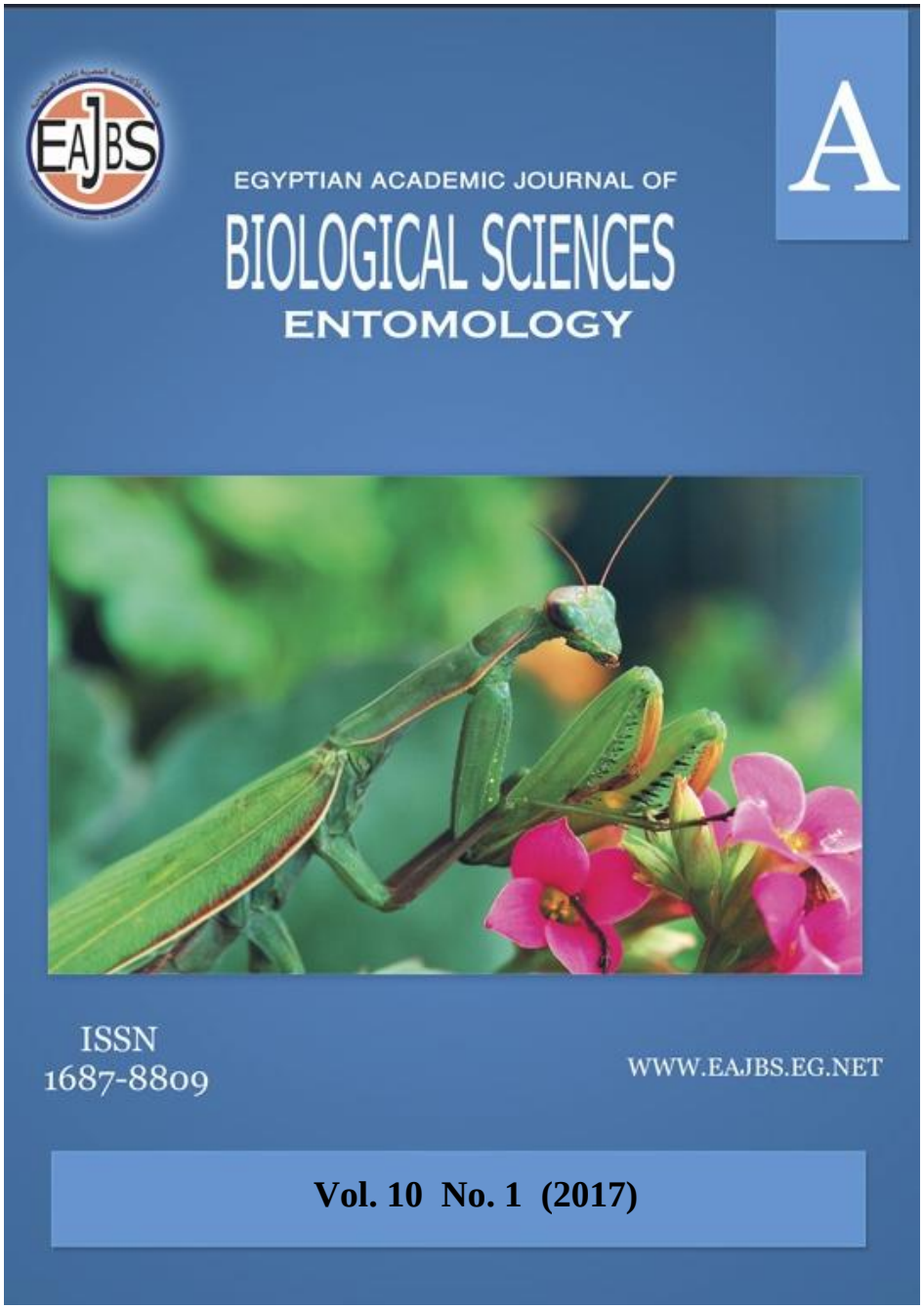

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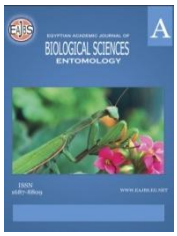

Toxicity and Latent Effects of Some Control Agents on Pink Bollworm *Pectinophora gossypiella* (Saunders)

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ABSTRACT

In the present study, newly hatched larvae of *Pectinophora gossypiella*, (Lab. Strain) were treated with LC_{20} values of six insecticides (**l**ambda-cyhalothrine, Mineral oil masrona, indoxacarb, emamectin benzoate, Microbial pesticides *Bacillus thuringiensis* and chlorfluazuron) (0.0846, 16548.017, 45.252, 0.154, 16043.16 and 3.0178 ppm respectively), to study their effects on duration of larval, pupal, total immature stages and longevity, fecundity and fertility of resulted adults.

