RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

I- Laboratory bioassay studies:

These studies is to evaluate the toxic effects of Esfenvalerate, Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron against one day old eggs, newly hatched larvae and adults of susceptible strain of pink bollworm, *Pectinophora gossypiella* (Saund.), and field strain of spiny bollworm, *Earias insulana* (Boisd.), under constant conditions of 27± 1°C and 80 ± 5% R.H. inside incubator.

The obtained results could be discussed as follows:

1- Effect of tested insecticides on egg hatch, larval and adults mortality of bollworms:

- **Effect of Esfenvalerate** :

Data presented in Table (1) indicated that percentages of unhatched eggs ranged between 41.33 to 100.00% for pink bollworm and from 57.33 to 82.66 for spiny bollworm for the concentration of Esfenvalerate ranged from 0.0183 to 150.00 ppm. of pink and spiny bollworm larvae were increased from 5.00 to 100.00 % for pink bollworm 8.33 to 100.00% for spiny bollworm by increasing the concentration of Esfenvalerate from 0.073 to 150.00 ppm.

Table (1): Effect of exposing eggs larvae and adult moths of both Pink and spiny bollworms to Esfenvalerate.

Concentrations ppm	% of					
	Eggs which did not hatch		Larval mortality		Adults mortality	
	P*	S**	P*	S**	P*	S**
150.00	100.00	82.66	100.00	100.00	100.00	100.00
75.00	100.00	80.00	100.00	100.00	100.00	100.00
37.50	100.00	78.66	100.00	100.00	94.44	100.00
18.75	100.00	77.33	100.00	100.00	88.88	100.00
9.37	100.00	74.66	100.00	100.00	83.33	100.00
4.68	100.00	73.33	100.00	100.00	66.66	83.33
2.34	100.00	72.00	96.66	96.66	61.11	66.66
1.17	97.33	69.33	85.00	90.00	55.55	50.00
0.585	93.33	68.00	75.00	68.33	44.44	33.33
0.292	90.66	65.33	28.33	30.00	33.33	22.22
0.146	86.66	64.00	8.33	16.66	27.77	16.66
0.073	64.00	62.66	5.00	8.33	22.22	11.11
0.036	61.33	60.00	-	-	11.11	5.55
0.0183	41.33	57.33	-	-	-	-

*p pink bollworm

**S spiny bollworm

Exposure of adults to treated surface :

The mortality percentage of pink and spiny bollworms adults were decreased from 100.00 to 11.11% for pink bollworm and from 100.00 to 5.55 % for spiny bollworm when concentration of Esfenvalerate decreased from 150 to 0.036 ppm.

- Effect of Chloropyrifos:

Data in Table (2) show the effect of Chlorpyrifos on pink and spiny bollworms eggs. Whereas the percentages of unhatched eggs decreased from 100 to 69.33 % for pink bollworm and from 100.00 to 18.66 for spiny bollworm when the concentrations of Chlorpyrifos decreased from 2400.00 to 0.036 ppm.. Also, in the same Table, it is clear that the mortality percentage of pink and spiny bollworms larvae were decreased from100.00 to 18.33 for pink bollworm and from 100.00 to 3.33 for spiny bollworm when concentration of Chlorpyrifos decreased from 2400.00 to 0.585 ppm.The mortality percentages of pink and spiny bollworms adults were decreased from 100.00 to 38.88 % for pink bollworm, when adult moths exposed to treated surface by Chlorpyrifos concentration ranged from 2400.00 to 0.146 ppm. Also the mortality percentage of pink and spiny bollworms adults, Were ranged between 100.00 to 5.55 % when concentration of Chlorpyrifos decreased from 2400.00 to 0.585 ppm.

- Effect of Thiodicarb on bollworms :

Data in Table (3) reveal that percent of unhatched eggs was decreased from 100.00 to 62.66 % for pink bollworm by decreasing the concentration of Thiodicarb from 2000.00 to 0.061 ppm., While it was decreased from 100.00 to 10.66 % for spiny bollworm when concentration of Thiodicarb decreased from 2000.00 to 0.244 ppm.

Table (2): Effect of exposing eggs larvae and adult moths of both Pink and spiny bollworms to Chlorpyrifos.

Concentrations ppm	% of					
	Eggs which did not hatch		Larval mortality		Adults mortality	
	P*	S**	P*	S**	P*	S**
2400.00	100.00	100.00	100.00	100.00	100.00	100.00
1200.00	100.00	100.00	100.00	100.00	100.00	100.00
600.00	100.00	100.00	100.00	100.00	100.00	100.00
300.00	100.00	100.00	100.00	100.00	100.00	100.00
150.00	97.33	100.00	100.00	100.00	100.00	100.00
75.00	93.33	100.00	100.00	100.00	100.00	88.88
37.50	90.66	96.00	100.00	100.00	100.00	66.66
18.75	88.00	93.33	100.00	91.66	100.00	44.44
9.37	86.66	86.66	96.60	83.33	100.00	33.33
4.68	85.33	84.00	68.33	48.33	100.00	27.77
2.34	84.00	82.66	41.66	28.33	94.44	16.66
1.17	82.66	80.00	30.00	6.66	83.33	11.11
0.585	81.33	46.66	18.33	3.33	72.22	5.55
0.292	77.33	41.33	-	-	55.55	-
0.146	74.66	34.66	-	-	38.88	-
0.073	72.60	26.66	-	-	-	-
0.036	69.33	18.66	-	-	-	-

Table (3): Effect of exposing eggs larvae and adult moths of both Pink and spiny bollworms to Thiodicarb.

Concentrations ppm	% of					
	Eggs which did not hatch		Larval mortality		Adults mortality	
	P*	S**	P*	S**	P*	S**
2000.00	100.00	100.00	100.00	100.00	100.00	100.00
1000.00	100.00	100.00	100.00	96.66	100.00	100.00
500.00	100.00	100.00	96.66	91.66	100.00	100.00
250.00	100.00	100.00	91.66	86.66	100.00	100.00
125.00	100.00	100.00	58.33	68.33	100.00	100.00
62.50	97.33	100.00	50.00	46.66	100.00	100.00
31.25	96.00	100.00	45.00	40.00	94.44	88.88
15.62	94.66	97.33	13.33	18.33	88.88	83.33
7.81	93.33	93.33	11.66	13.33	77.77	72.22
3.90	90.66	80.00	-	-	66.66	66.66
1.95	85.33	60.00	-	-	50.00	50.00
0.976	82.66	33.33	-	-	33.33	38.88
0.488	80.00	20.00	-	-	22.22	27.77
0.244	73.33	10.66	-	-	-	-
0.122	68.00	-	-	-	-	-
0.061	62.66	-	-	-	-	-

*p pink bollworm **S spiny bollworm

Concerning, mortality percentages of larvae, results in Table (3) indicated that these mortalities were increased from 11.66 to 100.00% and 13.33 to 100.00 % from pink and spiny bollworms, respectively, by increasing the concentration of Thiodicarb was increased from 7.81 to 2000.00 ppm. When adults exposed to treated surfaces the mortality percentages of pink and spiny bollworms adults were increased from 22.22 to 100.00 % for pink bollworm and from 27.77 to 100.00 % for spiny bollworm by increasing the concentration of Thiodicarb from 0.7488 to 2000.00ppm.

- Effect of Hexaflumuron :

Results in Table (4) indicate that percentages of unhatched eggs of pink and spiny bollworms were ranged from 36.00 to 66.66 % for pink bollworm and from 21.33 to 72.00 % for spiny bollworm when applied with different concentrations of Hexaflumuron.

On the other hand mortality percentages of pink bollworm larvae were increased from 20.00 to 61.66 % while, the mortality percentages of spiny bollworm larvae were increased from 13.33 to 48.33 % when fed on diet treated with different concentration of Hexaflumuron.

Concerning, the mortality percentages of pink and spiny bollworm adults these were decreased from 11.11 to 5.55 % when adult moths exposed to different concentrations of Hexaflumuron ranged from 100.00 to 50.00 ppm. Also mortality percentage of spiny bollworm adult was 5.55% when exposed to 100.00% ppm. concentration of Hexaflumuron.

- Effect of Chlorfluazuron:

Data presented in Table (5) show that percentages of unhatched eggs of pink and spiny bollworms were decreased from 78.66 to 45.33 % for pink bollworm and from 42.66 to 16.00 % for spiny bollworm when concentration of Chlorfluazuron decreased from 100.00 to 0.195 ppm.

The mortality percentages of pink and spiny bollworm larvae were decreased from 68.33 to 18.33 % for pink bollworm when concentration of Chlorfluazuron decreased from 100.00 to 1.56 ppm.. The mortality percentages of spiny bollworm were decreased from 91.66 to 10.00 % when concentration of Chlorfluazuron decreased from 100.00 to 3.12 ppm.

In case of mortality percentages of pink and spiny bollworm adults, it was found that the mortality decreased from 16.66 to 5.55 % for pink bollworm when concentration of Chlorfluazuron decreased from 100.00 to 25.00 ppm. While, in case of spiny bollworm adults mortalities were decreased from 11.11 to 5.50% when concentrations of Chlorfluazuron decreased from 100.00 to 50.00 ppm.

Generally, it can be concluded that all tested compounds induced a gradual increase in percent of unhatched eggs. Increasing the mortality of pink and spiny bollworms larvae and adults by increasing their concentrations.

Similar results were recorded by **Khodzhaev** and **Eshmatov 1983** who studied the ovicidal activity of Permethrin (Ambush), Deltamethrin (Decis), Cypermethrin (Ripcord) and fenvalerate (Sumicidin) against the cotton moth [*Heliothis armigera* (Hb.).

Table (4): Effect of exposing eggs larvae and adult moths of both Pink and spiny bollworms to Hexaflumuron.

Concentrations ppm	% of					
	Eggs which did not hatch		Larval mortality		Adults mortality	
	P*	S**	P*	S**	P*	S**
100.00	66.66	72.00	61.66	48.33	11.11	5.55
50.00	64.00	66.66	41.66	41.66	5.55	-
25.00	60.00	61.33	36.66	38.33	-	-
12.50	57.33	56.00	30.00	36.66	-	-
6.25	53.33	46.66	26.66	33.33	-	-
3.125	50.66	41.33	23.33	13.33	-	-
1.56	48.00	37.33	20.00	-	-	-
0.781	42.66	30.66	-	-	-	-
0.391	40.00	25.33	-	-	-	-
0.195	36.00	21.33	-	-	-	-

*p pink bollworm
**S spiny bollworm

Table (5): Effect of exposing eggs larvae and adult moths of both Pink and spiny bollworms to Chlorfluazuron.

Concentrations ppm	% of					
	Eggs which did not hatch		Larval mortality		Adults mortality	
	P*	S**	P*	S**	P*	S**
100.00	78.66	42.66	68.33	91.66	16.66	11.11
50.00	74.66	38.66	65.00	83.33	11.11	5.55
25.00	72.00	36.00	58.33	63.33	5.55	-
12.50	68.00	32.00	43.33	23.33	-	-
6.25	64.00	26.66	25.00	16.66	-	-
3.125	61.33	25.33	21.66	10.00	-	-
1.56	57.33	24.00	18.33	-	-	-
0.781	53.33	22.66	-	-	-	-
0.391	49.33	21.33	-	-	-	-
0.195	45.33	16.00	-	-	-	-

*p pink bollworm **S spiny bollworm

All tested compounds showed high ovicidal activity, especially Deltamethrin and fenvalerate, which caused 100 and 93.3% egg mortality after 3 days from treatment, respectively.Also **Xia Jing Yuan *et al.* (1996)** indicated that larvin (thiodicarb) has a good ovicidal effect on bollworms.while, **kathuria 2000** found that *Helicoverpa armigera* eggs were susceptible of to different insecticides varied with the age of the eggs. Young eggs (0-24 h old) being relatively more susceptible than the older ones. The synthetic Pyrethroids, fenvalerate and Cypermethrin, exhibited the highest egg mortality (>80%), followed by Methomyl and Triazophos (77% each). With the remaining five insecticides, Quinalphos, Monocrotophos, Endosulfan, Malathion and Carbaryl, the egg mortalities were 72, 64, 62, 56 and 56%, respectively. **Panickar *et al.* 2003** reported that Polytrin C and Acephate were the two most toxic insecticides to *H. armigera* and *Earias. vittella* eggs. Synthetic insecticides showed higher toxicity to the *H. armigera* eggs, Endosulfan and 0.6% Achook were at par in their ovicidal effects. More or less the same effect was found in *E. vittella* eggs except that 0.6%, Gronim also showed equal ovicidal effect as Endosulfan and 0.6% A chook.

