

**EFFICIENCY OF THREE INSECTICIDES AND ITS LATENT
EFFECTS ON SOME BIOLOGICAL AND BIOCHEMICAL ASPECTS
OF AMERICAN BOLLWORM IN THE COTTON.
HELICOVERPA ARMIGERA (HÜB.)**

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(Manuscript received 2 December 2018)

Abstract

Laboratory tests have been conducted in Bollworms Research Department, Plant Protection Research Institute (Sharkia Branch). Field experiments have been conducted at Aya, Dakahlia governorate during 2018 cotton season to evaluate the efficiency of Lufenuron, Pyridalyl and Chlorpyrifos on larval population of *H. armigera* (Hüb.) as well as their effect on some biological and biochemical aspects in cotton fields. Results showed that, three insecticides had toxic effect on the newly hatched larvae of *H. armigera*. The highest toxic effect was recorded with Lufenuron (LC₅₀ value was 0.95ppm) followed by Chlorpyrifos (LC₅₀ value was 4.29 ppm) while the lowest was recorded with Pyridalyl (LC₅₀ value was 6.02 ppm). The three pesticides caused increasing in the larval and pupal mortality and decreasing the larval and pupal duration also the larval and pupal weight, pupation, sex ratio percentages, adult longevity, oviposition periods, the number of laid eggs and hatchability percentages. Also the results showed changes in the activity of carbohydrates (amylase, trehalase, invertase), transaminase (ALT & AST) enzymes, acetylcholinesterase enzyme, total soluble protein (TSP) and total lipid (TL) on the American bollworm larvae treated with the three pesticides (Lufenuron, Pyridalyl and Chlorpyrifos). Field experiments showed that, the three insecticides caused population's reduction percentages of the *H. armigera* larvae in cotton fields. Chlorpyrifos caused the highest reduction reached (80.06%) while, Pyridalyl caused the lowest reduction reached (65.28%) as compared with control. Mean while population reduction rate resulted from used Lufenuron insecticide reach (70.07%).

Key words: Lufenuron, Pyridalyl, Chlorpyrifos, *Helicoverpa armigera*, Biology, Biochemical, enzymes, American bollworm (ABW).

INTRODUCTION

American bollworm (ABW), *Helicoverpa armigera* has been reported on over 180 cultivated hosts and wild species related to at least 45 plant families (Venette *et al.*, 2003). It feed on a wide range of the economically important crops including cotton, corn, tomato, sunflower, legumes, tobacco and citrus crops (Moral, 2006). Also in cotton field Chlorpyrifos and Profenofos showed 73.00 and 70.00% larval mortality on *H. armigera* (Tariq *et al.*, 2005). Field experiments indicated that Chlorfluazuron showed the highest initial reduction (75.00 and 80.6%); residual mean (83.75 and 79.45%) and annual mean (80.83 and 79.83%) on *H. armigera* (Al-

Shannaf *et al.*, 2012). In cotton fields the efficacy of Chlorpyrifos on eggs of American bollworm caused the highest reduction percentage (72.03%), followed by Profenofos recorded (68.93%) while the least reduction was 62.44% noticed for Chlorfluazuron. Other researcher indicated that Chlorpyrifos was most effective on the eggs and larvae of *H. armigera* in cotton field. Also, others indicated that, Chlorpyrifos was effective against 3rd instar larvae of *H. armigera* (El-Sayed *et al.*, 2013) and (Eliane *et al.*, 2014).

The aim of the present investigation is to determine the efficiency of three insecticides against the American bollworm, (*H. armigera* larvae) in laboratory and cotton fields.

MATERIALS AND METHODS

Table 1. Insecticides used.

Trade name	Common name	Rate /200 litter water/feddan
Match	Lufenuron EC- 5%	120 ml
Pleo	Pyridalyl EC- 50%	120 ml
Dursban	Chlorpyrifos EC- 48%	1000ml

I. Laboratory tests:

I. 1. Experimental insect:

Newly hatched larvae of ABW used in this study was obtained from laboratory colony of Bollworm Research Department, Plant Protection Research Institute (Sharkia Branch), Agric. Res. Center, reared for about 20th generations away from any insecticides treatments and kept in incubator at $26 \pm 1^\circ\text{C}$ and $75 \pm 5\%$ R.H. exposed on photoperiods (light 14hrs: 10hrs dark) on semi artificial diet that described by (Amer and El-Sayed, 2014).