The obtained results clear that the larval period prolonged to 21.67, 18.27, 20.42, 15.84, 23.50 and 19.65 days compared to 14.63 days in control; while, pupal period estimated by 10.67, 9.97, 9.27, 13.04, 9.1, 11.86 and 8.84 days in treatments and control, respectively. On the other hand, the adult stage resulted from treated larvae was highly affected by all used compounds. The respective fecundity was reduced to 122.82, 139.51, 134.31, 85.74, 183.7 and 173.57eggs /female for lambda-cyhalothrine masrona, indoxacarb, emamectin benzoate, *B. thuringiensis* and chlorfluazuron treatments compared to 262.48eggs/♀ in control. The percentages of hatchability were 38.06, 53.43, 65.00, 56.29, 48.65 & 78.97, respectively compared with 96.45 % in control.

INTRODUCTION

Pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) is one of the most important pests of cotton and is distributed throughout the world's cotton-growing areas.

The pyrethroides and mineral oils classes of insecticides represented the major elements for controlling these pests for many years. Insect growth regulators (IGRs) are a unique class of insecticides with selective effects on various life stags of some order of insects. Chitin synthesis inhibitors are group of IGRs that interfere with the formation of new cuticle, (Hoffmann and Lorenz 1998).

Emamectin benzoate a new bioinsecticide was isolated from fermentation of *Streptomyces avermitilis* a naturally occurring soil. Biochemistry acts by stimulating the release of γ-aminobutyric acid, an inhibitory neurotransmitter thus causing paralysis (Tomlin, 2003).

Many authors recorded that most pesticides play an important role in developmental periods of insect, it caused prolonged larval, pupal periods and the latent effect appears on the longevity, fecundity & fertility of adult stage of Lepidopteron pests on *S. litturales* (Bakr *et al*, 2004 and 2005), also, on *P.*

gossypiella (Kandil *et al*, 2005 and 2012 and El- Shennawy, 2009).

The present study was conducted to evaluate different insecticides (pyrethroids, mineral oil, IGR, antifeedent and Biotic agents like Emamectin benzoate and Bt) for their efficacy against pink bollworms.

MATERIAL AND METHODS

Insecticides used:

Six insecticides of different groups were tested for their larvicidal effect. They included (lambda-cyhalothrine, masrona, indoxacarb, emamectin benzoate, *Bacillus thuringiensis* and chlorfluazuron)

1- Lambda-cyhalothrin (lambda star 5% EC), pyrethroids group.
2- Mineral oil (Masrona 85%).
3- Indoxacarb (Steward 15%EC), oxadiazine group .
4- Emamectin benzoate (Proclaim5% SG), avermectin group
5- *Bacillus thuringiensis* (Diple DF).
6- Chlorfluazuron (Topron 5%EC) insect growth regulators (IGRs) group.

Insect used:

Newly hatched larvae of pink bollworm (PBW), *P. gossypiella* used in in this study was obtained from laboratory colony of Bollworm Research Department, Plant Protection Research Institute; Agriculture Research Center (ARC), which had reared for several generations away from any contamination with insecticides and maintained on a modified artificial diet, as described by Rashad and Ammar (1985), and incubated at 26 ± 1°C and 75 ± 5% RH.

Toxicological studies:

The toxicity of the tested compounds against newly hatched larvae of *P. gossypiella* was studied. Different concentrations of each tested compound were sprayed (except in case of Bt the diet was mixed with the compound) on the upper surface of 10 g of artificial diet (free from antimicrobial components in case of Bt. treatment) placed in Petri-dish (9 cm in diameter). Concentrations of each pesticide were (0.6250, 0.1563, 0.0782 and 0.039ppm) of lambda-cyhalothrine, (170000, 85000, 42500 and 21250 ppm) of masrona, (3750, 1875, 937.5 and 468.75 ppm) of indoxacarb, (10, 5 and 2.5 ppm) of emamectin benzoate, (128000, 64000.0, 32000.0 and 16000.0 I.U) of *Bacillus thuringiensis* and (25, 12.5, 6.25 and 3.125ppm) of chlorfluazuron.