In the present results the effects of some chemical compounds on larval mortality of bollworms were in similar with those of **Perimmer, 1979** who reported that Synthetic Pyrethroids, Permethrin and fenvalerate, and a new Carbamate, UC- 51762l (Dimethyl--N,N-tliio bis [methyl ammo] Carboxyl) bis Ethaininidothioate], were very efficient insecticides against the larvae of *Heliothis spp.* **El-Sheikh Fatma *et al.* 1994** found that Lannate was the most toxic insecticide against the pink bollworm

larvae (PBW larvae).**Weiland *et al.* 2000** found that the insect growth regulators Dimilin (Diflubenzuron), exhibited little activity on the cotton bollworms.

The obtained results showed that the adult mortalities of bollworms were in similar with those obtained by **Klein *et al.* 1982** They treated the moths of spiny bollworm with some insecticides, and found that the tested Pyrethroids insecticides were active than Organophosphorus. On the other hands **Cook *et al.* 2004** found that thiodicarb reduced beet armyworm adult densities up to 3 days after treatment. The LC_{50} values of Indoxacarb and Pyridalyl for beet armyworm and fall armyworm needed highest concentrations (100-200 micro g/vial) in the adult vial test. Dose-mortality values of Indoxacarb and Pyridalyl were higher than discriminating concentrations of Cypermethrin, Methomyl, Profenofos and endosulfan used in the adult vial test for monitoring tobacco budworm (*Heliothis virescens*) and bollworm (*Helicoverpa zea*). The adult vial test may not be the most efficient test method for Indoxacarb and Pyridalyl in insecticide susceptibility monitoring programmes.

2. Toxicological effects of some chemical compounds against different stages of pink and spiny bollworms.

2.1. Egg stage of:

2.1.1. Pink bollworm:

The LC_{50}, LC_{90}, slope values, toxicity index, LC_{90} / LC_{50} ratio and relative Potency are given in Table (6) and figs. (3 & 4). The obtained results revealed that Chlorpyrifos was the most potent insecticide against pink bollworm eggs (LC_{50}: 0.005 ppm) followed

Table (6): Toxicity data of tested compounds against one- day old eggs of pink bollworm.

	Compound	LC_{50} (ppm)	LC_{90} (ppm)	Slope	Toxicity index at		Relative potency (Folds) at	
					LC_{50}	LC_{90}	LC_{50}	LC_{90}
Insecticides	1- Esfenvalerate	0.027	0.258	1.297	1.85	100.00	111. 44	323523.87
	2- Chlorpyrifos	0.0005	29.197	0.268	100.00	0.883	6018.00	2858.82
	3- Thiodicarb	0.017	3.245	0.564	2.94	7.95	177.00	25722.34
IGR's	1- Hexaflumuron	3.009	83469.16	0.288	0.016	0.0003	1.00	1.00
	2- Chlorfluazuron	0.444	3473.92	0.329	0.112	0.0074	6.77	24.027

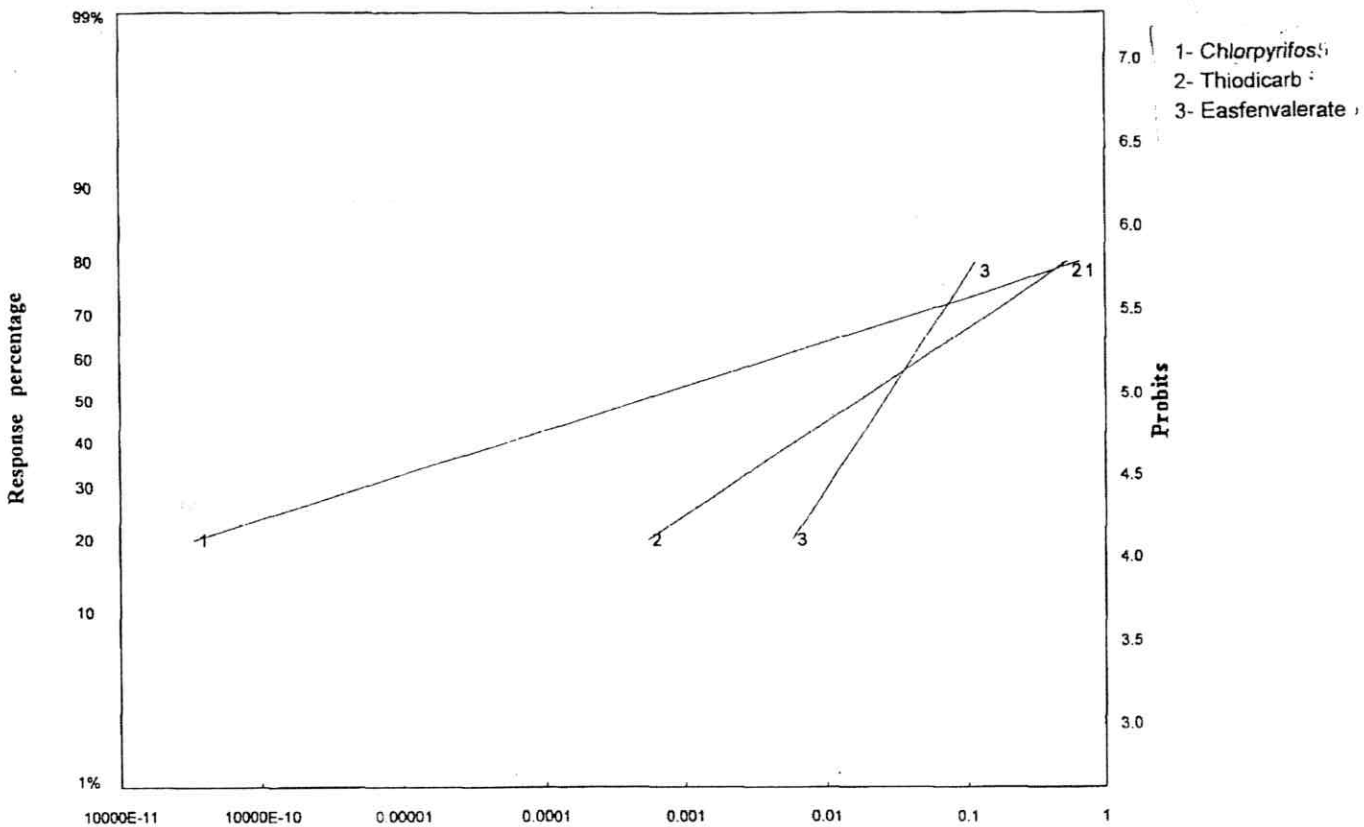

Fig. (3): Concentration-mortality probit lines of tested insecticides against 1-day old eggs of the pink bollworm.

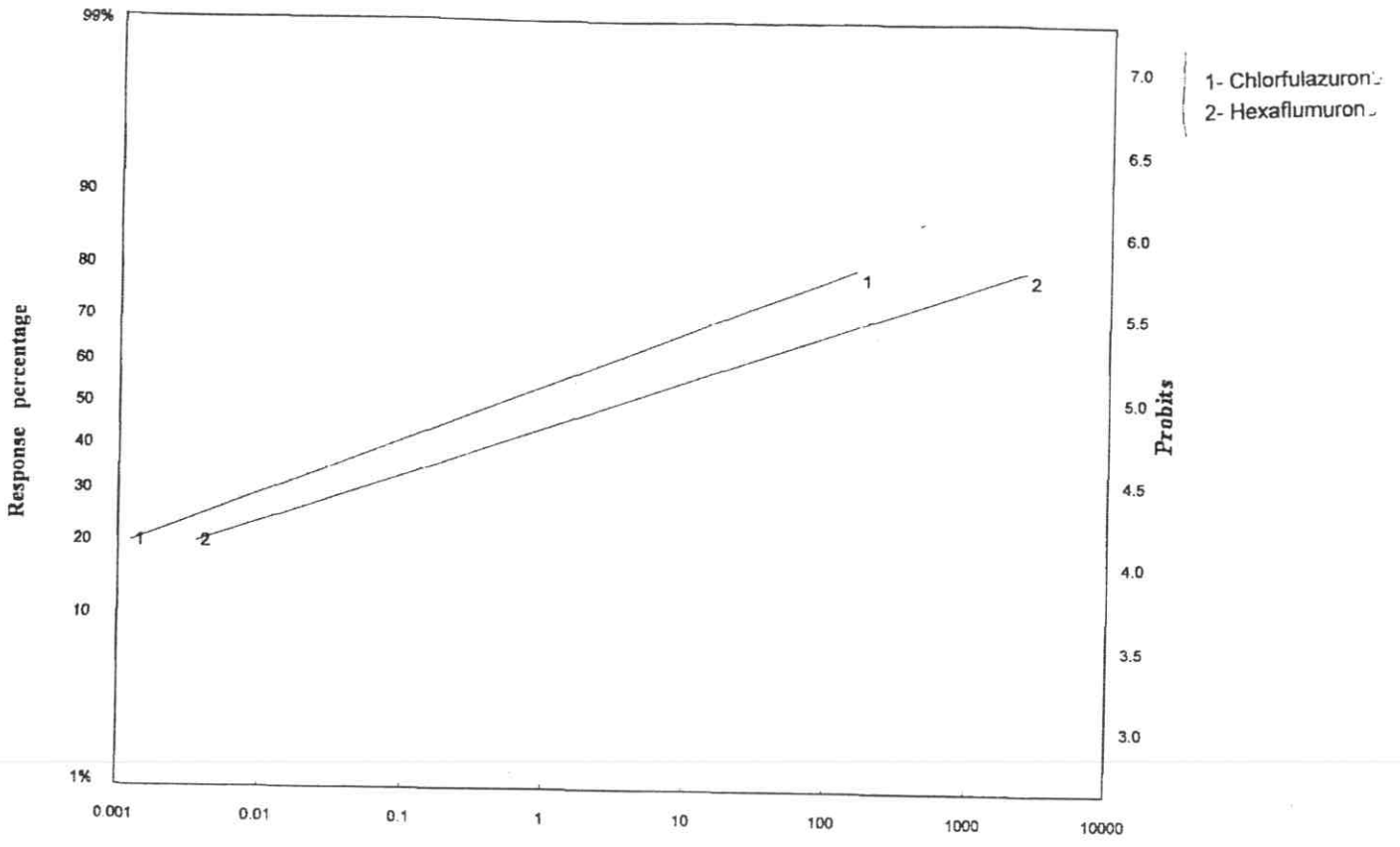

Fig. (4): Concentration-mortality probit lines of some insect growth regulators (IGR's) against 1-day old eggs of the pink bollworm.

by Esfenvalerate (LC_{50}: 0.027 ppm), thiodicarb (LC_{50}: 0.017 ppm) and Chlorfluazuron gave a moderate effect (LC_{50}: 0.444 ppm). Hexaflumuron gave the least effect (LC_{50}: 3.009 ppm). At LC_{90} level, the toxic action of the tested compounds showed another trend at LC_{90}, Esfenvalerate became the most potent insecticide (LC_{90}:0.258 ppm) followed by Thiodicarb (LC_{90}: 3.245 ppm). Chlorpyrifos gave a moderate effect (LC_{90}: 29.197 ppm), while Chlorfluazuron (LC_{90}: 3473.92 ppm) and Hexaflumuron (LC_{90}: 83469.16 ppm) gave the least effect.

