio among emerged adults were determined. Also, malformed ones were recorded. Other 200 newly hatched larvae were used as control.

Newly emerged moths resulted from different treatments were sexed and transferred to chimney glass cages (five pairs / cage). Each treatment was replicated 4 times. The moths were fed on 10 % sucrose solution. Cages were examined daily to record the number of eggs laid. Periods of pre-oviposition, oviposition and post-oviposition and hatchability percentage from eggs of each treatment was also estimated. Females and males longevity were estimated.

Effect of larvae treated by Curacron and Dimilin on the biology of *D. cavus*

Six hundred individuals of parasitoid (one day old) (300 ♀♀and 300 ♂♂) obtained from laboratory culture were divided to three groups (10 replicates of 10 pairs each/ group). Adults of each replicate were introduced in a 1/2 kg glass jar 1/2 kg. Five individuals of fullgrown PBW larvae produced from each treatment of LC_{20} or LC_{50} of Curacron or the recommended dose of Dimilin were offered to the parasitoid females inside the glass jar. Every 24 hours, the offered hosts/ jar were transferred to glass tube (10x5cm) to observe the paralyzed and parasitized host.

From ten to fifteen parasitized larvae of pink bollworm from each treatment by LC_{20}, LC_{50} of Curacron and recommended dose of Dimilin, about 150 eggs of the parasitoid were transferred to Petri-dishes to estimate the incubation period of egg, larval duration, pupal period and adult emergence.

Newly emerged adults of *D. cavus* resulted from reared larvae of the parasitoid on larvae treated by LC_{20}, LC_{50} of Curacron and Dimilin were sexed and transferred to glass jar (0.5 kg) (10 pairs of parasitoid adults); each treatment was replicated 5 times. Also, offered to these jars, five fullgrown larvae without treatment daily to estimate, pre-oviposition, oviposition and post-oviposition

periods, longevity of females, total eggs laid and hatchability percentage. At the same time, five parasitized untreated larvae (carried about 100 eggs of the parasitoid) were used as control.

RESULTS AND DISCUSSION

1. Effect of Curacron and Dimilin on pink bollworm

Larval duration

Data in Table (1) showed that the two compounds (Curacron and Dimilin) influenced the average of developmental period of the pink bollworm larvae compared with the untreated (check). The larval duration recorded (15.20±0.4, 20.1± 0.7 and 26.4±0.80 days) when newly hatched larvae treated with LC_{20} (0.0131 ppm) & LC_{50} (0.0558 ppm) of Curacron and the recommended dose of Dimilin compared with (14.7± 0.30 days) untreated (check), respectively.

Also, data indicated that, treating the newly hatched larvae of PBW with LC_{50} of Curacron and recommended dose of Dimilin prolonged the larval duration, compared with the check .While, LC_{20} did not affect the duration. This result is similar to that of Aioub *et al.* (2003).

Larval mortality

The analysis of variance for the data given in Table (1) showed a significant effect on larval mortality percentage between untreated and the three treatments for pink bollworm. The mortality percentages were 38, 62, 67 and 3 % for pink bollworm when treated by LC_{20} & LC_{50} of Curacron, Dimilin and check, respectively.

Larval malformation

Data presented in Table (1) show that the high malformation for 4^{th} instar larvae recorded when larvae fed on diet treated by recommended dose of dimilin followed by LC50 of Curacron, these were estimated by 17.9 & 16.0 %, respectively. This data clarify the relationship between the percentage of malformation and the concentration used.

Similar results were obtained by some authors such as Gutram (1972), Walker (1973) and Al-Shannaf (2002) who reported that synthetic juvenile hormone mimic or gossypol extracts and their used high concentrations had highly effects on

percentage of malformation of 4th instar larvae or emerged adults resulting from treated neonate larvae of *P. gossypiella.*

Pupation percentage

It's clearly from data in Table (1) that the two tested compounds significantly affected the pupation percentage of pink bollworm opposed to untreated check. The pupation percentages were 90.00, 83.70, 78.70 and 97.00 % when the newly hatched larvae treated by LC_{20} & LC_{50} of Curacron, recommended dose of Dimilin and control, respectively.