Ten newly hatched larvae of the pink bollworm were placed on the surface of the treated diet using a soft brush. Another group of Petri-dishes was prepared containing the same diet but sprayed (or mixed) only with distilled water (used as control) and an equal number of the maintained larvae were placed on their surface. Larvae were allowed to feed on the tested diets for one hour. Afterwards, died larvae were counted and alive ones were transferred individually to glass vials (2 X 7 cm) containing untreated diet. Vials were plugged with a peace of cotton and incubated at 26 ± 1°C and 75±5 %R.H. Larval mortalities were recorded after 24hr for tested compounds except for Bt (after 48hr) and for chlorfluazuron at the 6th day after treatment. LC_{20}, LC_{50} and LC_{90} of the tested compounds were calculated according to,Finney (1971).

Biological studies:

The LC_{20} of the tested compounds were calculated, and newly hatched larvae were allowed to feed on LC_{20} treated diet (three replicates for each assay). After that, the survivors in each assay were counted and transferred to glass vials (2 X 7cm)

containing 4gm of untreated diet and kept at 26±1°C and 75±5% R.H. Larvae of control check were fed on untreated diet sprayed only with distilled water. The tubes were stoppered with cotton wool and held until pupation. Resulted moths were sexes and crossed together and grouped 5 pairs/ replicate and replicated three times.

For all treatments mortality, abnormality, durations of larvae, pupae and moth emergence percent were recorded. After moth emergence, three replicates each contained 5-pairs/cage of emerged moths that appeared morphologically not impaired was used to measure the reproductive potential and adult longevity of the insects in each assay. Laid eggs were incubated under controlled conditions then counted after hatching to estimate the percentage of hatchability.

RESULTS AND DISCUSSION

Toxicity of six compounds on *P. gossypiella* larvae:

Data in Table (1) shown the LC_{20}, LC_{50} and LC_{90} values for newly hatched larvae of *P. gossypiella* treated with lambda-cyhalothrine, masrona, indoxacarb, emamectin benzoate, *B. thuringiensis* and chlorfluazuron. According to LC_{20} values lambda-cyhalothrine compound is considered the highest potent among other tested compounds (LC_{20} = 0.0846ppm) followed by emamectin benzoate (LC_{20} = 0.154ppm), this is reversed in LC_{50} & LC_{90} that recorded (0.404 & 1.757) and (1.009 & 43.9593) ppm for emamectin benzoate and lambada-cyhalothrine, respectively with more toxicity for emamectin.

Table 1: Toxicity of tested insecticides on newly hatched larvae of *P. gossypiella* under controlled conditions (26 ± 1°C and 75±5%R.H.).

Compound	Conc.	LC values			Slope ± SE
		LC_{20}	LC_{50}	LC_{90}	
Lambda-cyhalothrine	0.6250	0.0846	1.009	43.9593	0.7819± 0.3589
	0.1563				
	0.0781				
	0.0391				
Masrona	170000	16548.0	69928.7	627770	1.345± 0.361
	85000				
	42500				
	21250				
Indoxacarb	3750	45.252	335.489	7089.11	0.967±0.374
	1875				
	937.5				
	468.75				
Emamectin benzoate	10	0.154	0.404	1.757	2.008± 0.709
	5.0				
	2.5				
Bacillus thuringiensis	128000	16043.5	98430.3	1559100	1.068± 0.287
	64000				
	32000				
	16000				
Chlorfluazuron	25	3.0178	17.4723	253.360	1.1035±0.3990
	12.5				
	6.25				
	3.125				

Relatively similar results were obtained by Gupta *et al.,* (2005) who evaluated the toxicities of some insecticides against second instar larvae (5 days old) of *Earias*

vittella (Fabricius) by 'Potters tower spray method. Based on median lethal concentration emamectin benzoate, indoxacarb, abamectin and spinosad, were highly toxic to the tested insect and arranged descending according to their toxicity emamectin benzoate > indoxacarb > abamectin > spinosad > bifenthrin > quinolphos > cypermethrin > endosulfan > deltamethrin > fenvalerate > betacyfluthrin . Also, El-Didamony, (2012) who found that emamectin benzoate was the most toxic against *Earias insulana* larvae compared to control.