The toxicity lines of these toxicants are illustrated graphically in figs. (3 & 4). It is appear that the conventional insecticides were plotted in scale of efficiency which were higher than the two tested insect growth regulators,

The discussion of Hexaflumuron and Chlorfluazuron, from the standpoint of the slop were separated because they are IGR's. The comparison among insecticides according to there slops, obviously showed that Esfenvalerate had the steepest toxicity line (slope values: 1.297) followed by Thiodicarb (slope values: 0.564). While, chlorpyrifos had the low slope value (0.329). The IGR Chlorfluazuron was steepest than Hexaflumuron (slope values were: 0.288 and 0.329, respectively.

In comparing the toxic action of the five tested toxicants on the base of toxicity index, Chlorpyrifos was taken as the standard insecticide and given the arbitrary index value of 100 at LC_{50} level, the toxicity index of the other compounds at the LC_{50} level were 2.94, 1.85, 0.112 and 0.016 for Thiodicarb, Esfenvalerate, Chlorfluazuron and Hexaflumuron in respect. On the other hand, the toxicity index values at the LC_{90} level were 100.00, 7.95, 0.883

and 0.0074 Esfenvalerate, Thiodicarb, Chlorpyrifos, Chlorfluazuron and Hexaflumuron in respect. The exception was that of Chlorpyrifos and Esfenvalerate which exchanged their places.

On the base of the toxicity index values at the LC_{50} level, Chlorpyrifos was the most efficient on pink bollworm. Thiodicarb gave a moderate effect, while Esfenvalerate, Chlorfluazuron and Hexaflumuron gave the least effect. On the other hand, the toxicity index values at the LC_{90} level the Esfenvalerate was the most efficient followed by Thiodicarb. Chlorpyrifos gave a moderate effect, but Chlorfluazuron and Hexaflumuron gave the least effect.

Relative potency level may be used also as convenient method in comparing the degree of toxicity of different insecticides to any pest. The potency levels of the tested compounds are expressed as the number of folds, at the required toxicity levels, compared with the least effective insecticide included in the evaluation against the same test insect. The number of folds representing the relative potency level (Table, 6) was obtained by dividing the LC_{50} or LC_{90} of Hexaflumuron, which was considered the standard compounds at the LC_{50} and LC_{90} levels, by the corresponding figures of each tested insecticides.

At LC_{50} levels the relative potency levels expressed as number of fold indicate that Chlorpyrifos, Thiodicarb, Esfenvalerate and Chlorfluazuron were 6018.00, 177.00, 111.44 and 6.77 times more effective as ovicides against pink bollworm than Hexaflumuron, respectively. At the LC_{90} levels, the relative potency as compared with Hexaflumuron were 323523.87, 25722.34, 2858.82 and 24.027 for Esfenvalerate, Thiodicarb, Chlorpyrifos and Chlorfluazuron respectively.

2.1.2. Spiny bollworm.

In Table (7) and Figs. (5 & 6) results obtained show that at LC_{50} level, esfenvalerate (LC_{50}: 0.0015 ppm) was the most effect toxicant against spiny bollworm followed by Chlorpyrifos (LC_{50} 0.342 ppm) and Thiodicarb (LC_{50}: 1.463 ppm). Hexaflumuron gave a moderate effect (LC_{50}: 7.357 ppm). Chlorfluazuron (LC_{50} 678.027 ppm) was the least effect. At LC_{90} level, the toxicity of toxicants show another trend whereas Thiodicarb became the most effect (LC_{90}: 6.8337 ppm) followed by Chlorpyrifos (LC_{90}: 7.518 ppm) and Esfenvalerate (LC_{90}: 21015.204 ppm), Hexaflumuron (LC_{90}: 2260.25) and chlorfluazuron (LC_{90}: 4869400.00 ppm) gave the least effect.

Using the slop values for comparison; the results indicate that, Thiodicarb had the steepest toxicity lines (slope values: 1.914) followed by Chlorpyrifos (slope values: 0.954) and Hexaflumuron (slope values: 0.515) while, Chlorfluazuron (slope values: 0.264) and Esfenvalerate (slope values: 0.179) had the low slope values.

On ground of toxicity index, data at the LC_{90} level show that the most effective toxicant was Thiodicarb (100.00) followed by Chlorpyrifos (90.94), Esfenvalerate (0.0325), Hexaflumuron (0.302), and Chlorfluazuron (0.0001). At the LC_{50} level, Esfenvalerate was the most effective one, followed by Chlorpyrifos, Thiodicarb, Hexaflumuron, and Chlorfluazuron, which was the least effective one.

Relative potency level at LC_{50} and LC_{90} showed that chlorfluazuron was the standard, which had the least efficiency among all tested toxicants.

Table (7): Toxicity data of tested compounds against one -day old eggs of spiny bollworm.

Compound		LC_{50} (ppm)	LC_{90} (ppm)	Slope	Toxicity index at		Relative potency (Folds) at	
					LC_{50}	LC_{90}	LC_{50}	LC_{90}
Insecticides	1- Esfenvalerate	0.0015	21015.204	0.179	100.00	0.0325	452018.00	231.70
	2- Chlorpyrifos	0.342	7.518	0.954	0.438	90.94	1982.53	647698.85
	3- Thiodicarb	1.463	6.837	1.914	0.102	100.00	463.44	712212.95
IGR's	1- Hexaflumuron	7.357	2260.25	0.515	0.0203	0.302	92.16	2154.36
	2-Chlorfluazuron	678.027	4869400.00	0.264	0.0002	0.0001	1.00	1.00

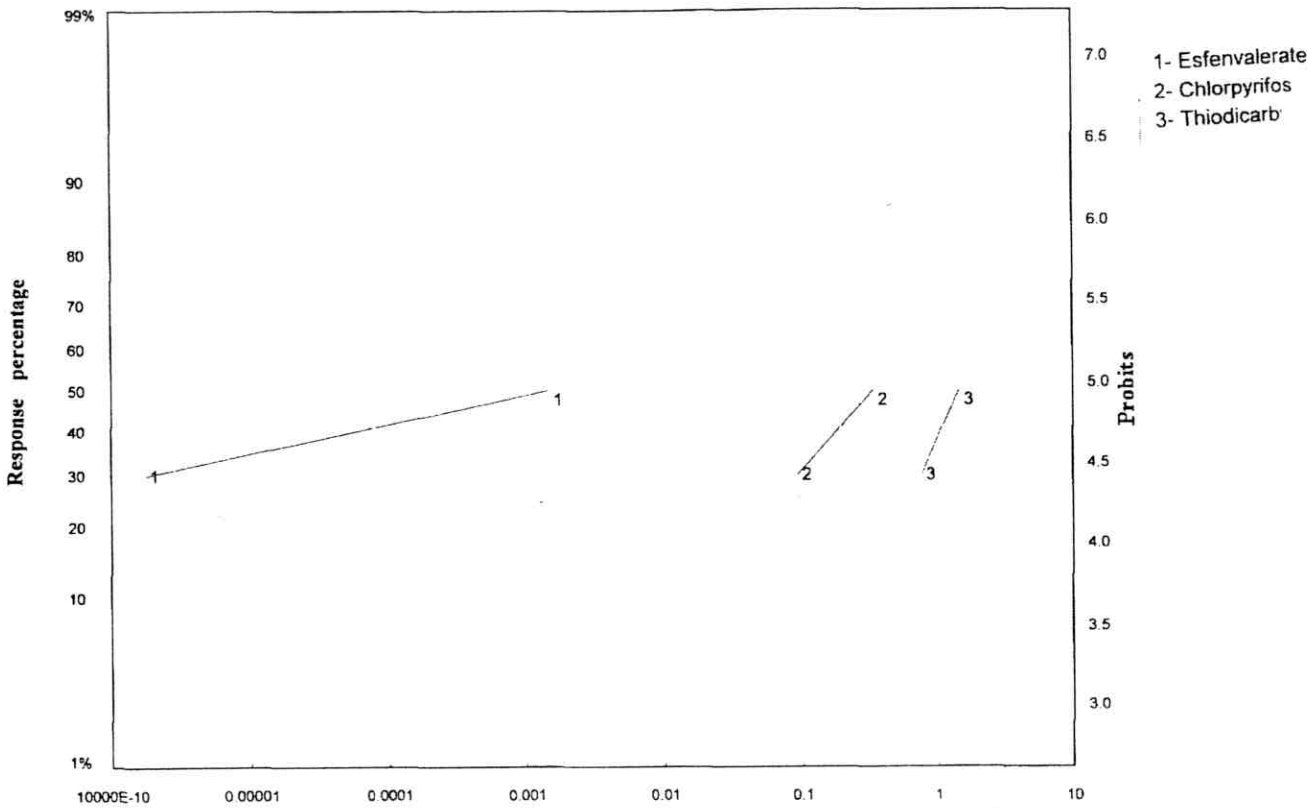

Fig. (5): Concentration-mortality probit lines of tested insecticides against 1-day old eggs of the spiny bollworm.

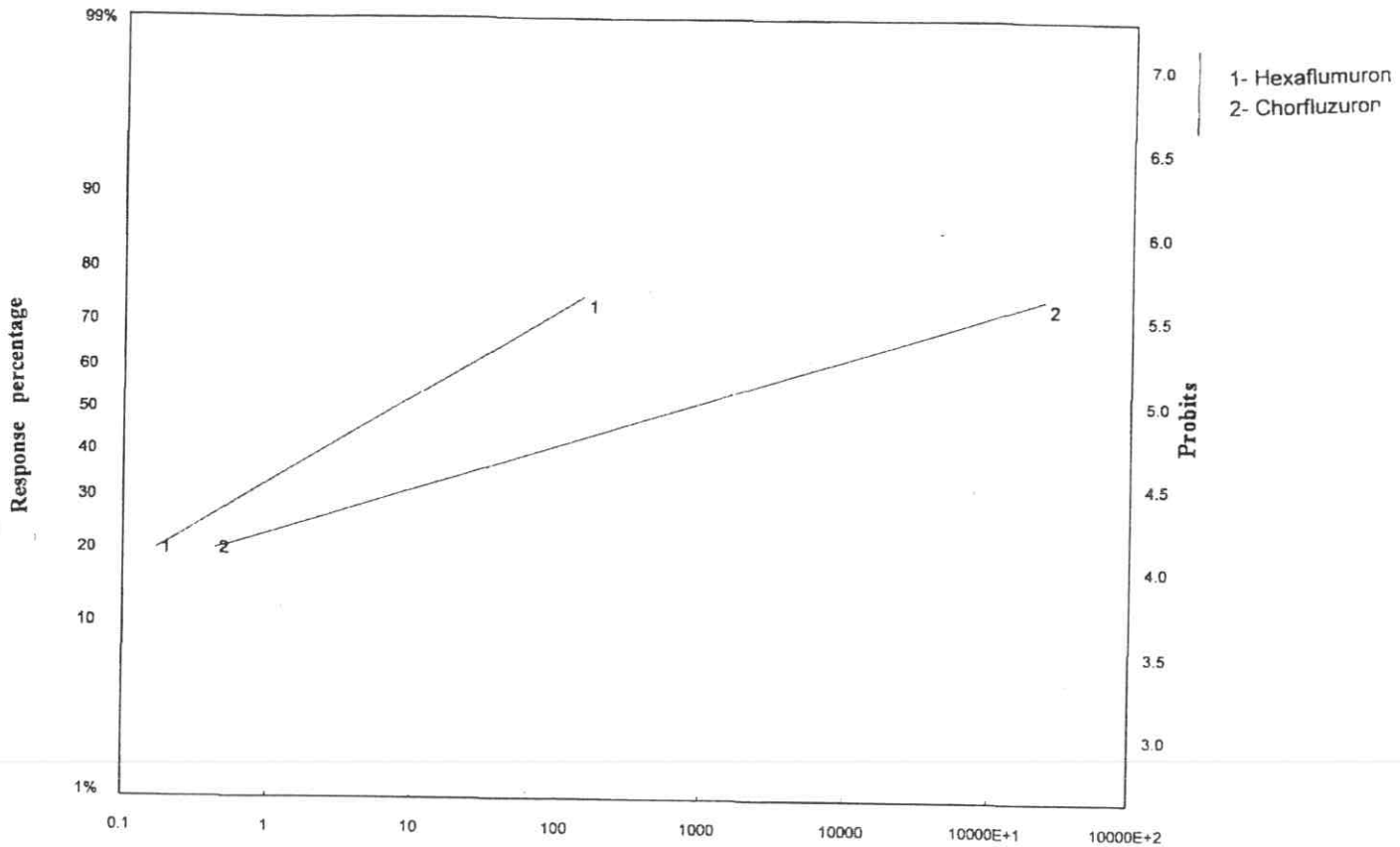

Fig. (6): Concentration-mortality probit lines of some insect growth regulators (IGR's) against 1-day old eggs of the spiny bollworm.