Pupal duration

From data in Table (1), a significant difference appeared between pupal periods of the treated and the untreated neonates of pink bollworm. These periods were 8.60±0.30, 9.10 ± 0.40, 9.60±0.30 and 8.30 ± 0.3 days when newly hatched larvae were treated with LC_{20}, LC_{50} of Curacron, recommended dose of Dimilin and control, respectively.

Pupal malformation

Data in Table (1) revealed that high malformation (10.9 %) appeared in pupae resulted from neonate larvae treated by LC_{50} of Curacron while, in case of those treated by LC_{20} of Curacron or recommended dose of Dimilin were nearly equal in malformation (5.1 & 6.3 %).

Immature stages

As shown from the data presented in Table (1), significant different appeared between the period of immature stages when newly hatched larvae were treated by LC_{50} of Curacron or recommended dose of Dimilin than control. These periods were 29.1, 32.1 and 22.6 days, respectively. Meanwhile, when larvae treated by LC_{20} of Curacron this period was estimated by 23.9 days showing no significant difference.

Adult emergence and sex ratio

Statistical analysis in Table (1) indicated that the effect of both insecticides on percentage of adult emerged appeared on treatment by Dimilin followed by LC_{50} of Curacron. The percentages of adult emergence were 88 and 90 %, respectively.

Sex ratio presented in Table (1) showed that the percentage of emerged females was low in treatment by Dimilin (42% ♀); but treatment with LC_{50} of Curacron produced very low males (27% ♂) compared with other treatment & control

TABLE (I)

Effect of LC_{20} and LC_{50} of Curacron (Profenofos) and recommended dose of Dimilin (Diflubenzuron) on immature stages of *P. gossypiella* at 26±1°c and 75-75% R.H.

Chemical used	Concentration	Initial No. of PBW	Larval stage			Pupal stage			Immature stage	Adult stage		
			Larval duration ±S.E.	Larvae mortality	% Malformation	% pupation	Pupal duration ±S.E.	% Malformation	Larval + pupae ±S.E.	Adult emergence	Sex ratio	
											♀	♂
Curacron	LC_{20} 0.0131ppm	1000	15.2±0.4 b (14-19)	38.00 c	9.70	90.00 b	8.6±1.10 bc (8-10)	5.10	23.90±1.30c (23-27)	97.00 a	59	41
	LC_{50} 0.0558ppm	1000	20.10±0.7ab (16-25)	62.00 b	16.00	83.20 c	9.1±0.40a (8-11)	10.90	29.10±1.60b (23-31)	90.00 b	73	27
Dimilin	288 ppm	1000	26.4±0.80 a (19-31)	67.00 a	17.90	78.70 d	9.60±0.30ab (9-11)	6.30	32.1±2.10a (23-.35)	88.00 b	42	58
Control		200	14.7±0.30 b (12-17)	3.00 d	0.00	97.00 a	8.30±0.90b (19-24)	1.10	22.6±0.90c (19-24)	99.00 a	56	44
P			*	***		*	*		**	***		
LSD			6.858	3.88		3.73	0.869		2.240	3.074		

Longevity of emerged females

The three treatments LC_{20} and LC_{50} of Curacron and Dimilin significantly prolonged the pre-oviposition period showing 1.5, 2.5 and 1.6 days, respectively compared with 1.3 days of the check. As shown in Table (2), oviposition period was highly significant influenced by both tested compounds. The LC_{20} and LC_{50} of Curacron caused shortness in females' oviposition period to 10.26 and 7.3 days. On contrast, the treatment by Dimilin increased the oviposition period to 13.9 days compared to 12.8 days for control.

Analysis of variance of the data in (Table 2) proved that post-oviposition period of emerged females was significantly affected by different tested compounds. The two concentrations of Curacron decreased this period to 1.2 and 0.96 days, while, Dimilin prolonged the post- oviposition period to 2.3 days compared to 2.1 days for control.