Biological activity:

Larval mortality and malformation:

Data represented in Table (2) showed that the Percent of larval mortality and malformation was higher in all treatments than that in untreated check. The larval mortality percentages were 56.07, 58.33, 66.90, 55.94, 54.21 and 66.94% for lambda-cyhalothrine, masrona, indoxacarb, emamectin benzoate, *B. thuringiensis* and chlorfluazuron, respectively compared to 5.89% for control. Highly significant differences were found between treated and untreated larvae. In the same trend chlorfluazuron and indoxacarb treatments recorded the highest percent of larval malformation (13.46 &13.30%, respectively) with no significant difference, these percents decreased significantly to (10.09%) for emamectin benzoate treatment, followed by (7.10%) for lambda-cyhalothrine and (6.69%) for masrona treatments (having non-significant difference), while the lowest percent of larval malformation was observed in *Bt* treated larvae (1.55%). All Treatments differed significantly with control (1.07%) except *Bt* treatment. These finding are in harmony with finding by Mouharib (2009) who found that emamectin benzoate with its LC_{50} was the most effective one giving in 34% larval mortality of *P. gossypiella*. Also, Lopez *et al*. (2010) found that treatment of adult females *Helicoverpa zea* with sub-lethal dosages of emamectin benzoate significantly reduced larval survival to the pupal stage. Also, El-Didamony, (2012) indicated that the mortality percent increased markedly when larvae of *Earias insulana* were treated with emamectin benzoate to 43.99%.

In addition, Abdel-Aziz (2000) and Dutton *et al*. (2005) recorded a high susceptible larvae of *S. littoralis* toward the *B. thuringiensis* var *kurstaki* (Dipel- 2x) represented by a higher mortality compared to control. The larval mortality caused by mineral oil may be due to inhibition to physiological processes (Ebeling, 1936). Ismail *et al*. (1995) explained that, oils show a strong deterrent activity against *S. littoralis* larvae reducing the food consumption significantly. Thus, the larvae were died due to starvation.

Larval, **duration and weight:**

Data in Table (2) illustrates the LC_{20} latent effect of tested compounds on larval duration and weight of (PBW). The six tested compounds prolonged the duration of larval stage, significantly. These periods were estimated by 21.67, 18.27, 20.42, 15.84, 23.50 and 19.65 days for lambda-cyhalothrine, masrona, indoxacarb, emamectin benzoate, *Bacillus thuringiensis* and chlorfluazuron, respectively compared with 14.63 days in control. In addition, the average larval weight decreased significantly to 0.0325, 0.0317, 0.0244, 0.0285, 0.0250 and 0.0273 g/ larva for previous compounds, respectively, while it was 0.0377g/ larva in control.

These results are in agreement with data reported by Khoja *et al*., (2006) & El-Didamony (2012) who found that treatment of larvae of *E. insulana* with *B. thuringiensis* and emamectin benzoate was extended the larval period and decreased larval weight in comparison with control. Also, El- Shennawy (2009) reported a significant prolongation in larval duration and reduction in larval weight of *P. gossypiella* after IGRs treatment.

Table 2: Effect of tested compounds on biological aspects of PBW larval and pupal stages resulted from treating newly hatched larvae under controlled conditions (26±1°& 75±5% R.H.).

Com.	Conc. Ppm	LARVAL STAGE				PUPAL STAGE				Total Immatur
		Mortality %	Malform %	Duration	Wieght	Mortality %	Malform%	Duration	Wieght	
Lambda-cyhalothrine	0.0838	56.07^{b} ±1.76	7.1^{c} ±0.51	21.67^{ab} ±0.57	0.0325^{ab} ±0.001	2.53^{cd} ±0.33	4.4^{d} ±1.76	10.67^{bc} ±0.33	0.0215^{b} ±0.00	32.33a ±0.01
Masrona	16548.02	58.33^{b} ±1.38	6.69^{c} ±0.40	18.27^{cd} ±0.27	0.0317^{ab} ±0.002	3.6^{c} ±0.08	3.6^{d} ±1.37	9.97^{cd} ±0.258	0.0193^{b} ±0.0017	32.39 ±0.10
Indoxacarb	45.252	66.90^{a} ±0.52	13.3^{a} ±0.36	20.42^{bc} ±0.6	0.0244^{c} ±0.003	16.89^{b} ±0.36	8.33^{c} ±0.73	9.27^{d} ±0.1	0.0186^{b} ±0.0	29.69a ±0.053
Emamectin benzuat	0.154	55.94^{b} ±0.43	10.09^{b} ±0.44	15.84^{de} ±0.082	0.0285^{bc} ±0.001	19.3^{a} ±0.005	17.82^{a} ±0.26	13.04^{a} ±0.12	0.0193^{b} ±0.001	28.52^{a} ±0.05
Bacillus thuringiensis	16043.16	54.21^{b} ±3.52	1.55^{d} ±0.2	23.5^{a} ±1.02	0.0250^{c} ±0.001	1.33^{d} ±0.13	0.76^{e} ±0.29	9.1^{d} ±0.29	0.0193^{b} ±0.001	32. 6 ±0.93
Chlorfluazuron	4.0251	66.94^{a} ±0.4	13.46^{a} ±0.34	19.65^{bc} ±0.49	0.0273^{bc} ±0.002	15.89^{b} ±0.66	11.13^{b} ±0.26	11.83^{ab} ±0.79	0.0207^{b} ±0.002	31.48a ±0.56
Control		5.89^{c}	1.07^{d}	14.63^{e}	0.0377^{a}	1.28^{d}	0.27^{e}	8.84^{d}	0.028^{a}	23.47
F		126.170	44.429	15.156	4.605	340.598	57.137	12.303	3.273	
LSD 0.05		5.674	2.301	2.4490	0.00663	1.351	2.525	1.353	0.0055	