At LC_{50} levels the relative potency levels expressed as number of folds of efficiency indicate that Esfenvalerate Chlorpyrifos, Thiodicarb, and Hexaflumuron were 452018.00, 1982.53, 463.44 and 92.16 times more effective as ovicides against spiny bollworm than Chlorfluazuron, respectively. At the LC_{90} levels, the relative potency of the above mentioned compounds as compared with Chlorfluazuron were 231.70, 647698.85, 712212.95 and 2154.36, respectively.

The efficiency of the tested compounds against the eggs of pink and spiny bollworms may be summarized as follows:

1- Pink bollworm eggs at LC_{50} were highly affected with Chlorpyrifos, (Organophosphorous) followed by Thiodicarb, (Carbamate), Esfenvalerate, (Synthetic pyrethroid), Chlorfluazuron (IGR's) and Hexaflumuron, (IGR's) At the LC_{90} Esfenvalerate was the most active one followed by Thiodicarb, Chlorpyrifos, Hexaflumuron and Chlorfluazuron.

2- Spiny bollworm eggs at LC_{50} level were highly affected with esfenvalerate followed by, thiodicarb, hexaflumuron, and chlorfluazuron. At the LC_{90} level Thiodicarb was the most active one followed by chlorpyrifos, Hexaflumuron, Esfenvalerate and Chlorfluazuron.

The results mentioned above on the egg stage of pink and spiny bollworms are in agreement with the results recorded by. **khodzhaev** and **Eshmatov (1983)**, when the ovicidal activity of Permethrin (Ambush), Deltamethrin (Decis), Cypermethrin (Ripcord) and Fenvalerate (Sumicidin) were tested against the cotton moth *Heliothis armigera* (Hb), a serious pest of cotton in

central Asia, the tested compounds showed high ovicidal activity. Also **Horowitz *et al.* (1992)**, indicated that Hexaflumuron was efficient and Chlorfluazuron showed no effect against eggs of pink and spiny bollworms. **Nada (1996)** found that fastack was proved highly efficient ovicidal action against pink bollworm, followed by kendo and finally Delfos, which showed very weak ovicidal action .On the other hand **Xia Jangyuan *et al.* (1996)** indicated that larvin (thiodicarb) has a good ovicidal effect on bollworms.

2.2. Larval stage of.

2.2.1. Pink bollworm.

Results obtained in Table (8) and Fig. (7) show that at LC_{50} level, Esfenvalerate (LC_{50}: 0.42 ppm) was the most effective toxicant against pink bollworm followed by Chlorpyrifos (LC_{50}: 2.648 ppm) while Chlorfluazuron (LC_{50}: 21.927 ppm) gave a moderate effect. Thiodicarb (LC_{50} 51.876 ppm) and Hexaflumuron (LC_{50}: 70.127 ppm) gave the least effect.

At LC_{90} level, the toxicity of compounds reveal that Esfenvalerate (LC_{90}: 1.224 ppm) was the most active one followed by Chlorpyrifos (LC_{90}: 15.549 ppm), Thiodicarb (LC_{90}: 431.386 pm) Chlorfluazuron (LC_{90}: 513.95 ppm) gave a moderate effect while, Hexaflumuron (LC_{90}: 12384.21 ppm) gave the least effect.

Also results show that Esfenvalerate (slope value: 2.761) had the steepest toxicity lines followed by chlorpyrifos and Thiodicarb (slope values: 1.667 and 1.393, respectively). Chlorfluazuron and Hexaflumuron (slope values: 0.936 and 0.57, respectively) had the low slope values.

Table (8): Toxicity data of tested compounds against newly hatched larvae of pink bollworm.

Compound		LC_{50} (ppm)	LC_{90} (ppm)	Slope	Toxicity index at		Relative potency (Folds) at	
					LC_{50}	LC_{90}	LC_{50}	LC_{90}
Insecticides	1- Esfenvalerate	0.42	1.224	2.761	100.00	100.00	166.96	10117.81
	2- Chlorpyrifos	2.648	15.549	1.667	15.86	7.87	26.48	796.46
	3- Thiodicarb	51.876	431.386	1.393	0.809	0.283	1.35	28.70
IGR's	1- Hexaflumuron	70.127	12384.21	0.57	0.598	0.009	1.00	1.00
	2- Chlorfluazuron	21.927	513.95	0.936	1.915	0.238	3.19	24.09

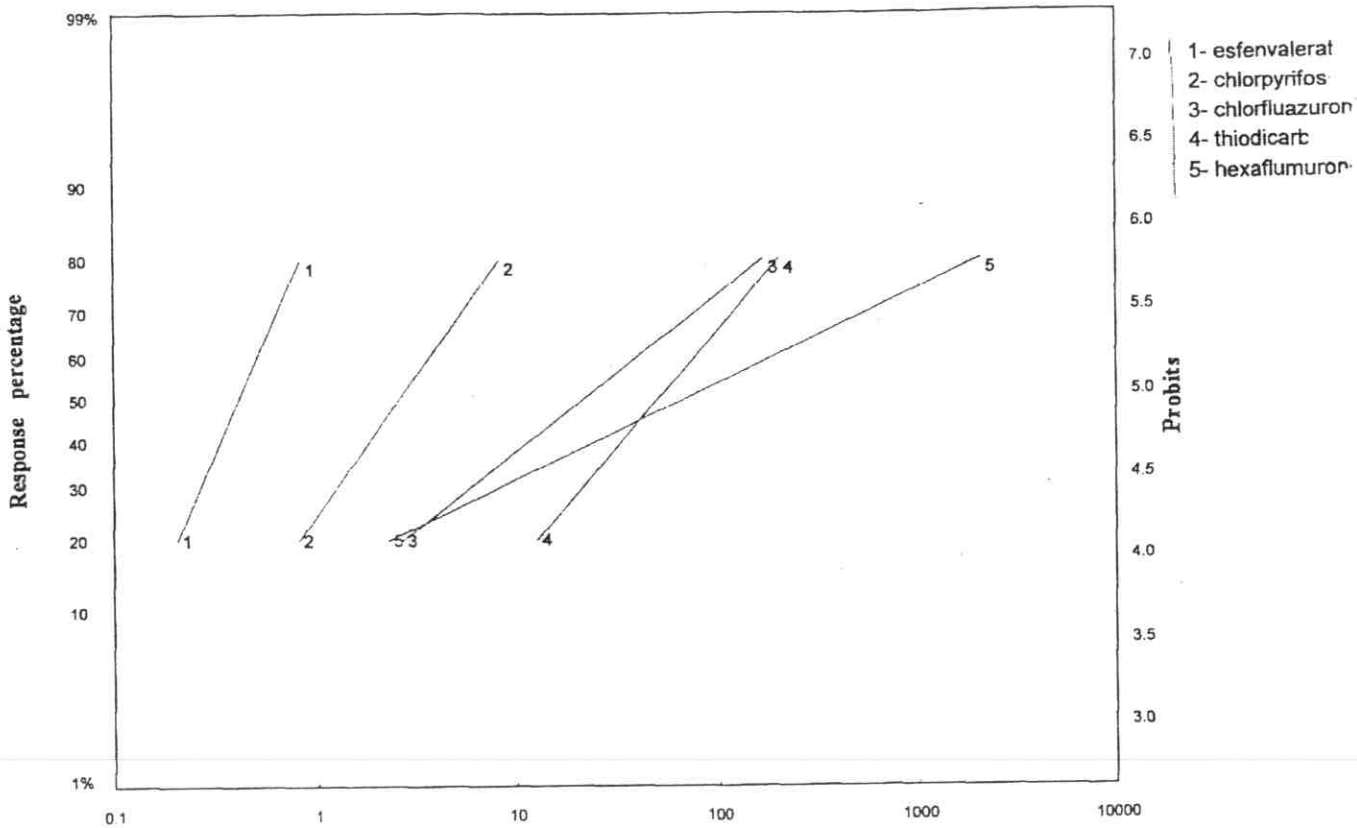

Fig. (7): Concentration-mortality probit lines tested compounds against newly hatched larvae of the pink bollworm.

Toxicity index reveal that Esfenvalerate was the stander (100.00) at LC_{50} and LC_{90} showing the most effect The toxicity index of the other toxicants at LC_{50} level were Chlorpyrifos (15.86), Chlorfluazuron (1.915), Thiodicarb (0.809) and Hexaflumuron (0.598). On the other hand, the toxicity index values at LC_{90} level were Chlorpyrifos (7.87), Thiodicarb (0.283), Chlorfluazuron (0.238) and Hexaflumuron (0.009).

Relative potency level at LC_{50} and LC_{90} reveal that Hexaflumuron was the least active one and was the stander (1.00).

Relative potency levels at LC_{50} show that Esfenvalerate Chlorpyrifos, Chlorfluazuron and Thiodicarb were 166.96, 26.48 3.19, and 1.35 folders active than Hexaflumuron, respectively. At LC_{90} levels of Esfenvalerate, Chlorpyrifos, Thiodicarb and Chlorfluazuron were 1017.81, 796.46, 28.70 and 24.09 folders active than Hexaflumuron, respectively.

2.2.2. Spiny bollworm.

In Table (9) and Fig. (8) data reveal that at LC_{50} level, Esfenvalerate (LC_{50}: 0.426 ppm) was the most potent action against spiny bollworm, followed by Chlorpyrifos (LC_{50}: 4.26 ppm) and Chlorfluazuron (LC_{50}: 21.158 ppm). Thiodicarb (LC_{50}: 55.744 ppm) gave moderate effect. While, Hexaflumuron (LC_{50}: 186.67 ppm) gave the least effect

Levels at LC_{90} displayed the same trend at $LC_{50;}$ which were 1.128, 13.701, 59.816, 395.95 and 3240900.00 ppm, for Esfenvalerate, Chlorpyrifos, Chlorfluazuron, Thiodicarb and Hexaflumuron respectively.

Table (9): Toxicity data of tested compounds against newly hatched larvae of spiny bollworm.