Adult emergence and sex ratio

Statistical analysis in Table (1) indicated that the effect of both insecticides on percentage of adult emerged appeared on treatment by Dimilin followed by LC_{50} of Curacron. The percentages of adult emergence were 88 and 90 %, respectively.

Sex ratio presented in Table (1) showed that the percentage of emerged females was low in treatment by Dimilin (42% ♀); but treatment with LC_{50} of Curacron produced very low males (27% ♂) compared with other treatment & control.

Longevity of emerged females

The three treatments LC20 and LC50 of Curacron and Dimilin significantly prolonged the pre-oviposition period showing 1.5, 2.5 and 1.6 days, respectively compared with 1.3 days of the check. As shown in Table (2), oviposition period was highly significant influenced by both tested compounds. The LC20 and LC50 of Curacron caused shortness in females' oviposition period to 10.8 and 7.3 days. On contrast, the treatment by Dimilin increased the oviposition period to 13.9 days compared to 12.8 days for control.

Analysis of variance of the data in (Table 2) proved that post-oviposition period of emerged females was significantly affected by different tested compounds. The two concentrations of Curacron decreased this period to 1.2 and 0.96 days, while, Dimilin prolonged the post- oviposition period to 2.3 days compared to 2.1 days for control.

TABLE (II)

Effect of Profenofos and Diflubenzuron on longevity and fecundity of *P. gossypiella*

Treatment		Pre-oviposition (days)	Oviposition (days)	Post Oviposition (days)	Total No eggs laid/♀	% Hatchability	Adult longevity	
							♀♀	♂♂
Curacron	LC_{20} 0.0131ppm	1.5±0.12a (1-2)	10.26±0.5d (8-12)	1.2±0.6 (0-2)	110.6±4.8d (71-130)	67	14.3±0.1d (9-13)	7.99±0.5d (6-10)
	LC_{50} 0.0558ppm	2.5±0.23b (2-3)	7.3±0.18c (5-8)	0.96±0.5 (0-2)	57.0±3.4 b (31-68)	35	9.4±0.6c (6-11)	5.5±0.3c (4-7)
Dimilin	288 ppm	1.6±0.1b (1-2)	13.9±0.4a (10-18)	2.3±0.5 (2-3)	97.6±2.1c (56-121)	48	16.9±1.2a (15-22)	11.2±0.3b (8-15)
Control		1.3±0.05b (1-2)	12.8±0.26b (9-17)	2.1±0.1 (1-3)	198.8±3.6a (170-210)	96	15.8±0.5b (12-20)	11.9±0.1a (9-17)
P		**	**	ns	***		***	***
LSD		0.567	0.499		5.645		0.753	0.492

Female fecundity and fertility

The presented data in Table (2) indicated significantly decrease in the average number of deposited eggs per female of P. gossypiella emerged from larvae treated by LC20, LC50 of Curacron and Dimilin. Averages were 110.6, 57.5 and 97.6 eggs/ treated ♀, respectively in comparison to 198.7 eggs/ ♀ for untreated check.

Also, the percentage of hatchability decreased to 67, 53 & 48% at LC20 and LC50 Curacron and Dimilin, respectively compared to 96% for control.

Previous data indicated that the high concentration from the two compounds used as IGR or the chemical insecticide Curacron caused prolongation in larval and pupal duration, high percentage in mortality and malformation among immature stages and caused highly affected the fecundity and fertility in females. In contrarily, this biological character was not high affected when low concentration of Curacron was used. These results agreed with those of some author such as Simwat and Dhawan (1992), Rashad et al. (1993), Aioub et al. (2003) and Temerak (2003).

2. Effect of rearing parasitoid wasp, D. cavus on treated pink bollworm larvae:

Larval duration

Data presented in Table (3) showed that larval period of D. cavus reared on larvae of P. gossypiella treated by LC20, LC50 of Curacron and recommended dose of Dimilin was high significantly affected by the two compounds, this periods were 7.25, 9.90 and 8.7 days, respectively compared to 7.50 days for control. The LC50 of Curacron and the recommended dose of Dimilin caused prolongation in the parasitoid larval duration compared with untreated check.