I.2.Bioassay:

To study the efficiency of Lufenuron (Match), Pyridalyl (Pleo) and Chlorpyrifos (Dursban) compounds on ABW newly hatched larvae were conducted in laboratory and cotton fields. The tested concentrations were determined as recommended, half, quarter up to 13th concentrations for Match & Pleo and 14th concentrations for Dursban based on recommended used concentration using distilled water. The tested concentrations used were started from 15.00 to 0.007 ppm for Lufenuron (Match) IGR; 0.064 to 0.007 ppm for Pyridalyl (Pleo) and 0.938 to 0.029 4.69 ppm for Chlorpyrifos (Dursban).

Ten grams of semi artificial diet was poured into conventional Petri-dish (7cm diameter x 2cm high). One ml of each concentration was distributed on the upper

surface of the poured diet using volume syringe. The treated dishes were held uncapped for dryness under room conditions ($25 \pm 1^\circ\text{C}$). Twenty newly hatched larvae of ABW were transferred to the surface of treated diet using fine hair brush and repeated four times for each treatment and kept at mentioned above conditions in an electrical incubator. Similar numbers of larvae were transferred to artificial diet treated with 1ml water only as control. The larval of each compound were transferred individually to new glass tube of (2 x 7.5 cm) capacity as well as untreated larvae after treatment. The glass tube treatments were containing about two grams of artificial diet and covered using absorbent cotton then it was changed by new one after 4 days from treatment then changed after a week of treatment. The treatments were placed in the incubator under the same conditions as previously mentioned.

I.3. Toxicity and latent effect on larvae:

a. Toxicity effect: After 24 hrs of exposure and feeding, larval mortality were recorded and corrected using (Abbott, 1925), formula. The LC_{25} , LC_{50} , LC_{90} and slope values were determined according to (Finney, 1971).

The toxicity index values were calculated as (Suns, 1950) equation.

Toxicity index = LC_{50} or LC_{90} of HEC/ LC_{50} or LC_{90} of OTC x100

Where: HEC= The highest efficient compound. OTC= the other tested compounds.

The relative potency values were calculated as (Zidan and Abd EL-Megeed, 1988) equation:

Relative potency = LC_{50} or LC_{90} of LEC/ LC_{50} or LC_{90} of OTC

Where: LEC= the lowest efficient compound. OTC= the other tested compounds.

b. Latent effect: After 24 from treatment of each compound, alive larvae from each replicate were transferred individually to glass tubes (2 x 7.5 cm), each containing about five grams of untreated diet. The tubes were inspected daily. Larval mortality, larval and pupal duration, larval and pupal weight, pupation and sex ratio were recorded. Newly emerged moths of ABW were sexed and transferred to glass jars (three pairs /cage) and repeated four times. The emerged moths were fed on 10 % sugar solution as well as untreated moths. Each Jar was inspected daily to record the oviposition periods, longevity of males and females, the number of laid eggs / female and hatchability percentages.

I.4. Biochemical effects of Lufenuron, Pyridalyl and Chlorpyrifos on larvae of *H. armigera*:

The present experiment was designed to study the changes in the activities of transaminase enzymes (AST & ALT), carbohydrate hydrolyzing enzymes, acetylcholine esterase (AChE), total soluble protein and total lipid contents in the supernatant of the

homogenate of the American bollworm larvae as affected by LC₅₀ of Lufenuron, Pyridalyl and Chlorpyrifos as compared to untreated larvae.

Preparation of samples: After seven days from treatment the samples of ABW larvae were prepared. Twenty larvae for each compound and untreated once were placed in clean jars and left to starved four hours. The starved larvae were homogenized in distilled water (1 larvae: 1 ml) using a Teflon homogenizer surrounded with jacket of crushed ice for three minutes. The homogenate larvae were centrifuged at 3500 R.P.M. for 10 minutes at 5°C. The supernatant was immediately assayed to determine amylase, invertase, trehalase, aspartate amino transferase (AST), alanine amino transferase (ALT) enzymes, acetylcholine esterase (AChE) activities & total soluble protein and total lipid.

a. Enzymes measurements:

The activities of AST and ALT enzymes were determined calorimetrically according to the method of **(Reiteman and Frankel 1957)**.

The Carbohydrate hydrolyzing enzymes: The methods used to determine the activities of amylase, invertase and trehalase enzymes according to (Ishaaya and Swiriski, 1976).