	Compound	LC_{50} (ppm)	LC_{90} (ppm)	Slope	Toxicity index at		Relative potency (Folds) at	
					LC_{50}	LC_{90}	LC_{50}	LC_{90}
Insecticides	1- Esfenvalerate	0.426	1.128	3.027	100.00	100.00	438.19	2873138.20
	2- Chlorpyrifos	4.256	13.701	2.524	10.009	8.23	43.86	236544.70
	3- Thiodicarb	55.744	395.95	1.505	0.764	0.284	3.34	8185.12
IGR's	1- Hexaflumuron	186.67	3240900.00	0.352	0.228	0.0000003	1.00	1.00
	2- Chlorfluazuron	21.158	59.816	2.84	2.01	1.88	8.82	54181.15

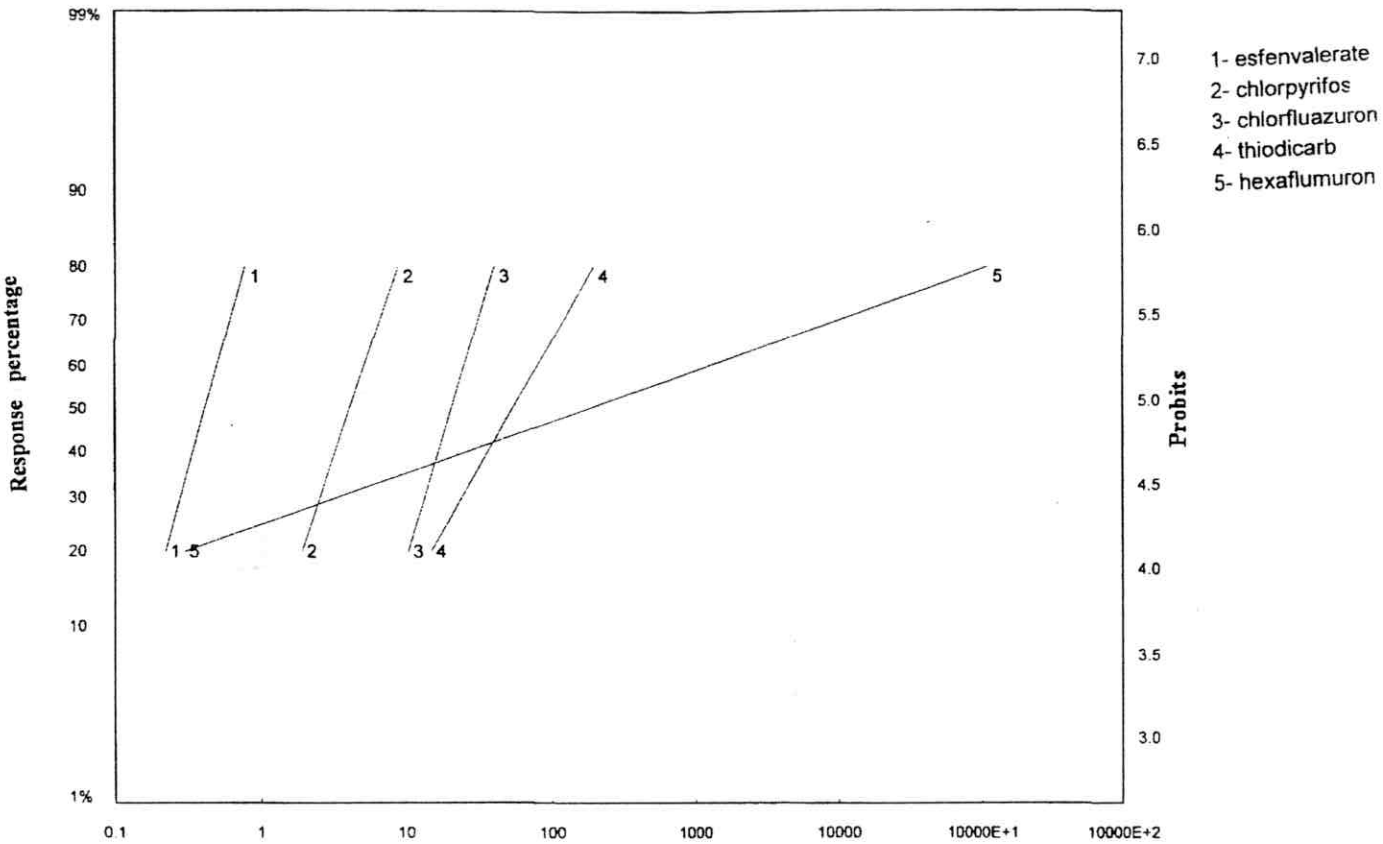

Fig. (8): Concentration-mortality probit lines tested compounds against newly hatched larvae of the spiny bollworm.

According to the slop values, results show that Esfenvalerate had steepest toxicity lines (Slope values: 3.027) followed by Chlorfluazuron, Chlorpyrifos and Thiodicarb (slope values: 2.84, 2.524 and 1.505) respectively). While, Hexaflumuron (slope values: 0.302) had the low slope values. Also results show that Esfenvalerate had high slope values so that it showed higher effect at LC_{90} level.

About the toxicity index at LC_{50} level, Esfenvalerate was the stander (100.00), followed by Chlorpyrifos (10.009), Chlorfluazuron (2.01), Thiodicarb (0.764), and Hexaflumuron (0.228). On the other hand, the toxicity index at LC_{90} level displayed the same trend at LC_{50} level.

On grounds of the toxicity index values at LC_{50} and LC_{90} levels, Esfenvalerate was the most efficient on spiny bollworm followed by Chlorpyrifos. Chlorfluazuron gave a moderate effect while, Thiodicarb and Hexaflumuron gave the least effect.

Relative potency level at LC_{50} and LC_{90} revealed that Hexaflumuron was less active one and was considered the stander (1.00).

Relative potency level at LC_{50} showed that Esfenvalerate, Chlorpyrifos, Chlorfluazuron, and Thiodicarb values, were 438.19, 43.86, 8.82 and 3.34 folders active than Hexaflumuron, respectively. At LC_{90} level, they were 2873138.20, 236544.70, 54181.15 and 8185.12, folders active than Hexaflumuron, respectively.

The efficiency of the tested compounds against the eggs of pink and spiny bollworms can be summarized as follows:

1- Pink bollworm newly hatched larvae at LC_{50} were highly affected with Esfenvalerate, (Synthetic pyrethroid) followed by Chlorpyrifos, (Organophosphorus) Chlorfluazuron,(IGR's) Thiodicarb, (Carbamate) and Hexaflumuron (IGR's). At the LC_{90} Esfenvalerate was the most active one followed by Chlorpyrifos, Thiodicarb, Chlorfluazuron and Hexaflumuron.

2- Spiny bollworm newly hatched larvae at LC_{50} were highly affected with Esfenvalerate followed by Chlorpyrifos, Chlorfluazuron, Thiodicarb and Hexaflumuron, and. At the LC_{90} the same trend was obtained Esfenvalerate followed by Chlorpyrifos, Chlorfluazuron, Thiodicarb and Hexaflumuron.

These results of larval stage of pink and spiny bollworm are in agreement with those obtained by **Abbassy *et al.* (1984)**, they found that Cypermethrin was the most toxic compound against pink bollworm after treated the full mature larvae topically with some insecticides.Also, **Weiland *et al.* (2000)** found that the insect growth regulators Dimilin (Diflubenzuron), exhibited little activity on the cotton bollworms. Also in this respect **Aioub *et al.* (2003)** reported that Esfenvalerate was the most toxic compounds against pink bollworm after exposed the newly hatched larvae to artificial diet treated with some chemicals. .

2.3. Adult stage of:

2.3.1. Pink bollworm.

Results in Table (10) and Fig. (9) indicate that at LC_{50} level, Chlorpyrifos (LC_{50}:0.231 ppm) was the most effective against pink bollworm, but Esfenvalerate (LC_{50}: 0.966 ppm) gave a moderate effect while, Thiodicarb (LC_{50}: 1.952 ppm) gave the least effect.

Table (10): Toxicity data of insecticides against adult moths of pink bollworm.

Insecticide	LC_{50} (ppm)	LC_{90} (ppm)	Slope	Toxicity index at		Relative potency (Folds) at	
				LC_{50}	LC_{90}	LC_{50}	LC_{90}
Esfenvalerate	0.966	65.166	0.701	23.91	2.90	2.02	1.00
Chlorpyrifos	0.231	1.959	1.396	100.00	100.00	8.45	34.13
Thiodicarb	1.952	18.701	1.306	11.83	10.20	1.00	3.48

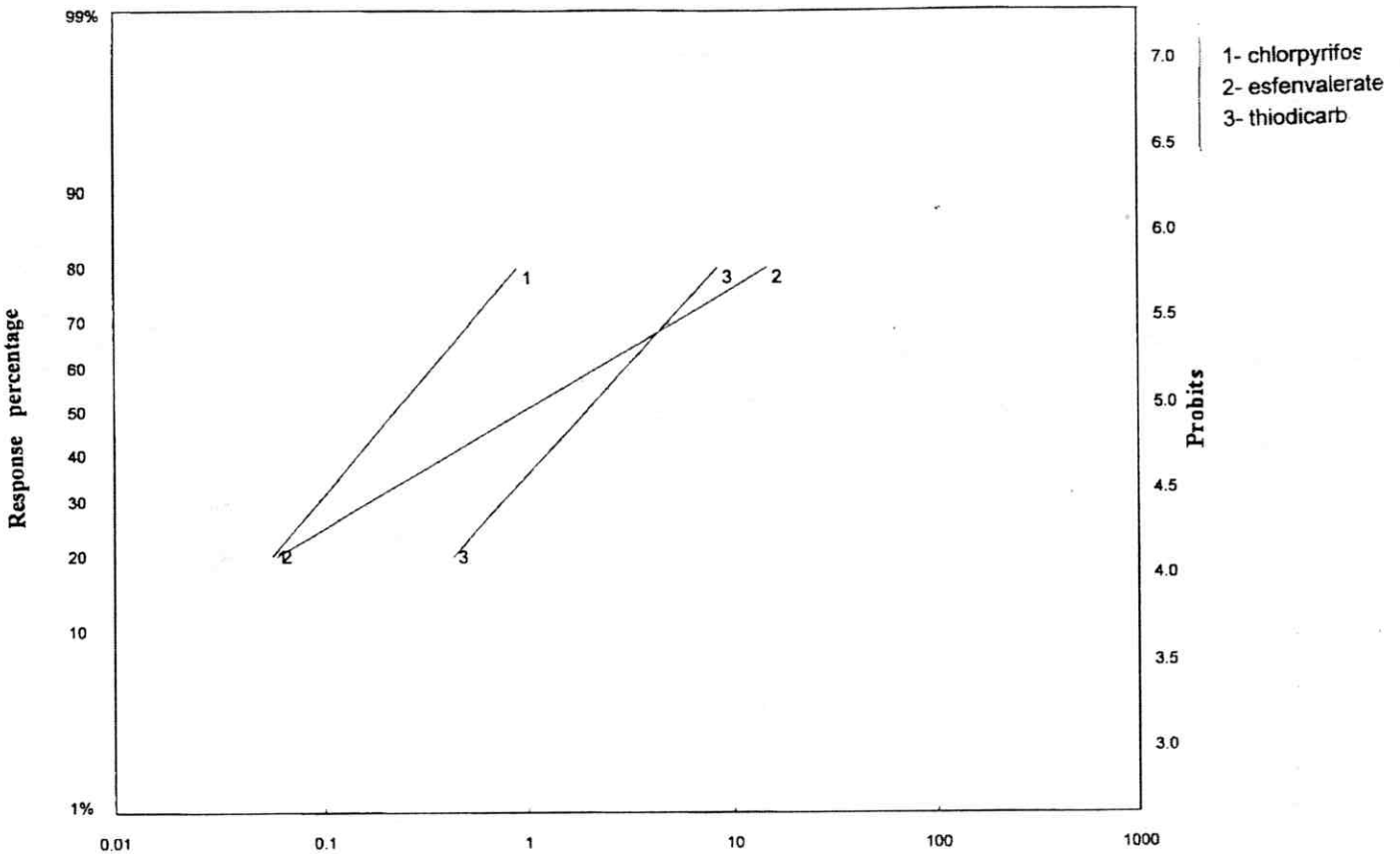

Fig. (9): Concentration-mortality probit lines of tested insecticides against adult moths of the pink bollworm.

The LC_{90} levels, were.909, 65.166 and 18.701 for Chlorpyrifos, Thiodicarb and Esfenvalerate, respectively.

Regarding the slope value, results show that the slope value: was 1.396 for Chlorpyrifos followed by Thiodicarb (slope value: 1.306) and they have high slope values so that they showed high effect on adults at LC_{90}, while, Esfenvalerate (slope value: 0.701) has the low slope value.