Larval mortality

The larval mortality percentages of the parasitoid were 18.00, 27.30 and 23.10% when the parasitoid larvae were reared on fullgrown larvae of pink bollworm treated on the newly hatched larvae with the LC_{20}, LC_{50} from Curacron and recommended dose of Dimilin, respectively, Table (3).

Pupal stage

Data in Table (3) showed the effect of rearing larvae of parasitoid *D. cavus* on pink bollworm larvae treated with Curacron and Dimilin on duration of parasitoid pupae. Pupal period was highly affected, this period was 8.50, 9.87 and 10.10 days in pupae resulted from larvae reared on PBW larvae treated by LC_{20}, LC_{50} of Curacron and Dimilin compared to 7.40 days for control, respectively, while, the pupal mortality

were 8.5, 19.0 and 38.3 %, respectively (Table 3). From these results, it could be concluded that treatment of pink bollworm with IGR resulted high mortality in parasitoid pupae and registered the higher toxic tested compound (38.3 %).

In addition, data in Table (3) revealed that the durations of immature stage of the parasitoid were 17.95, 19.86 and 20.1 days when reared on larvae treated by LC_{20}, LC_{50} of Curacron and Dimilin, respectively compared to 15.8 days for control ones.

Percentage of adult emergence

There were significant differences between adult emergence percentages in case of rearing the parasitoid on treated host larvae. The treated larvae of PBW with LC_{50} of Curacron and Dimilin were the most toxic; the estimated percentages of parasitoid emergence were 53 and 42.3 %, respectively. While treating PBW larvae with LC_{20} of Curacron resulted highest percentage of adult emergence of the parasitoid (81.90 %). In contrast, adult emergence in control averaged 96.30 % (Table 3).

Data in Table (4) showed that adults of *D. cavus* emerged from pink bollworm larvae treated by the two compounds was significantly affected by the treatment compared with the control.

Fecundity and longevity

The emerged parasitoid *D. cavus* reared on pink bollworm larvae treated by LC_{20} and LC_{50} of Curacron and recommended dose of Dimilin showed significant decrease in ovipostion period (8.34, 5.4 and 12.3 days) compared with 13.30 days for control. Results indicated that there is high decrease in ovipostion period when progeny of *D. cavus* reared on larvae treated by LC_{50} of Curacron. The decrease was estimated by 2.90 times than control. Also, pre-ovipostion and post ovipostion periods were highly significant affected when progeny of parasitoid reared on treated larvae of PBW.

Effect on longevity

D. cavus reared on larvae treated by the LC_{20} & LC_{50} of Curacron significantly affected longevity of the emerged females and males compared to control; these longevities were 10.3 &, 7.9 days/female, respectively, and was non significant when emerged from treatment by Dimilin (14.7 days) compared to 15.1 days for control. It is clearly obvious that host larvae treated by LC_{20} & LC_{50} of Curacron shortened the female parasitoid longevity than the other insecticides treatments significantly by 0.4 and 0.5 times, while in case of males the longevities

TABLE (III)

Rearing *D. cavus* on *P. gossypiella* fullgrown larvae treated by LC_{20} and LC_{50} of Profenofos and Diflubenzuron at 26±1°C and 75-75% R.H.