Pupal mortality and malformation:

According to Table (2) indicated the percent of pupal mortality and malformation. The highest percent of pupal mortality recorded 19.3% for emamectin benzoate followed by indoxacarb (16.89%), chlorfluazuron (15.89%), masrona (3.6%), lambda-cyhalothrine (2.53%) and *Bt* (1.33%) opposite to 1.28% for control. While the percent of malformed pupae recorded 17.82, 8.33, 11.13, 3.6, 4.4 and 0.76 for the previous pesticides, respectively compared to 0.27% for control. These results confirmed those previously obtained by El-Aw (2003) on *S. littoralis*, Mouharib (2009) on *P. gossypiella*, and El-Didamony (2012) on *E. insulana,* who reported that emamectin benzoate reduced the percent of pupation with significant increase in pupal mortality percent.

Pupal duration and weight:

The used compounds caused high significant increase in pupal duration of PBW resulted from treated newly hatched larvae. The emamectin benzoate, chlorfluazuron and lambda-cyhalothrine recorded 13.04, 11.83 and 10.67days/ pupa, respectively. On contrast, insignificant decrease of masrona, indoxacarb and *Bt* treatments to 9.97, 9.27 and 9.1days/ pupa, respectively, those compared with 8.84 days in control.

Total immature stage:

The total immature stage of PBW resulted from treated newly hatched larvae were highly elongated to 32.6, 32.39, 32.33, 31.48, 29.69 and 28.52 days for *Bt*, masrona, lambda-cyhalothrin, chlorfluazuron, indoxacarb and emamectin benzoate, respectively, compared with 23.47 days in control (Table, 2).

Khoja *et al.,* (2006) who indicated that the duration of pupal stage was not significantly affected; however, the weight of pupae was significantly reduced when larvae of *E. insulana* were treated with *Bt* product. Also, El-Aw (2003) recorded that sublethal effect of emamectin benzoate on larvae of *S. littoralis* significantly reduced male and female pupal weight. In case of mineral oil the reduction in the pupal weights may be due to larval starvation during larval stage (Bakr *et al.* 2013) or may be due to insufficient food intake by larvae resulted from mouth parts malformation and anti-feeding of mineral oils El-Sweerki (1994); Aly *et al*., (1999) on *S.littoralis*.

In addition Kandil *et al*., 2005 and El-Barkey, 2009 on *P. gossypiella* reported that the pupal duration was increased significantly with Chlorfluazuron treatment compared with control.

Adult stage:

Table (3) showed that the average percent of adult emergence was 98.86% in the control. This average decreased insignificantly to 98.23 & 97.47 % for *Bt* and lambada, respectively and significantly to 96.4, 84.11, 83.11 and 80.03 % for masrona, chlorfluazuron, indoxacarb and emamectin benzoate, respectively. On other hand, a percent of morphological malformations was recorded (7.4, 6.65, 5.37, 5.2, 2.89 and 0.0 %) for the tested compounds, respectively compared with no malformations for control. Kandil *et al*., 2005 and El-Barkey, 2009 on *P. gossypiella* recorded significant decrease in adult emergence was obtained by treatment of chlorfluazuron on larval instar at different concentrations. The main cause of inhibition of adult emergence in the case of treatment with mineral oils may be due to starvation of larvae which need sufficient food to complete its development into adults (Salama *et al*., 1974). In addition El-Didamony (2012) indicated that the application of protecto for *E. insulana* larvae caused slight percentage of malformation of adults resulting from treated newly hatched larvae. Also, Khedr (2011) found that there were deformations of larvae, pupae and adults resulted from 4th instar larvae of *S. littoralis* treated with Dipel 2x.

Table 3: Effect of tested compounds on biological aspects on adult stage resulted from treating newly hatched larvae under controlled conditions (26±1°& 75±5% R.H.).