Data of toxicity index at LC_{50} and LC_{90}, showed that Chlorpyrifos, had the highest efficiency, was considered the slandered (100.00) at LC_{50}, and LC_{90} followed by Esfenvalerate (23.91) and Thiodicarb (11.83) at LC_{50} while, at $LC_{90}$the value were 10.20 and 2.90 for Thiodicarb and Esfenvalerate, respectively.

Relative potency at LC_{50} level showed that they Thiodicarb was the least active toxicant and was considered the standard (1.00). These values of Chlorpyrifos and Esfenvalerate were 8.45 and 2.02 folds and active than Thiodicarb. but, Esfenvalerate, was the least effect at LC_{90}, while folds of Chlorpyrifos and Thiodicarb were 34.13 and 3.48 folds and effective than Esfenvalerate.

2.3.2. Spiny bollworm.

At LC_{50} level results in Table (11) and Fig. (10) show that Esfenvalerate (LC_{50}: 1.153 ppm) was the most effect compound against the spiny bollworm adults, followed by Thiodicarb (LC_{50}:1.85) while, Chlorpyrifos (LC_{50}: 18.593 ppm) gave the least effect.

On the other hand, at LC_{90} level, Esfenvalerate (LC_{90}: 10.488 ppm) was the most effective toxicant followed by Thiodicarb (LC_{90}: 35.536 ppm) and Chlorpyrifos (LC_{90}: 58088.20 ppm).

Table (11): Toxicity data of insecticides against adult moths of spiny bollworm.

Insecticide	LC_{50} (ppm)	LC_{90} (ppm)	Slope	Toxicity index at		Relative potency (Folds) at	
				LC_{50}	LC_{90}	LC_{50}	LC_{90}
Esfenvalerate	1.153	10.488	1.337	100.00	100.00	16.12	5538.53
Chlorpyrifos	18.593	58088.20	0.367	6.20	0.018	1.00	1.00
Thiodicarb	1.85	35.536	0.998	62.32	29.51	10.05	1634.62

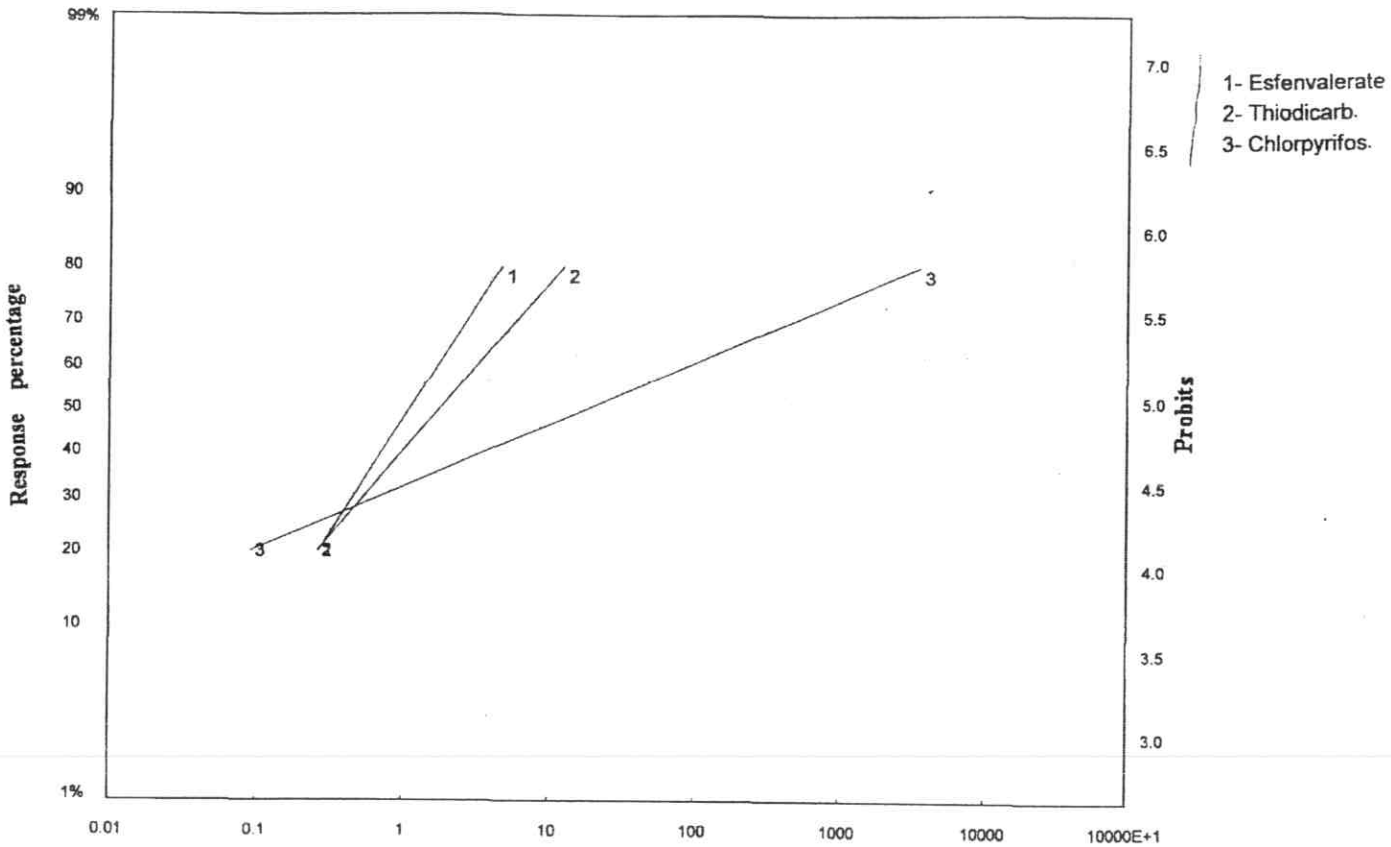

Fig. (10): Concentration-mortality probit lines of tested insecticides against adult moths of the spiny bollworm.

Also, results indicate that Esfenvalerate had the steeper toxicity lines (slope value: 1.337). Thiodicarb and Chlorpyrifos (slope values: were 0.998 and 0.367, respectively) and had the low slope values.

Data of toxicity index at LC_{50} and LC_{90} levels reveal that Esfenvalerate which had the highest efficiency was considered the standard (100.00), at LC_{50} followed by Thiodicarb (62.32) and Chlorpyrifos (6.20), and also at LC90 followed by Thiodicarb (29.51) and Chlorpyrifos (0.018).

Relative potency show that Chlorpyrifos was the least active toxicant at LC_{50} and LC_{90} levels and was considered the standard (1.0), but Thiodicarb and Esfenvalerate values were 10.05 and 16.12 folds and active than Chlorpyrifos at LC_{50}, and LC_{90} levels, where folds were about 1634.62 and 5538.53 folds more effective than Chlorpyrifos.

The efficiency of the tested insecticides against the adult moths of pink and spiny bollworms can summarized as follows:

1- Pink bollworm adults at LC_{50} level were highly affected with Chlorpyrifos, followed by Esfenvalerate and Thiodicarb. At the LC_{90} level Chlorpyrifos, was the most active one followed by Thiodicarb and Esfenvalerate.

2- Spiny bollworm adults at LC_{50} and LC_{90} levels were highly affected with Esfenvalerate, (Synthetic pyrethroid) followed by, Thiodicarb, (Carbamate) and Chlorpyrifos, (Organophosphorous).

These results of adult stage of spiny bollworm are in agreement with those obtained by **Klein *et al.* (1982)** who, found that the tested Pyrethroid insecticides were active than Organophosphorus on adults of spiny bollworm.

3. Residual effects of tested compounds on some biological aspects of pink and spiny bollworms:

3.1. One – day old eggs treated with the tested compounds by using dipping technique

3.1.1. Pink bollworm:

Larval duration:

The effects of different compounds on pink bollworm larval durations were given in Table (12) Results indicate that different concentrations of Esfenvalerate, Hexaflumuron, Chlorfluazuron and Thiodicarb caused a significant prolonged in larval duration, compared with control, but chlorpyrifos caused non significant prolonged in larval duration.

Also, the mean of concentrations of each compound gave significant prolongation comparing with control.

From the same data it is appear that the longest mean larval duration (20.18 days) was obtained with Chlorfluazuron, while the shortest one (13.91 days) was recorded with Chlorpyrifos, compared with (13.45 days) for control.

Larval weight:

Mean weights of full grown larvae of pink bollworm developed from treated eggs were 0.0352, 0.0412, 0.0418, 0.0418 and 0.042g for Esfenvalerate, Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron, respectively, compared with untreated one (0.0423g) (Table 12).

Table (12): Effect of different concentrations of tested compounds on duration, weight and mortality of both larvae and pupae of pink bollworm, when one -day old eggs were treated using dipping technique.

Compound	Conc. (ppm)	Larval duration (days)	Larval weight (gram)	% mortality of larvae	Pupal duration (days)	Pupal weight (gram)	% mortality of pupae
Insecticides:							
1- Esfenvalerate	0.0732	15.50a	0.0328c	27.00a	10.00	0.0240c	20.00a
	0.0366	15.16ab	0.0358b	25.00a	10.12	0.0260b	16.00b
	0.0183	14.80b	0.0370b	24.00a	10.14	0.0270a	13.00b
	Mean	15.15C	0.0352B	25.33A	10.10BC	0.0257B	16.33A
	Control	13.45c	0.0423a	0.00b	10.14	0.0277a	3.70c
	F-test for concentration	**	**	**	N.S.	**	**
2- Chlorpyrifos	0.146	14.00	0.0415	14.00a	9.00	0.0272	13.50a
	0.073	14.00	0.0421	13.00ab	10.00	0.0275	13.00a
	0.036	13.72	0.0423	12.22b	10.14	0.0275	12.22a
	Mean	13.91D	0.0420A	13.10B	9.71C	0.0274A	12.91B
	Control	13.45	0.0423	0.00c	10.14	0.0277	3.70b
	F-test for concentration	N.S.	N.S.	**	N.S.	N.S.	**
3- Thiodicarb	0.244	14.35a	0.0410	5.00a	10.00	0.0271	9.52a
	0.122	14.15ab	0.0420	4.00b	10.13	0.0275	8.55b
	0.061	13.99ab	0.0423	3.33b	10.14	0.0275	7.41c
	Mean	14.16D	0.0418A	4.11D	10.10BC	0.0273A	8.49C
	Control	13.45b	0.0423	0.00c	10.14	0.0277	3.70d
	F-test for concentration	*	N.S.	**	N.S.	N.S.	**
IGR's:							
1-Hexaflumuron	0.781	19.00a	0.0410	6.37a	11.20	0.0270	10.37a
	0.391	18.44a	0.0420	6.00a	11.00	0.0275	9.76ab
	0.195	18.30a	0.0423	5.55a	10.63	0.0277	9.00b
	Mean	18.58B	0.0418A	5.97CD	10.94B	0.0274A	9.71C
	Control	13.45b	0.0423	0.00b	10.14	0.0277	3.70c
	F-test for concentration	**	N.S.	**	N.S.	N.S.	**
2-Chlorfluazuron	0.781	20.21a	0.0400	9.72a	12.30	0.0272	9.52a
	0.391	20.17a	0.0415	7.24b	12.20	0.0277	8.39b
	0.195	20.15a	0.0420	4.76c	12.14	0.0277	7.91c
	Mean	20.18A	0.0412A	7.24C	12.21A	0.0275A	8.61C
	Control	13.45b	0.0423	0.00d	10.14	0.0277	3.70d
	F-test for concentration	**	N.S.	**	N.S.	N.S.	**
Control		13.45E	0.0423A	0.00E	10.14BC	0.0277A	3.70D
F-test for compounds		**	**	**	**	*	**

L.S.D at 5%

N.S. = non significant * = significant **= highly significant

The influence of different concentrations of each compound proved to be non significant for all tested compounds with exception of those regarding esfenvalerate which caused a highly significant reduction in larval weight. Also, data reveal that increasing the concentration of all tested compounds induced a gradual decrease in larval weight.