Host / Compound	Incubation period (mean ± S.E.)	Larval stage		Pupal stage			Immature stage (Mean ±S.E)	Adult's stage		
		Duration (mean ±S.E)	% mortality	% pupation	Duration (Mean ±S.E)	% mortality		% emergence	♀	♂
Profenofos LC_{20}	1.43±0.13a (1.2)	7.25±0.20c (7-9)	18.00	81.5	8.50±0.30b (7-9)	8.50	17.95±0.23b (15-19)	81.00b	58	42
Profenofos LC_{50}	1.40±0.08a (1-2)	9.90±0.13a (7-1)	27.00	68	9.87±0.50a (8-11)	19.00	19.86±0.3a (15-20)	53.40c	69	31
Diflubenzuron (288ppm)	1.3±0.3a (1-2)	8.7±0.3b (8-10)	23.00	76	10.1±0.1a (10-11)	38.3	20.1±0.09a (17-23)	42.3d	59	41
Control	0.9±0.30b (0-2)	7.50±0.3c (6-8)	2.00	98	7.4±0.20c (7-8)	2.00	15.80±0.40c (13-19)	96.3a	66	34
P	*	***			***		***	***		
LSD	0.278	0.636			0.64		0.302	2.50		

TABLE (IV)

Fecundity and longevity of *D. cavus* adults emerged from fullgrown larvae of *P. gossypiella* previously treated with Profenofos and Diflubenzuron.

Compounds		Pre-oviposition (days)	Ovipostion (days)	Post-oviposition (days)	Eggs		Longevity ±s.e.	
					Total No.	% hatching	♀	♂
Curacron	LC_{20} 0.0131ppm	1.25±0.08b (1-2)	8.40±0.30b (5-10)	1.65 ±0.40c (1-3)	72.43 ±2.4 b (53-90)	70.00	10.35± 0.6b (8-14)	6.53±0.23 b (6-10)
	LC_{50} 0.0558ppm	1.9±0.16a (1-3)	5.4±0.20 c (4-8)	2.3±0.35b (1-3)	33.40± 1.37d (13-50)	46.00	7.90± 0.2 c (3-10)	3.3± 0.17c (2-5)
Dimilin	288 ppm	1.77± 0.08a (1-2)	12.30±0.50a (11-18)	3.27±0.27a (3-4)	54.18± 3.95c (40-111)	67.00	14.75±.0.2a (9-17)	7.68±.0.3b (7-11)
Control		1.3±0.08c (1-2)	13.13±0.40a (10-17)	1.35±0.12c (2-3)	143.50± 4.12a (113-190)	98.00	15.10± 1.8a (13-21)	10.48± 1.4a (7-15)
P		***	***	***	***		***	***
LSD		0.175	1.289	0.418	5.237		0.609	2.776

were highly decreased to 3.2, 7.6 & 8.1 days /♂ when reared on larvae treated by LC_{20}, LC_{50} of Curacron & recommended dose of Dimilin compared to 11.90 days / ♂ for control, Table (4). These data indicated that the males of the parasitoid nearly lived half time than females when reared on PBW larvae treated by the two tested compounds. This may affect fecundity and/or fertility of the parasitoid

Effect on fecundity and fertility

Data in Table (4) recorded that fecundity of females emerged from parasitoid developed in treated larvae of pink bollworm highly significant decreased compared to control. The numbers of eggs laid were 72.43, 33.4 and 54.18 eggs/female, respectively compared to 143.5 eggs/female for control.

On the other hand, percentage of progeny resulted from eggs laid by females emerged from larvae reared on treated PBW by LC_{20} & LC_{50} of Curacron and Dimilin were 70, 46 and 98 % compared to 98% for control; *i.e.* decreased fertility.

Generally, high concentration from Curacron and recommended dose of Dimilin were more toxic to larvae or adult parasitoid when the adults fed on the oozed fluid after stinging the host larvae or when reared on the treated host larvae, high effect appeared on larval and pupal duration and percentage of adult emergence of the parasitoid as well as on reproductive and fertility. On contrary, the low concentration of Curacron showed no effect on parasitoid. This results are in agreement with those of some authors such as Tillman and Mulrooney (2000), Murray and Lioyd (1997), Tilman (1995) and Ruberson and Tillman (1999) who found that the used pyrethroid lambada cyhalothrin, spinosad and S-1812 caused high toxic effect on lepidopteran pests in field and laboratory and more toxic to parasitoids such as *Bracon mellitor, Cardiochiles nigriceps* and *Cotesia marginiventris* (Hymenoptera: Braconidae).