Acetylcholine esterase (AChE) activity: Determined according to the method described by (Simpson *et al.*, 1964).

b. Determination of total lipid and total soluble protein:

Total lipids (TL): The total lipids were estimated by **(Schmit, 1964)** method.

Total soluble protein (TSP): Colorimetric determination in total homogenate of larvae was carried out as described by (Gornall *et al.*, 1949).

II. Field experiments: The field experiments were carried out at Aga district, Dakahlyia governorate, Nile Delta, Egypt during cotton season of 2018 to evaluate the efficiency of three insecticides Match, Pleo and Dursban against ABW larvae in cotton fields. The experimental area about two feddans cultivated with the Egyptian cotton variety, Giza 94 and sown during the 3rd week of April at 2018 season. The cotton areas were subjected to normal agricultural practices allover study periods.

a. Experimental design: The experimental area was divided to four plots each plot half feddan (2100m²), three plots for treatments and the other for untreated control. Each plot was divided to four replicates (525 m² each). The plots were distributed in completely randomized block design. Cotton plants in this experiment did not previously receive any pesticide treatments.

The evaluation of tested insecticides was based on one treatment at June 19th during 2018 season using a motor solo 20-L volume sprayer.

b. Sample technique: Twenty cotton plants (five plants for each replicate) were chosen randomly and investigated visually from each treatment to count the numbers of ABW larvae different instars on plant. The numbers of larvae were recorded before treatment and one, seven and after ten days for the two conventional insecticides Pyridalyl, Chlorpyrifos compounds and Insect Growth Regulators (IGR) compound Lufenuron inspected at three, seven and ten days as pesticide evaluation protocol. The reduction in ABW larvae infested cotton plants were calculated using the equation of (Tilton and Henderson, 1955).

III. Statistical analysis: The obtained data were statistically analyzed used one way randomized design. The proper "F" and LSD value were calculated as described by (Fisher, 1944).

RESULTS and DISCUSSIONS

1-Toxicity of the three insecticides:

Results in Table (2) showed that the LC₂₅, LC₅₀ and LC₉₀ values were 0.02, 0.95 and 2141.35 ppm for Lufenuron; 1.42, 6.02 and 94.29 ppm for Pridalyl and 2.34, 4.29 and 13.45 ppm for Chlorpyrifos, respectively against 1st instar larvae of American bollworm, *H. armigera* (ABW). The Lufenuron was more toxic than Pyridalyl and Chlorpyrifos. In regarding to toxicity index, the results indicated that the Pridalyl recorded the lowest toxicity index at LC₅₀ (0.16) in relation to the most potent compound Chlorpyrifos 0.22. The slope values of 1.07 and 2.57 recorded for the two compounds, respectively. The results of relative potency at folds values indicated that, Chlorpyrifos compound recorded the highest number of folds (1.41 fold) at LC₅₀ followed by (0.64 fold) for Pyridalyl compound.

Table 2. Toxicity effect of certain insecticides against 1st instar larvae of *H. armigera*.

Trade name	Treatments	LC ₂₅	LC ₅₀	LC ₉₀	Toxicity index at LC ₅₀	Relative potency at LC ₅₀	Slope ±SE
Match	Lufenuron	0.02	0.95	2141.35	1.00	0.64	0.38 ± 0.05
Pleo	Pyridalyl	1.42	6.02	94.29	0.16	1.00	1.07± 0.11
Dursban	Chlorpyrifos	2.34	4.29	13.45	0.22	1.41	2.57 ± 0.33

2. Effect of Lufenuron, Pyridalyl and Chlorpyrifos on some biological aspects of the 1st instar larvae of *H. armigera*:

Larval duration: Results in Table (3) indicated significantly differences found between larval duration of ABW treated with different concentrations of Lufenuron and Chlorpyrifos while non-significant effect was noticed in case of Pyridalyl compared to untreated check. The tested concentrations shortened the larval durations, but Chlorpyrifos caused the highest reduced in larval duration 12.17 days compared with 17.22 days for untreated larvae. Also, data showed that significant differences found between the tested compounds and control treatment.