Larval mortality percentage:

Data presented in Table (12) indicate that both insecticides and concentrations caused highly significant effects on larval mortality percentages of pink bollworm compared with check. The highest average percentage of larval mortality (25.33 %) was obtained from Esfenvalerate, while, the lowest percentage (4.11 %) was recorded for thiodicarb as compared with control, which was (0.00 %).

Generally, it could be conclude that increasing the concentration of all tested compounds induced gradual increase in larval mortality percentages.

Pupal duration:

Data given in Table (12) show that the mean pupal periods of pink bollworm were highly significant affected by Hexaflumuron and Chlorfluazuron compounds compared with control, but no significant differences were found for Esfenvalerate, Chlorpyrifos and Thiodicarb. The longest average of pupal period (12.21 days) was obtained with Chlorfluazuron, while, the shortest period (9.71 days) was recorded for Chlorpyrifos as compared with control, which was (10.14 days).

Also, it was found that concentration of any compound caused non significant effects in pupal duration period from the pupae produced from treated eggs.

Pupal weight:

The effects of tested compounds on the pupal weight of pink bollworm derived from treated eggs were shown in Table (12). the Pupal weight was significantly affected by the treatment of Esfenvalerate only. The highest average of pupal weight (0.0275 g / pupa) was recorded for Chlorfluazuron while, the lowest weight (0.0257g / pupa) was recorded for Esfenvalerate as compared with check, which was (0.0277 gram / pupae). The concentration of all tested compounds displayed non significant influence in Pupal weight with exception of those regarding Esfenvalerate concentrations which indicated highly significant reduction in pupal weight.

Pupal mortality percentage:

Mortality percentages of pupae produced from treated eggs were affected by tested compounds and their concentrations (Table 12). Highly significant differences were found between both tested compounds and their concentrations on pupal mortality compared with untreated. The highest average percentage of pupal mortality (16.33 %) was recorded for Esfenvalerate, while the lowest one (8.49 %) was recorded for Thiodicarb as compared with control, which was (3.70 %).

Increasing the concentration of all tested compounds induced a gradual increase in pupal mortality percentage.

Percent of adult emergence:

Statistical analysis of the data found in Table (13) indicated that percent of adults emergence was highly significant affected by both tested compounds and their concentrations. Averages percentages of adult's emergence were 83.67, 87.10, 91.50, 90.38 and 91.68% for Esfenvalerate, chlorpyrifos, thiodicarb, hexaflumuron and chlorfluazuron, respectively compared with control (96.30%). Also, results reveal that increasing the concentration of each tested compound induced a gradual decreased in adult's emergence.

Sex ratio:

Data in Table (13) indicate that sex ratios were significantly affected with Chlorpyrifos; Thiodicarb and Hexaflumuron compounds comparing with control. Belonging the effects of different concentrations of each compound, it was found that significant effects were obtained except esfenvalerate comparing with control. The sex ratio was irregularly varied as the concentration of all compounds. The highest average of sex ratio as females (52.44 %) was recorded with Chlorfluazuron, while the lowest one (38.89%) was recorded with Chlorpyrifos as compared with (55.55%) of control.

Male longevity:

Data presented in Table (13) illustrated that the effects of both compounds and their concentrations were highly significant effects on males longevities which were developed from eggs treated with different tested compounds. The longest average of males longevities (24.41 days) was recorded with Chlorfluazuron,

Table (13): Effect of different concentrations of tested compounds on emergence, sex ratio and longevity of adult stage of pink bollworm, when one- day old eggs were treated using the dipping technique.

Compound	Conc. (ppm)	% Emergence	% Sex ratio as females	Male longevity (days)	Female longevity (days)
Insecticides:					
1-Esfenvalerate	0.0732	80.00c	50.0	3.00c	8.00b
	0.0366	84.00bc	50.00	4.00bc	9.00b
	0.0183	87.00b	50.00	5.00b	10.50b
	Mean	83.67D	50.00A	4.00E	9.17B
	Control	96.30a	55.55	29.00a	22.00a
	F-test for concentration	**	N.S.	**	**
2-Chlorpyrifos	0.146	86.50c	33.33b	10.00b	20.70
	0.073	87.00b	33.33b	10.50b	21.00
	0.036	87.67b	50.00a	11.00b	21.00
	Mean	87.10C	38.89B	10.50D	20.90
	Control	96.30a	55.55a	29.00a	22.00
	F-test for concentration	**	**	**	N.S.
3-Thiodicarb	0.244	90.47c	43.45b	8.83b	20.33
	0.122	91.45bc	42.22b	9.00b	21.75
	0.061	92.59b	48.68ab	9.00b	22.00
	Mean	91.50B	44.78AB	8.94D	21.36
	Control	96.30a	55.55a	29.00a	22.00
	F-test for concentration	**	*	**	N.S.
IGR's:					
1-Hexaflumuron	0.718	89.89c	43.33c	19.5bc	20.66
	0.391	90.24bc	44.05b	20.67b	21.67
	0.195	91.00b	53.79a	18.83c	21.66
	Mean	90.38B	47.10AB	19.67C	21.33
	Control	96.30a	55.55a	29.00a	22.00
	F-test for concentration	**	**	**	N.S.
2-Chlorfluazuron	0.781	90.48d	55.56a	20.00c	16.50
	0.391	91.67c	57.22a	23.56b	20.61
	0. 195	92.88b	44.55b	29.67a	21.00
	Mean	91.68B	52.44A	24.41B	19.37
	Control	96.30a	55.55a	29.00a	22.00
	F-test for concentration	**	*	**	N.S.
Control		96.30A	55.55A	29.00A	22.00
F-test for compounds		**	*	**	N.S.

L.S.D at 5%
N.S. = non significant * = significant ** = highly significant

while the shortest one (4.00 days) was obtained from Esfenvalerate compared with (29.00 days) of check. Increasing the concentration of each compound induced a gradual decreased in male longevity.

Female longevity:

Data in Table (13) indicate that female longevities, developed from eggs treated with different concentrations of each tested compounds were non- significantly affected except that of Esfenvalerate treatment which caused highly significant reduction on the pink bollworm female longevity.

The longest average female longevity (21.36 days) was recorded with thiodicarb, while, the shortest one (9.17 days) was recorded with Esfenvalerate as compared with (22.00 days) in control.

Increasing the concentration of the compounds induced a gradual decreased in female longevity.

Pre-oviposition period:

Analysis of variance of the results arranged in Table (14) reveal that the pre-oviposition period of pink bollworm was significantly affected with Esfenvalerate and Hexaflumuron compounds. Also the concentrations of Esfenvalerate, Hexaflumuron and Chlorfluazuron induced significant differences in pre- oviposition periods. The longest average of pre-oviposition period (3.24 days) was recorded for Hexaflumuron, while, the shortest one (2.19 days) was recorded for Chlorfluazuron, as compared with (2.50 days) in check.

Table (14): Effect of different concentrations of tested compounds on oviposition periods, number of deposited eggs and hatchability of eggs of pink bollworm, when one- day old eggs were treated using the dipping technique.

Compound	Conc. (ppm)	Pre-oviposition period (days)	Oviposition period (days)	Post oviposition period (days)	Number of laid eggs /female	Incubation period of eggs	% Hatchability of eggs
Insecticides:							
1-Esfenvalerate	0.0732	4.00a	3.00d	1.00	10.00b	7.97a	91.48
	0.0366	3.00b	5.00c	1.00	11.00b	7.50ab	92.72
	0.0183	2.50c	7.00b	1.00	12.00b	7.00bc	94.00
	Mean	3.17AB	5.33D	1.00B	11.00C	7.49A	92.73A
	Control	2.50c	18.50a	1.00	328.00a	6.47c	94.00
	F-test for concentration	**	**	N.S.	**	**	N.S.
2-Chlorpyrifos	0.146	2.70	9.00b	9.00a	180.00b	6.98	67.22d
	0.073	2.60	9.50b	8.90ab	185.00b	6.70	80.00c
	0.036	2.50	10.00b	8.50b	190.00b	6.60	86.11b
	Mean	2.60ABC	9.50C	8.80A	185.00B	6.76B	77.78B
	Control	2.50	18.50a	1.00c	328.00a	6.47	94.00a
	F-test for concentration	N.S.	**	**	**	N.S.	**
3-Thiodicarb	0.244	2.00	16.33	2.00a	207.50c	6.86	90.83
	0.122	2.25	17.50	2.00a	215.00c	6.63	91.25
	0.061	2.50	18.00	1.50b	234.00b	6.49	92.00
	Mean	2.25C	17.28A	1.83B	218.83B	6.66B	91.36A
	Control	2.50	18.50	1.00c	328.00a	6.47	94.00
	F-test for concentration	N.S.	N.S.	**	**	N.S.	N.S.
IGR's:							
1-Hexaflumuron	0.718	3.50a	7.83d	9.33a	67.42d	6.89	83.10b
	0.391	3.33a	10.67c	7.67b	164.00c	6.47	91.67a
	0.195	2.90ab	16.33b	3.83c	287.67b	6.47	92.00a
	Mean	3.24A	11.61BC	6.94A	172.81B	6.61B	88.92A
	Control	2.50b	18.50a	1.00d	328.00a	6.47	94.00a
	F-test for concentration	*	**	**	**	N.S.	**
2-Chlorfluazuron	0.781	1.92a	11.58c	3.00a	180.92c	6.80	90.00
	0.391	2.33a	16.22b	2.06b	232.34b	6.68	92.62
	0.195	2.33a	16.67b	2.00b	310.00a	6.65	94.0
	Mean	2.19C	14.82AB	2.35B	241.10AB	6.71B	92.21A
	Control	2.50b	18.50a	1.00c	328.00a	6.47	94.00
	F-test for concentration	*	**	**	**	N.S.	N.S.
Control		2.50BC	18.50A	1.00B	328.00A	6.47B	94.00A
F-test for compounds		*	**	**	**	**	*

L.S.D at 5%

N.S. = non significant * = significant ** = highly significant

Increasing the concentration of Esfenvalerate, Chlorpyrifos and Hexaflumuron induced gradually prolonged in pre- oviposition period, while in case of Thiodicarb and Chlorfluazuron induced shortened pre- oviposition period.

Oviposition period:

Eggs laying period of female derived from eggs of pink bollworm treated with different concentrations of the tested compounds were affected. Data in Table (14) show that the oviposition periods were highly significant affected with tested compounds and their concentrations with exception of those regarding Thiodicarb concentrations, which indicated non significant. The longest mean of oviposition period (17.28 days) was recorded for Thiodicarb, while, the shortest one (5.33 days) was recorded for Esfenvalerate, as compared with (18.50 days) in check.

Generally, increasing the concentration of all compounds caused a gradually shortened in oviposition period.

Post-oviposition period:

Data presented in Table (14) show that the effects on post-oviposition period were highly significant for the tested compounds and concentrations with exception of Esfenvalerate concentrations, which were had non significant effect. The longest average post-oviposition period (8.80 days) was recorded for Chlorpyrifos, while, the shortest one (1.00 day) was recorded for Esfenvalerate, as compared with (1.00 day) in control. Also increasing the concentration of all compounds induced a gradually prolonged post–oviposition period.

Generally, all compounds caused prolonged post-oviposition periods with the exception of Esfenvalerate.

Number of deposited eggs / female:

Data in Table (14) indicate that both compounds and their concentrations caused highly significant reduction in the numbers of deposited eggs/ female, when the females resulted from eggs treated with these compounds. Average number of laid eggs / female decreased from (328.00 eggs / female) in untreated check to reach 241.10, 218.83, 185.00, 172.81, 11.00 eggs / female with Chlorfluazuron, Thiodicarb, Chlorpyrifos, Hexaflumuron and Esfenvalerate, respectively.