Com.	Conc. Ppm	Adult emergence%	Malformed.% Mean	Six ratio		Pre-oviposion (days)	Oviposit ion (day)	Post-oviposion (days)	Longevity		Total eggs/♀	egg/♀/day	Hatchability% Mean
				♂	♀				♂	♀			
Lambda-cyhalothrine	0.0838	97.47^{ab} ±0.33	6.65^{a} ±1.91	54.3^{a} ±0.17	45.7^{d} ±0.17	3.83^{b} ±0.44	12.67^{d} ±0.33	3.33^{bc} ±0.33	13.1^{e} ±0.66	19.83^{e} ±0.44	122.82^{d} ±1.05	9.71^{b} ±0.34	38.06^{e} ±3.52
Masrona	16548.02	96.4^{b} ±0.23	7.4^{a} ±1.5	34.49^{d} ±0.29	65.51^{a} ±4.8	3.83^{b} ±0.19	19.43^{a} ±0.27	4.83^{a} ±0.16	19.63^{a} ±0.3	28.09^{a} ±0.53	139.51^{cd}±21.4	7.18^{c} ±0.3	53.43^{d} ±1.9
Indoxacarb	45.252	83.11^{c} ±0.11	0.0^{c}	53. 4^{a} ±0.19	46.6^{d} ±0.23	4.33^{ab} ±0.21	15.67^{c} ±0.23	4.87^{a} ±0.34	17.53^{bc} ±0.29	24.87^{b} ±0.41	134.31^{d} ±3.72	8.57^{bc} ±0.29	65.00^{c} ±2.51
Emamectin benzoate	0.154	80.03^{d} ±0.60	5.37^{ab} ±0.20	52.77^{a} ±0.23	47.23^{d} ±0.45	4.43^{ab} ±0.1	12.00^{d} ±0.26	2.87^{c} ±0.12	14.93^{d} ±0.08	19.3^{e} ±0.15	85.74^{e} ±1.69	7.15^{c} ±0.23	56.29^{c} ±3.04
Bacillus thuringiensis	16043.16	98.23^{a} ±0.65	2.89^{bc} ±1.4	43.56^{c} ±0.8	56.44^{b} ±0.83	4.17^{ab} ±0.16	19.37^{a} ±0.30	4.8^{a} ±0.26	17.7^{bc} ±0.4	28.34^{a} ±0.30	183.7^{b} ±0.77	9.48^{b} ±0.10	48.65^{d} ±0.33
Chlorfluazuron	4.0251	84.11^{c} ±0.17	5.2^{ab} ±1.37	47.37^{b} ±0.56	52.63^{c} ±0.56	4.83^{a} ±0.01	12.63^{d} ±3.4	3.87^{b} ±5.2	17.1^{c} ±0.76	21.33.^{d} ±0.76	173.57^{bc}±4.7	13.74^{a} ±0.25	78.97^{b} ±0.6
Control		98.86^{a}	0.0^{c}	52.85^{a}	47.15^{d}	2.7^{c}	17.44^{b}	2.8^{c}	18.88^{ab}	22.94^{c}	262.48^{a}	15.051^{a}	96.45^{a}
F		256.99	6.42	159.26	170.98	9.360	97.616	16.345	25.44	81.31	23.270	37.61	84.85
LSD 0.05		1.574	3.628	1.745	1.694	0.671	0.992	0.699	1.361	1.222	35.55	1.504	6.45

Data in Table (3) showed that the tested compounds elongate significantly the pre-oviposition period of emerged females from larvae treated by chlorfluazuron, emamectin benzoate, indoxacarb, Bt, lambda-cyhalothrin and masrona to 4.83, 4.43, 4.33, 4.17, 3.83 and 3.83 days, respectively, compared with 2.7 days in control. The oviposition period also elongated significantly to19.43 and 19.37 days in case of masrona and Bt, while it shortened significantly to 15.67, 12.67, 12.63 and 12.00days, for indoxacarb, lambda-cyhalothrine, chlorfluazuron and emamectin benzoate, respectively, compared to 17.44 days in control. Also, the post oviposition