SUMMARY

The insecticide Profenofos (Curacron 72 % EC) and the insect growth inhibitor Diflubenzuron (Dimilin 48 % SC) were (bioassayed against 1st instar larvae of susceptible strain of pink bollworm *Pectinophora gossypiella* and its parasitoid *Dibrachys cavus* in the laboratory under constant conditions 26±1°C and 70-75 % R.H.. Toxicity data including mortality percentage, LC_{20} and LC_{50} values, moreover, the latent effects of these compounds on some biological aspects of the survival

larvae were considered. Observations on the parasitoid *Dibrachys cavus* reared on fullgrown larvae of PBW treated by LC_{20} and LC_{50} of Profenofos and recommended dose of Diflubenzuron were conducted. The obtained results can be summarized in the following points:

- Biological aspects of the subsequent developmental stages descended from the treated larvae were considerably influenced by the two tested compounds.
- Insecticide treatments prolonged the durations of larvae and shortened pupal period and adult longevity. Also, the two compounds shortened the pre-ovipostion, ovipostion and post ovipostion periods.
- On the other hand, rearing the parasitoid *D. cavus* on fullgrown larvae of pink bollworm treated by LC_{20}, LC_{50} of Curacron and recommended dose of Dimilin (288ppm) caused non significant effect on rearing parasitoid on pink bollworm larval treated by LC_{20} compared with control, but it was significant when the parasitoid was reared on LC_{50} of Curacron and recommended dose of Dimilin treated larvae and caused prolongation in larval and pupal periods of parasitoid to 9.9, 9.87 and 19.86 days, respectively and 8.7, 10.1 and 20.1 days, respectively when reared on LC_{50} & recommended dose Dimilin compared to 7.5, 7.4 & 15.8 days for control
- Also the adult of *D. cavus* emerged from rearing on larvae treated by LC_{20} and LC_{50} of Curacron showed high significant shortened ovipostion period and longevity of adult by 5.4 & 7.9 days, respectively and 8.4 &10.3 days, respectively compared to 13.13 & 15.1 days for control. At the same time, the total numbers of eggs laid and percentage of hatchability were high decreased.

REFERENCES

ABBAS, M.G.; S.A. MOSTAFA; M. ABDEL-MEGUID; N.A. BADR and A.M. HOSSAIN (1996): Susceptibility of pink bollworm *Pectinophora gossypiella* (Saund.) to some insecticides in different Governorates. (*Egypt. J. Appl. Sic., 11(11): 297-311*).

ABBASSY, M.A.; M. ASHRY; F. ADEM; F. KHALIL and M.A. ABOU-SHLOU (1984): Toxicological and histopathological studies on cotton bollwarm *Pectinophora gossypiella* (Saund). (*Mededelingen Van de Faculteit Land bouwwetensch Appen, Pijks*).

AIOUB, A.A.A.; S.A.A. RASLAN; S.S.M HASSANEIN and M.E.A. HAGAB (2003): Effect of certain insecticides on the pink bollworm, *Pectinophora gossypiella* (Saund). (*Zagazig J. Agric. Res., 30(4):172-1734*).

AL-SHANNAF, H.M.H. (2002): Studies on some cotton pests. (*Unpublished Ph.D. Thesis Fac. of Agric., Zagazig Univ).*

CHU, H.F. (1978): Strategies and tactic of pest management with special reference to Chinese cotton insects. (*Acta Entomologica Sinica, 21 (3): 297- 308*).

COCK, M.J.W. (1985): The use of parasitoids for augmentative biological control of pests in the people's republic of China. (*Biocontrol News and information, 6(3): 213-224*).

HOROWITZ, A.R.; M.K. LEINS; S. YABLAVSKI and I.I. ISHAAY (1992): Evaluation of benzoylphenurea for controlling the spiny bollworm, *Earias insulana* (Boisd.) in cotton. (*Crop Protection, 11:465-469*).