Table 3. The latent effect of different concentrations of the three compounds on immature stages of *H. armigera*

Treatment	Concentrations ppm	Larval Duration (days)	Larval Weight (g)	Larval Mortality%	Pupation%	Pupal Duration (days)	Pupal Weight (g)	Pupal mortality%
Lufenuron	0.014	10.00b	0.4208 ^b	61.48 ^a	38.42 ^c	8.00	0.3651 ^a	21.58 ^a
	0.007	12.33b	0.3749 ^c	37.77 ^b	62.23 ^b	9.00	0.2920 ^c	13.42 ^b
Mean		11.17 ^c	0.2078	49.63 ^b	50.33	8.50 ^b	0.3286 ^b	17.50 ^A
Untreated		17.00 ^a	0.4961 ^a	1.22 ^c	98.78 ^a	12.66	0.3571 ^b	1.12 ^c
P.		0.0012 ^{**}	0.000 [*]	0.000 ^{**}	0.000 ^{**}	0.037 N.S.	0.000 ^{**}	0.000 ^{**}
LSD _{0.05}		3.64	3.02	6.54	7.21		0.0017	5.24
Pyridalyl	0.001	16.33	0.3322 ^c	75.33 ^a	24.67 ^c	10.00 ^b	0.2730 ^b	12.66 ^a
	0.007	16.66	0.4192 ^b	69.33 ^b	60.67 ^b	11.00 ^{ab}	0.2784 ^b	5.15 ^b
Mean		16.49 ^{AB}	0.3757	72.33 ^A	42.67	10.50 ^{AB}	0.2757 ^c	8.91 ^C
Untreated		17.00	0.4328 ^a	3.66 ^c	96.34 ^a	13.00 ^a	0.4089 ^a	1.744 ^c
P.		0.92 N.S.	0.000 ^{**}	0.000 ^{**}	0.000 ^{**}	0.098 ^{**}	0.0185 [*]	0.0002 ^{**}
LSD _{0.05}			1.99	7.23	3.99	2.83	0.092	2.83
Chlorpyrifos	0.058	12.33 ^b	0.4219 ^b	40.73 ^a	59.27 ^c	9.00 ^{ab}	0.3106	14.66 ^a
	0.029	12.00 ^b	0.3912 ^b	23.70 ^b	76.30 ^b	7.33 ^b	0.3145	11.96 ^a
Mean		12.17 ^{BC}	0.4066	32.26 ^B	67.69	8.17 ^B	0.3126 ^{BC}	13.31 ^B
Untreated		17.66 ^a	0.5140 ^a	2.18 ^c	97.82 ^a	11.00 ^a	0.4053	4.33 ^b
P.		0.0316 ^{**}	0.0079 ^{**}	0.0000 ^{**}	0.000 ^{**}	0.052 [*]	0.226 N.S.	0.001 ^{**}
LSD _{0.05}		4.32	0.0636	2.63	3.46	2.82	-	4.29
Untreated		17.22 ^A	0.4809	2.35 ^C	97.65	12.22 ^A	0.3904 ^A	2.39 ^D
P.		0.000 [*]	0.6883 N.S.	0.000 ^{**}	0.1808 N.S.	0.0208 [*]	0.0047 ^{**}	0.0000 ^{**}
LSD _{0.05}		4.43		11.66		2.55	0.0504	3.91

Within the same column and source data followed by the same letter are not significantly different ($P > 0.05$; LSD mean separately). * = Significant ** = highly significant

Larval weight: The present results in Table (3) showed significant differences were found between the tested concentrations of Lufenuron, Chlorpyrifos and Pyridalyl as compared with untreated larvae. The lowest weight was 0.2078 gm. for Lufenuron as compared with 0.4809 gm. in control. Also, data cleared that non-significant effect were found between the tested compounds and control treatment.

Larval mortality percentages: Data in Table (3) indicated highly significantly differences between larval mortalities of ABW treated with different concentrations of the three insecticides compared with untreated once. The highest mean larval mortality was 72.33 % for Pyridalyl insecticide compared with 2.35 % for untreated larvae. Increased concentrations from each insecticides increased larval mortality percentage. Also, data cleared that highly significant effect between the tested compounds and control treatment.

Pupation percentages: All the tested insecticides showed highly significant effects between all concentrations and decreasing pupation percentages of ABW larvae with increasing concentration as compared with control. The lowest mean of pupation percentage was 42.67 % for Pyridalyl while it was 97.65 % in untreated. Also, data cleared that non-significant differences were found between the tested compounds and untreated (Table, 3).