period elongated significantly to 4.87, 4.83, 4.8 and 3.87 days for indoxacarb, masrona, Bt and chlorfluazuron but, insignificantly to 3.33 and 2.87 days for lambada-cyhalothrine and emamectin benzoate, respectively, compared to 2.8 days in control. The variation in pre, ovi- and post oviposition periods leads to subsequent variation in female's longevity which increased significantly to 28.09, 28.34 and 24.87 days for masrona, Bt and indoxacarb treatments respectively, and decreased significantly to reach 21.33, 19.83 and 19.3 days for chlorfluazuron, lambda-cyhalothrine and emamectin benzoate respectively, compared to 22.94 days/ female in control. In contrast, the males longevity resulted from PBW treated larvae were decreased in comparison to control that recorded 18.88 days, except in masrona treatment (the male longevity increased to19.63 days) Table (3). El-Didamony (2012) indicated that emamectin benzoate caused reduction in male adults longevity compared with control adults, but no noticeable effect was observed on adult female's longevity. In addition, Bakr *et al*., (2013) declared that the longevity of the resulting adults of *S. littoralis* is slightly affected by the mineral oil CAPL-2.

Reproductive potential:

Data of average numbers of eggs and hatchability percentage deposited from normal adults emerging from treated larvae are given in Table (3). All the moths that succeeded to emerge were able to lay a reduced number of eggs, which varied significantly as a result of treatment in comparison with control. The average number of eggs recorded 262.48 eggs/untreated female. These values significantly decreased to 122.82, 139.51, 134.31, 85.74, 183.7 and 173.57eggs /female for lambda-cyhalothrine, Masrona, indoxacarb, emamectin benzoate, *Bt* and chlorfluazuron respectively, with the most efficiency of emamectin benzoate compound in this respect. The average of egg hatchability percent reached 96.45 % in case of untreated pink bollworm, while it greatly decreased to reach 38.06, 53.43, 65.00, 56.29, 48.65 and 78.97% emerged moths from treating newly hatched larvae with LC_{20} of the previous compounds, respectively (Table3). Statistical analysis proved highly significant difference between treated and untreated insects with the most efficiency to lambada compound in this respect. Mouharib (2009) on *P. gossypiella*, Lopez *et al.* (2010) on *H. zea* reported that emamectin benzoate reduced fecundity and egg hatchability of females resulted from treated larvae. Hegab (2008) and El-Didamony (2012) who recorded a significant reduction in the number and hatchability of deposited eggs of bollworm, this deficient in fecundity may be due to the toxicity of larval haemolymph (the major source of egg protein) due to *Bacillus* infection which affected the female fertility (Yoshinori and Kaya, 1993). Also, Rashad *et al.* (2006) indicated that treating adults of *P. gossypiella* with diflubenzuron, caused reduction in female fecundity and fertility. The reduction in fecundity could be due to interference of the tested IGR with oogenesis; it induced decrease in the concentration of yolk, proteins, carbohydrates, lipids (Shaurub *et al*., 1998), while reduction in hatchability percent could be due to sterilization of either eggs or sperms or may be due to inability of the sperms to be transferred to females during copulation (Ismail, 1980).

According to mineral oil our findings go in the same direction with that of El-Sweerki (1994); Badr., (1995); and Bakr *et al*., (2013); who showed the efficiency of CAPL-2 on *S. littoralis* which induce sever reduction in the fecundity and fertility. The sterility of larvae treated with mineral oils may be due to the malnutrition caused by antifeedent effect of mineral oils which require food before they can deposit fertile eggs as many lepidopteron species. Also, malnutrition may be leads to inhibition in the development of sex organs leads to produce unfertile eggs.

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ARABIC SUMMERY

تأثير السمية لبعض عوامل التحكم على دودة اللوز القرنفلية

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تم تحضير سلسلة من التركيزات لكل مركب وذلك لتحديد التركيز تحت المميت لكل مركب LC_{20} فى حالة معاملة الفقس الحديث وكانت التركيزات كالتالى:

١- لامبادا ٠,٠٣٩١ ، ٠,٠٧٨١ ، ٠,١٥٦٣ و ٠,٦٢٥٠ جزء فى المليون.
٢- مصرونا ٢١٢٥٠,٠ ، ٤٢٥٠٠ ، ٨٥٠٠٠ و ١٧٠٠٠٠ جزء فى المليون.
٣- توبرون ٣,١٢٥ ، ٦,٢٥، ١٢,٥، ٢٥ وجزء فى المليون.
٤- ستيوارد ٤٦٨,٧٥ ، ٩٣٧,٥٠، ١٨٧٥ و ٣٧٥٠ جزء فى المليون.
٥- ايمامكتين ٢,٥ ، ٥ و ١٠ جزء فى المليون.
٦- باسيلس ١٦٠٠٠، ٣٢٠٠٠، ٦٤٠٠٠، ١٢٨٠٠٠ وحدة دولية.