KASSEM, S.M.L.; M.L. ALY; N.S. BAKRY and M.I. ZIED (1986): Efficacy of methomyl and its mixtures against the Egyptian cotton leaf worm and bollworm. (*Alexandria, Journal of Agricultural Research, 31(3): 291-300*).

KHAFAGI, W.E. and E.M. HEGAZI (2000): Reproductive potential of the parasitic wasp *Microplitis rufiventris* (Braconidae: Hymenoptera) reared in hosts treated with chitin synthesis inhibitors. (*Ann. Entomol. Soc. Am., 93(3):524*).

KILINCER, N. (1982): Investigation on the parasite complex of the small cabbage white butterfly *Piris rapae* (L.) (Lep.: Pieridae) in the Ankra Region. (*Bitki Koruma Bülteni, 22(3):107-119*).

Outram, I. (1972): Effects of synthetic Juvenile hormones on adult emergence and reproduction of the female spurce budworm *Choristoneura fumiferana* (Lepidoptera: Tortricidae). (*Can. Entomol., 104:271-273*).

PERVEEN, F. (2000): Sublethal effect of chlorofulzuran on reproductivity and viability of *Spodoptera litura* (F.) (Lep. Noctuidae). (*J. Appl. Ent., 124:223-231*).

RASHAD A.M. and E.D. AMMAR (1985): Mass rearing of the spiny bollworm, *Earias insulana* (Boisd.) on semi-artificial diet. (*Bull. Soc. Entomol. Egypt, 65: 239-244*).

RASHAD, A.M.; N.M. ABD EL-SALAM; N.M. HUSSEIN and M.A. ZIDAN (1993): IGRs as bioactive against the pink and spiny bollworms. (*Egypt. J. Appl. Sci., 8 (1): 303- 315*).

SAAD, A.F.S.A.; M.A. ELEWA; T. HAUWILA and M.M. IBRAHIM (1984): Synthetic pyrethroids used for pests control as a factor affecting constituents of cotton seeds. (*Mededelingen Van. De. Facutteit, Landbouwwetens shappen Rijksuniveisiteit, Gent, 49 (3b): 995-1004*).

SIMWAT, G.S. and A. DHAWAN (1992): Efficacy of diflubenzuron alone and combination with insecticides for control of bollworm on different varieties of upland cotton (*Gossypium hirsutum*). (*India J. Agric. Sic., 62 (6): 424- 426*).

STAPEL, J.O.; A.M. CORTESERO and W.J. LEWIS (2000): Disruptive sublethal effect of insecticides on biological control: Altered foraging ability and life span of parasitoid after feeding on extra floral nectar of cotton treated with systemic insecticides.(*Biological Control, (17):243-249*).

TEMERAK, S.A. (2003): Differential susceptibly of pink and spiny bollworms to the ovalarvicidal activity of spinosad with special reference to solve the field failure of thiodiocarb in the current resistance rotation spraying program in Egypt. (*Resistant Pest Management Newsletter, 13(1): 42-46*).

TILLMAN, P.G. and J.E. MULROONEY (2000): Effect of selected insecticides on the natural enemies *Coleomegilla maculate* and *Hippodamia convergens* (Coleoptyera: Coccinellidae), *Geocoris punctipes* (Hemiptera: Lygaeidae), and *Bracon mellitor*, *Cardiochiles nigriceps* and *Cotesia marginiventris* (Hymenoptera: Braconidae) in cotton. (*J. Econ. Entomol., 93(6):1638-1643).*

TKACHEV, V.M. (1976): Insect enemies of the codling moth. (*Zashchita Rastenii, (8):26*).

WALKER, W.F. (1973): Mexican bean beetle: compounds with Juvenile hormone activity (Juvegens) as potential control agents. (*J. Econ. Entomol., 66:30-33*).

ZEROVA, M.D.; L.Y. SEREGINA and A.I. TSYBUL (1986): Mass production of natural enemies (Parasites end Predators) of insect pests. (*Natural Enemies of Insects, 8 (1): 52- 62*).