Pupal duration: The results in Table (3) showed all concentrations of the three tested compounds showed significant shorten in ABW pupal period compared with the untreated once. The shortest pupal period was 8.17 days for Chlorpyrifos as compared with 12.22 days for untreated. Also, data cleared that significant effect were found between the tested compounds and control treatment.

Pupal weight: Data presented in Table (3) showed significant effect were found between the tested concentrations for Lufenuron and Pyridalyl while Chlorpyrifos showed non-significant effect compared to untreated once. The lowest pupal weight was 0.2757 gm. for Pyridalyl as compared with 0.3904 gm. for untreated. Also, data cleared that highly significant effect between the tested compounds and control treatment.

Pupal mortality percentages: Data in Table (3) showed the effect of all tested compounds highly significant effect in the pupal mortality percentages which increased by increased concentration as compared with control. The highest mean pupal mortality was 17.50 % recorded for Lufenuron but in case of untreated was 2.39 % in control. Also, data cleared that highly significant effect were found between the tested compounds and control.

Adult stages:

Female sex ratio percentage: The results in Table (4) showed non-significant effect between the tested concentrations for Lufenuron and Pyridalyl but it was significant for Chlorpyrifos insecticide compared with the untreated. On the other

hand, significant differences found between the tested compounds and recorded the highest mean of percent sex ratio 58.70 % for Lufenuron compared to 59.44 % in control.

Oviposition periods: Data in Table (4) recorded the non-significant effect of the three tested compounds and their concentrations, of both pre-oviposition, oviposition periods. While post-oviposition periods showed non-significant effect for all tested concentration of Lufenuron and Pyridalyl, but it was significant for Chlorpyrifos compared with untreated. On the other hand, Pyridalyl caused shortest the mean of pre-oviposition and oviposition periods 2.17 and 6.83 days, but Chlorpyrifos recorded 6.83 and 2.66 days in oviposition and post-oviposition periods compared with 6.89 and 3.22 days for untreated moths respectively, also, data cleared significant effect between the tested compounds and control in pre-oviposition periods. Mean while in case of oviposition and post-oviposition periods it was non-significant effect compared with untreated.

Adult longevity:

Female and male longevity: Data presented in Table (4) showed non-significant effect between the tested concentrations for both Lufenuron and Pyridalyl insecticides in female longevity while significant noticed for Chlorpyrifos as compared with control. But in case of male longevity both of Lufenuron and Pyridalyl showed significantly effect while Chlorpyrifos noticed non-significant effect. The lowest female longevity was 11.99 days for Chlorpyrifos compared with 13.05 days for untreated. Also, results cleared that male longevity was non-significant effect between the tested concentrations for all compounds as compared with control. On the other hand significant effect between the tested concentrations for Lufenuron and Pyridalyl compounds and non-significant between the tested concentrations and control in male longevity as compared with control. Results proved that Chlorpyrifos was the most affected compound shortened female and male longevity periods recorded 8.83 days compared with 13.05 and 12.22 days in untreated once. Also, data cleared that non-significant effect found between the tested compounds in female and male longevity compared to control.

Fecundity: Data in Table (4) indicated that all the tested insecticides and their concentrations showed highly significant reduction of the laid eggs/female compared with control treatment. The lowest mean number of laid eggs was 102.99 eggs/female for Lufenuron compared with 619.44 eggs/ female in control. Also, data cleared that highly significant effect found between the tested compounds and control treatment.

Table 4. The latent of different concentrations of the three compounds on mature stages of *H. armigera*