عوملت اليرقات حديثة الفقس عن طريق رش سطح أطباق بترى (٧سم) بالتركيزات المختلفة (فيما عدا الباسيلس تمت المعاملة عن طريق الخلط بالبيئة) لعدد ٣ مكررات/ تركيز بالاضافة لعدد ٣ مكررات بدون معامله كمقارنه ثم التعريض المباشر للفقس الحديث (عدد ١٠٠ يرقه / مكرره) لمدة ساعه بالتركيزات السابقة.

تم تحديد التركيز تحت المميت لكل من مركبات لامبادا، مصرونا، ستيوارد وايمامكتين بعد ٢٤ ساعه من المعاملة بينما حددت بعد ٤٨ ساعة فى حالة الباسيلس، وفى اليوم السادس فى حالة التوبرون.

أدى استخدام التركيز تحت المميت فى المعاملة الى نسبة عالية من الموت التراكمى فى الطور اليرقى بلغت ٥٦,٠٧، ٥٨,٣٣، ٦٦,٩٤، ٦٦,٩٠، ٥٥,٩٤ و ٥٤,٢١ % لكل من مركبات لامبادا، مصرونا، توبرون، ستيوارد، ايمامكتين وباسيلس على التوالى مقارنة بـ ٥,١٥٣% لمتوسط الكنترول.

كذلك سببت المعاملة نسبة موت فى العذارى سجلت ٢,٥٣، ٣,٦، ١٥,٨٩، ١٦,٨٩، ١٩,٣٠ و ١,٣٣% لكل من المركبات السابقه على التوالى مقارنة بـ ٢,٦٧ % لمتوسط الكنترول.

أيضا سببت المعاملات اطاله فى أعمار اليرقات الناتجه مقارنه بالكنترول حيث سجلت ٢١,٦٧، ١٨,٢٧، ١٩,٦٥، ٢٠,٤٢، ١٥,٨ و ٢٣,٥ يوم لليرقات لكل من لامبادا، مصرونا، توبرون، ستيوارد، ايمامكتين وباسيلس على التوالى.

فى حالة العذارى أثرت مركبات لامبادا، مصرونا، توبرون،وايمامكتين بالاطالة على أعمار العذارى الناتجة مقارنة بالكنترول حيث سجلت ١,٦٧، ٩,٩٧، ١١,٨٣ و ١٣,٠٤ يوم للعذارى لكل من المركبات السابقه على التوالى على العكس من ذلك لم يكن لمركبى سيتوارد وباسيلس تأثير فى اعمار العذارى الناتجة مقارنة بالكنترول حيث سجلا ٩,١ و ٩,٢٧ يوم للعذارى على التوالى.

من جهة أخرى تم حساب نسبة التشوهات فى الاطوار المختلفة حيث كان لمركبى، التوبرون والستيوارد الفاعلية الأقوى بالنسبه لتشوهات اليرقات حيث سجلا نسب تشوه قدرت بـ ١٣,٤٦ و ١٣,٣% على التوالى مقارنة بـ ١,١٠٧% لمتوسط الكنترول، بينما سجل مركب الايمامكتين النسبة الاعلى فى تشوهات العذارى والتى قدرت بـ ١٧,٨٢% مقارنة بـ صفر % لمتوسط الكنترول، أما بالنسبة لتشوه الفراش فقد أظهر مركب مصرونا الفاعلية الأقوى حيث سجل ٧,٤% مقارنة بـ ٠,٥٧% لمتوسط الكنترول الفاعلية، على العكس من ذلك كان مركب الستيوارد هو الاقل فاعليه حيث لم يسجل أى نسبه لتشوهات الفراش.

كما سببت تلك المعاملات انخفاض فى عدد البيض الناتج حيث سجل ١٢٢,٨٢، ١٣٩,٥١، ١٧٣,٥٦، ١٣٤,٣١، ٨٥,٧٤ و ١٨٣,٧ بيضه/ أنثى ناتجة من معاملة الفقس الحديث بكل من لامبادا، مصرونا، توبرون، ستيوارد، ايمامكتين وباسيلس على التوالى (بفاعلية أقوى لمركب الايمامكتين فى هذا الصدد) مقارنة بـ ٢٥٦,٣٨ بيضه/ أنثى فى متوسط الكنترول. كذلك انخفضت النسبة المئوية للفقس بصوره ملحوظه لمعظم المركبات كان على رأسها مركب اللامبادا والذى سجل ٣٨,٠٦% مقارنة بـ ٩٦,٩٢% فى متوسط الكنترول.