Treatment	Concentrations ppm	Sex Ratio%/♀	Oviposition periods/days			Adult longevity		Fecundity/♀	Hatchability%
			pre	Ovi	post	♀	♂		
Lufenuron	0.014	62.22ab	5.00	8.00	3.00	16.00	10.33 ^b	33.33 ^c	28.45 ^c
	0.007	55.18b	4.66	6.00	2.66	13.32	10.33 ^b	172.66 ^b	49.63 ^b
Mean		58.70 ^A	4.83 ^A	7.00	2.83	14.66	10.33	102.99 ^D	39.04 ^C
Untreated		69.33a	2.8	6.00	3.33	12.16	17.00 ^a	616.66 ^a	79.33 ^a
P.		0.005	0.210 N.S.	0.338N.S.	0.726N.S.	0.039 N.S.	0.013**	0.0001**	0.0001**
LSD _{0.05}		9.57					6.57	25.	18.58
Pyridalyl	0.001	52.36	2.00	7.00	4.33	13.33	12.66 ^b	151.33 ^c	32.86 ^b
	0.0007	55.55	2.33	6.66	4.00	13.00	14.00 ^a	254.33 ^b	70.12 ^a
Mean		53.96 ^{AB}	2.17 ^B	6.83	4.17	13.17	13.33	202.83 ^B	51.49 ^B
Untreated		55.66	3.00	7.00	2.66	12.66	10.00 ^c	653.33 ^a	85.33 ^a
P.		0.62N.S.	0.25N.S.	0.93N.S.	0.29N.S.	0.83N.S.	0.02*	0.000**	0.000**
LSD _{0.05}		-	-	-	-	-	2.40	62.82	15.56
Chlorpyrifos	0.058	39.78 ^b	2.66	7.00	1.66 ^b	11.33 ^c	10.33	108.33 ^c	42.46 ^c
	0.029	56.91 ^a	2.33	6.66	3.66 ^a	12.66 ^b	7.33	192.00 ^b	62.08 ^b
Mean		48.35 ^B	2.49 ^B	6.83	2.66	11.99	8.83	150.17 ^C	52.27 ^B
Untreated		53.33 ^{ab}	2.33	7.66	3.66 ^{ab}	13.65 ^a	9.66	588.33 ^a	74.83 ^a
P.		0.09	0.898N.S.	0.828N.S.	0.125*	0.002**	0.16N.S.	0.000**	0.000**
LSD _{0.05}		16.68	-	-	1.99	1.15		75.79	6.21
Untreated		59.44 ^A	2.72 ^B	6.89	3.22	13.05	12.22	619.44 ^A	79.83 ^A
P.		0.0731*	0.0240*	0.9993N.S.	0.2540N.S.	0.8182N.S.	0.2565 N.S.	0.000**	0.0000**
LSD _{0.05}		9.03	1.68					34.22	10.19

Within the same column and source data followed by the same letter are not significantly different ($P>0.05$; LSD mean separately). * = Significant ** = Highly significant

Hatchability percentage: Data in table (4) cleared that, highly significant effects were found between all tested compounds and their concentration compared with untreated check. The lowest mean of hatchability percentages was 30.04% for Lufenuron as compared with 79.83% in untreated moths.

II- Biochemical effect of Lufenuron, Pyridalyl and Chlorpyrifos insecticides on *H. armigera* larvae:

The biochemical response of seven days old larvae of *H. armigera* (ABW) was assessed at different times after treatments with the tested compounds (Lufenuron, Pyridalyl and Chlorpyrifos) at different concentrations as follows: (0.95, 0.02 and 4.29 ppm). The biochemical activities investigated were determine the activities of transaminases; Alanine aminotransferase (ALT), Aspartate aminotransferase and (AST), the carbohydrate hydrolyzing enzymes (trehalase, invertase and amylase), actyle- cholinesterase (AChE), the total soluble protein and total lipid levels.

A. Transaminase activities: The changes in transaminases (ALT & AST) activities as the concentration of the formed pyruvate and the relative activity as a percentage from the control of larval supernatants of seven days old larvae of ABW are shown in Table (5). Gradually data showed that, the treatment of seven days old larvae recorded fluctuated increase in ALT and AST activities however, the activity of ALT was negatively decreased in Pyridalyl insecticide recording -27.53 % followed by 548.31 % relative activity in Chlorpyrifose, while AST activity was positively and high decreased in Lufenuron insecticide recording 31.58 % relative activity followed by 368.42 % recorded in Chlorpyrifose compound.

B. Carbohydrate hydrolyzing enzymes: Data represented in Table (5) proved the changes in the activity of carbohydrate hydrolyzing enzymes of *H. armigera* seven days old larvae with sub lethal concentrations (0.95, 0.02 and 4.29 ppm) for the tested compounds, respectively. The activity of amylase enzyme was positively decreased with Chlorpyrifose followed by for Pyridalyl reaching to 543.09 & 775.17% activity. Also, results indicated that trehalase activity was highly decreased for Chlorpyrifos recording 3.52% activity followed by 84.73% activity which recorded for Pyridalyl insecticide compared to untreated larvae. In case of the activity of invertase enzyme Chlorpyrifos achieved the lowest activity recording-23.85% as a negatively value followed by Lufenuron lead to 226.88% positive activity.

C. Acetyl Choline esterase (AChE): The obtained data in Table (5) showed the concentration of acetyle-cholinesterase (AChE) and the changes as a percentage from the untreated larvae in larval supernatants of *H. armigera* treated with sub-lethal concentrations of the tested insecticides at different concentrations. Generally, all treatments negatively decreased (AChE) activates as compared to untreated larvae, it recorded -72.93, -79.49 and -91.87% in Lufenuron, Chlorpyrifos and Pyridalyl insecticides for seven days old larvae.

Table 5. Biochemical effect of Lufenuron, Pyridalyl and Chlorpyrifos insecticides at LC₅₀ on the 1st instar larvae of *H. Armigera*

Treatments	LC ₅₀ ppm	% Increase or decrease than untreated larvae							
		(RA%)					(C%)		
		Transaminase enzymes µg pyruvate /g. b. wt./ min.)		Carbohydrate hydrolyzing enzymes mg glucose /g. b. wt./min.			(ACHE) esterase u/g	(TSP) mg protein /g b.wt.	(TL) Mg/g Pyruvate/g
		ALT	AST	Amylase	Trehalase	Invertase			
Lufenuron	0.95	1160.67	31.58	1021.38	301.62	226.88	-72.93	244.83	-47.06
Pyridalyl	6.02	-27.53	400.00	775.17	84.73	429.07	-91.87	153.45	135.03
Chlorpyrifos	4.29	548.31	368.42	543.09	3.52	-23.85	-79.49	13.79	-45.99

(ALT)= Alanin amino transferse (AST) = Asparate amino transferase Concentration expressed as (mg/ml) TSP= (Total Soluble Protein)

TL = (Total lipid) AChE= (Acetylcholine esterase)

RA (Relative activity %) = Treatment-Untreated / Untreated x 100

C% = (Change %) = Treatment- Untreated / Untreated x 100

Total soluble protein and lipids: The obtained data in Table (5) showed that, the concentration of total soluble protein (TSP) & total lipid and the changes as a percentage from the control in *H. armigera* larvae treated with sub-lethal concentrations of Lufenuron, Pyridalyl and Chlorpyrifos. The results proved that total soluble protein was severely decreased when the larvae treated with the sub-lethal concentrations of Chlorpyrifos recorded 13.79 % levels followed by Pyridalyl recorded 153.45 % levels as compared with untreated larvae. Generally, Chlorpyrifos and Lufenuron treatments decreased total lipid levels as compared to untreated, it recorded -45.99 & -47.06 % for seven days old larvae.

III. Field experiment:

Data in Table (6) indicated the reduction percentages of *H. armigera* (ABW) larvae in cotton plants after one, seven and ten days for Pyridalyl (Pleo) and Chlorpyrifos (Dursban) from treatment. While in case of Lufenuron (Match) it recorded after three, seven and ten days from treatment. The tested compounds in cotton fields caused the highest initial reduction of different instars ABW larvae after 24h recorded (69.12%) reduction for Chlorpyrifos while the highest initial reduction for Lufenuron recorded (62.28%) after three days from treatment. Also results showed that the highest reduction rate after ten days from treatment were 87.06 % reduction in number larvae for Chlorpyrifos. The results also showed that the best compounds resulted in the highest annual rate of reduction for the number of American bollworm larvae of Chlorpyrifos and recorded 80.06 % reduction, while the pesticide Pyredalyl was moderate effect and recorded of 65.28% reduction in the number larvae.

The present results coincide with those obtained by Al-shannaf *et al.* (2012) tested the effect of the IGR (Chlorfluazuron and Pyriproxyfen) against larvae of *H. armigera*. Results showed the highest initial reduction of Chlorfluazuron were (75.00 and 80.6%); residual mean (83.75 and 79.45%) and annual mean (80.83 and 79.83%) during 2009 and 2010 cotton seasons, respectively.

Table 6. Reduction percentages of the *H. armigera* larvae numbers after treated with different compounds during 2018 season.

Treatments	Trade name	Rate/feddan/cm	Days after treatments				Annual average
			1	3	7	10	
Lufenuron EC- 5%	Match	120	-	62.28	68.43	79.52	70.07
Pyridalyl EC-50%	Pleo	100	51.43	-	68.23	76.19	65.28
Chlorpyrifos EC- 48%	Dursban	1000	69.12	-	84.02	87.06	80.06

Based on 200 litter water/feddan

Generally, Chlorpyrifos caused the highest reduction percentage in eggs of American bollworm (72.03%), followed by Profenofos 68.93% while the least

reduction was 62.44% for Chlorfluazuron. Field experiments showed that Chlorpyrifos was most effective on the eggs and larvae of *H. armigera* (El-Sayed *et al.*, 2013). Field experiment indicated that Quinalphos was most effective up to three days, whereas Chlorpyrifos were most toxic up to 7 days against *H. armigera* larvae (Aslam *et al.*, 2004). Profenofos insecticide caused inhibition in *H. armigera* egg hatch (Preetha *et al.*, 2007). Enzymes hydrolyzing carbohydrates such as trehalase is activated during molting to generate production of glucose for chitin build-up (Candy and Kilby, 1962), and two important digestive enzymes, amylase and invertase were investigated in this study. In insect amylase and invertase enzymes were the most frequent in the salivary glands; trehalase is present in the haemolymph and fat body. Also, others stated that, Chlorfluazuron, Pyriproxyfen gave the lowest significant decrease in the activity of amylase; invertase and trehalase enzyme in *H. armigera* larvae compared to control also stated insect growth regulators caused highly significant increases in the activity of chitinase enzyme compared with control (Wigglesworth, 1972; Al-shannaf *et al.*, 2012).

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إختبار كفاءه ثلاث مبيدات حشريه وتأثيراتها المتأخره على بعض الصفات البيولوجية و البيوكيميائيه لدودة اللوز الأمريكية في القطن

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معهد بحوث وقاية النباتات - مركز البحوث الزراعية - دقى- جيزة - مصر

أجريت التجارب المعملية في معهد بحوث وقاية النباتات (فرع الشرقية) - قسم بحوث ديدان اللوز واجريت التجارب الحقلية فى منطقة اجا ، محافظة الدقهلية خلال موسم قطن 2018 لتقييم تأثير ثلاثة مبيدات حشرية ليوفينيورون (ماتش) ،بيريداليل(بليو) وكلوربيريفوس (دورسبان) على بعض الصفات البيولوجية والبيوكيميائيه ونسبة الخفض المئوية في تعداد يرقات دودة اللوز الامريكيه فى حقول القطن. أظهرت النتائج ان الثلاث مبيدات لها تأثير سام على اليرقات حديثة الفقس و سجل ليوفينيورون أعلى سمية عند التركيز النصفى المميت (0.95 جزء في المليون) يليه كلوربيريفوس (4.29 جزء في المليون) بينما سجل بيريداليل اقل سمية التركيز النصفى المميت (6.02 جزء في المليون). أظهر التأثير المتأخر للمبيدات الثلاثة قصر فى مدة الطور اليرقى والعذري ، وايضا وزن اليرقات والعذاري ،نسبة التعذير، النسبة الجنسيه،فترة حياة الحشرات الكاملة،فترات وضع البيض وانخفاض عدد البيض الموضوع ونسبة الفقس. أظهرت النتائج ان التغير في نشاط أنزيمات الكربوهيدرات (الأميليز ، إنفرتيز وتريهاليز، الانزيمات الناقلة لمجموعة الامين (ALT) و (AST) ، إنزيم أستيل كولين أستيريز (AChE) ومستوى البروتين الكلي القابل للذوبان (TSP) ومستويات الدهون الكلية (TL) علي يرقات دودة اللوز الامريكيه المعامله بثلاثة مبيدات حشريه (ليوفينيورون ، بيريداليل وكلوربيريفوس). وأظهرت التجارب الحقلية ان الثلاثة مبيدات سببت خفض في تعداد يرقات دودة اللوز الامريكية فى حقول القطن و سبب مبيد كلوربيريفوس أعلى نسبة خفض بلغت 80.06 % ،بينما سبب مبيد بيريداليل اقل نسبة خفض بلغت 65.28% مقارنة بالكنترول فى حين كان معدل خفض التعداد الناتج عن استخدام مبيد ليوفينيورون بلغ 70.07% .

546 EFFICIENCY OF THREE INSECTICIDES AND ITS LATENT EFFECTS ON SOME BIOLOGICAL AND
BIOCHEMICAL ASPECTS OF AMERICAN BOLLWORM IN THE COTTON.
HELCOVERPA ARMIGERA (HÜB.)