From the same data it can be observed that increasing the concentrations of each compound induced a gradual reduction in number of deposited eggs / female.

Incubation period of eggs:

Data presented in Table (14) show that all tested compounds were have non-significant effects on incubation period of deposited eggs which laid by females derived from treated eggs, except Esfenvalerate concentrations .

The longest average incubation period of eggs (7.49 days) was recorded with Esfenvalerate while, the shortest incubation period (6.61 days) was recorded for Hexaflumuron. Also, increasing the concentration of each compound caused a gradual increase in incubation period of eggs.

Hatchability of eggs:

The obtained results in Table (14) clear that Chlorpyrifos caused significant effect on the viability of eggs deposited by females developed from treated eggs.

The effect of concentration was non significant for Esfenvalerate, Thiodicarb and Chlorfluazuron and highly significant for Chlorpyrifos and Hexaflumuron on hatchability percentage of pink bollworm comparing with control. The highest hatchability percentage was 92.73 % for Esfenvalerate, while, the lowest one (77.78 %) was recorded with Chlorpyrifos, as compared with (94.00 %) control. Also, increasing the concentration of each compound induced a gradual decrease in hatchability of eggs.

3.1.2. Spiny bollworm

Larval duration:

Statistical analysis of data in Table (15) shows that both concentrations and compounds caused non-significant prolonged larval duration, except Esfenvalerate concentration which caused significant prolonged larval duration. Mean while, the highest larval duration period (16.40 days) was recorded for Esfenvalerate, while, the lowest one (15.53 days) was recorded for Hexaflumuron, as compared with (15.00 days) in control.

Increasing the concentration of the compound induced a gradual prolonged larval duration.

Table (15): Effect of different concentrations of tested compounds on biological aspects of larvae and pupae of spiny bollworm, when one- day old eggs were treated using the dipping technique.

Compound	Conc. (ppm)	Larval duration (days)	Larval weight (gram)	% mortality of larvae	Pupal duration (days)	Pupal weight (gram)	% mortality of pupae
Insecticides:							
1-Esfenvalerate	0.0732	16.66a	0.0799	35.00a	8.14b	0.0634	19.50a
	0.0366	16.37a	0.0802	32.00b	8.31b	0.0637	18.00ab
	0.0183	16.18a	0.0805	29.00c	8.40b	0.0647	16.50b
	Mean	16.40	0.0802AB	32.00A	8.28	0.0639 A	18.00A
	Control	15.00b	0.0835	4.50d	10.00a	0.0640	4.00c
	F-test for concentration	*	N.S.	**	**	N.S.	**
2-Chlorpyrifos	0.146	15.75	0.0810	20.00a	9.50	0.0600	17.00a
	0.073	15.60	0.0825	15.00b	9.75	0.0610	13.00b
	0.036	15.50	0.0840	10.00c	9.95	0.0620	9.00c
	Mean	15.62	0.0825A	15.00B	9.73	0.0610 A	13.00B
	Control	15.00	0.0835	4.50D	10.00	0.0640	4.00d
	F-test for concentration	N.S.	N.S.	**	N.S.	N.S.	**
3-Thiodicarb	0.976	16.50	0.0730b	15.00a	8.50	0.0513c	13.00a
	0.488	16.00	0.0740b	10.00ab	8.80	0.0550c	9.00ab
	0.244	15.5	0.0805a	7.00bc	9.20	0.0590b	7.00bc
	Mean	16.00	0.0758C	10.67B	8.83	0.0551 B	9.67B
	Control	15.00	0.0835a	4.50c	10.00	0.0640a	4.00c
	F-test for concentration	N.S.	**	**	N.S.	**	**
IGR's:							
1-Hexaflumuron	0.781	15.80	0.0750c	16.00a	7.66	0.0520c	12.00a
	0.391	15.50	0.0770bc	13.00ab	9.62	0.0536c	11.00a
	0.195	15.30	0.0790b	10.00b	10.00	0.0580b	9.00a
	Mean	15.53	0.0770BC	13.00B	9.09	0.0545 B	10.67B
	Control	15.00	0.0835a	4.50c	10.00	0.0640a	4.00b
	F-test for concentration	N.S	**	**	N.S.	**	**
2-Chlorfluazuron	0.781	16.00	0.0730c	13.00a	7.00	0.0500c	10.00a
	0.391	15.80	0.0750bc	11.00ab	9.00	0.0570b	9.00a
	0.195	15.50	0.0765b	10.00b	9.00	0.0590b	8.00a
	Mean	15.77	0.0748C	11.33B	8.33	0.0553 B	9.00B
	Control	15.00	0.0835a	4.50c	10.00	0.0640a	4.00b
	F-test for concentration	N.S.	**	**	N.S.	**	**
Control		15.00	0.0835A	4.50C	10.00	0.0640A	4.00C
F-test for compounds		N.S.	**	**	N.S.	**	**

L.S.D at 5%
N.S. = non significant * = significant ** = highly significant

Larval weight:

As shown in Table (15) all tested compounds and their concentrations caused different degrees of reduction on weight of larvae which hatched from treated eggs. This reduction was significant with Thiodicarb, Hexaflumuron and Chlorfluazuron, while with Esfenvalerate and chlorpyrifos was non significant. The highest larval weight (0.0825 g/larva) was obtained with chlorpyrifos, while, the lowest average (0.0748 g/larva) was recorded with Chlorfluazuron.

From the obtained results it is appeared that weight of treated larvae was lesser than untreated ones (0.0835 g / larva). Also, increasing the concentration of each compound induced a gradual decrease in larval weight.

Mortality percentages of larvae:

Data in Table (15) indicate that both compounds and their concentrations caused increases on larval mortality percentages of spiny bollworm as compared with control. Averages of larval mortality percentage were 32.00, 15.00, 10, 67, 13, 00 and 11.33% for Esfenvalerate, Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron, respectively. It was (4.50 %) in check. Increasing concentration of each compound induced a gradual increase in larval mortality percentage.

Pupal duration:

Data presented in Table (15) indicate that pupal duration periods of spiny bollworm were non-significant and affected by both tested compound and concentration of each compound, except

all concentrations of Esfenvalerate which induced highly significant reduction in pupal duration.

The mean of pupal period decreased from 9.73 days in case of Chlorpyrifos to reach the shortest period of 8.28 days for Esfenvalerate, as compared with 10.00 days in control.

Pupal weight:

Results in Table (15) show that, weight of the pupae resulted from treated eggs was less in weight than from untreated eggs. These reductions in Pupal weights were significant with Thiodicarb, Hexaflumuron & Chlorfluazuron and non significant in case of both Esfenvalerate and chlorpyrifos.

The highest average Pupal weight of 0.0639 g / pupa was recorded with Esfenvalerate, while the lowest one 0.0545 gram/ pupa was recorded with Hexaflumuron, but was 0.0640 g / pupa, .in check. Also data reveal that increasing the concentration of the compound induced a gradual decrease in pupal weight.

Mortality percentages of pupae:

Table (15) show the effect of both compounds and their concentrations on mortality percentage of pupae, which resulted from treated eggs. The highest mean of pupal mortality percentage (18.00 %) was recorded for Esfenvalerate, while the lowest one of 9.00% was recorded for Chlorfluazuron. Increasing the concentration of each compound induced a gradual increase in pupal mortality percentage.

Percent of adult emergence:

Statistical analysis in Table (16) indicated that percent adult emergence was highly significant affected by both compounds and concentrations, but concentrations of Hexaflumuron was non significant.

The highest percent adult emergence of 91.00 % as recorded for Chlorfluazuron, whereas the lowest one of 82.00 % were recorded with Esfenvalerate, as compared with control (96.00 %).

All tested compounds caused decreases in adult emergence. Increasing the concentrations of each compounds induced a gradual decreasing in percent adult emergence.

Sex ratio:

The sex ratio of emerged adults resulted from treated eggs were shown in Table (16). Whereas non significant differences were found between the tested compounds and control in the sex ratio. In case of concentrations, these differences were highly significant for Chlorfluazuron, Thiodicarb and Chlorpyrifos and significant for Hexaflumuron and non significant for Esfenvalerate. The highest average of sex ratio (53.00%) was recorded with Chlorpyrifos, while the lowest one of 49.76 % was recorded with Thiodicarb, as compared with 45.00 % of check. All tested compounds caused increase in ratio, of emerged females compared with control.

Male longevity:

Data in Table (16) indicate that the applications of both compounds and their concentrations gave non significant differences in male longevity, except esfenvalerate concentrations which gave significantly differences in male longevity.

Table (16): Effect of different concentrations of tested compounds on emergence, sex ratio and longevity of Adult stage of spiny bollworm, when one- day old eggs were treated using the dipping technique.

Compound	Conc. (ppm)	% Emergence	% Sex ratio as females	Male longevity (days)	Female longevity (days)
Insecticides:					
1-Esfenvalerate	0.0732	80.50c	50.00	10.00b	14.00b
	0.0366	82.00bc	58.68	11.25b	15.00ab
	0.0183	83.50b	40.67	12.00ab	15.50ab
	Mean	82.00C	49.78	11.08	14.83B
	Control	96.00a	45.00	16.00a	18.50a
	F-test for concentration	**	N.S.	*	*
2-Chlorpyrifos	0.146	83.00d	53.00a	12.20	18.25
	0.073	87.00c	52.00a	12.45	18.35
	0.036	91.00b	54.00a	12.55	18.50
	Mean	87.00B	53.00	12.40	18.37A
	Control	96.00a	45.00b	16.00	18.50
	F-test for concentration	**	**	N.S.	N.S.
3-Thiodicarb	0.976	87.00c	50.00b	12.50	18.00
	0.488	91.00bc	57.00a	14.00	18.50
	0.244	93.00ab	42.28c	15.00	18.50
	Mean	90.33B	49.76	13.83	18.33A
	Control	96.00a	45.00bc	16.00	18.50a
	F-test for concentration	**	**	N.S.	N.S.
IGR's:					
1-Hexaflumuron	0.718	88.00	53.00a	12.50	14.00b
	0.391	89.00	46.15bc	14.00	14.50b
	0.195	91.00	50.00ab	15.00	15.00b
	Mean	89.33B	49.72	13.83	14.50B
	Control	96.00a	45.00c	16.00	18.50a
	F-test for concentration	N.S.	*	N.S.	**
2-Chlorfluazuron	0.781	90.00b	46.15c	11.50	14.00
	0.391	91.00b	51.00b	13.00	15.00
	0. 195	92.00b	56.00a	14.00	16.00
	Mean	91.00B	51.05	12.83	15.00B
	Control	96.00a	45.00c	16.00	18.50
	F-test for concentration	**	**	N.S.	N.S.
Control		96.00A	45.00	16.00	18.50A
F-test for compounds		**	N.S.	N.S.	**

L.S.D at 5%
N.S. = non significant * = significant ** = highly significant

Mean of male longevities were 11.08, 12.40, 13.83, 13.83 and 12.83 for Esfenvalerate, Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron, respectively. It was 16.00 days in check. Also, results in the same table reveal that increasing the concentration of each compounds induced a gradual decreasing in male longevity.

Female longevity:

As clearly shown from the data in Table (16) female longevity was highly significant affected by the treatment by Esfenvalerate, Hexaflumuron and Chlorfluazuron, while concentrations of Esfenvalerate and Hexaflumuron only induced significant reduction in female longevity comparing with control.

The highest female longevity (18.37) days was recorded with chlorpyrifos, while, the lowest one (14.50) days was recorded with Hexaflumuron, as compared with 18.50 days of check. Increasing the concentration of the compounds induced a gradual decreasing in female longevity.

Pre- oviposition period:

Statistical analysis of data in Table (17) showed that pre-oviposition periods were increased with all tested compounds except for Esfenvalerate, which was equal to control. The increase of pre-oviposition periods was significant with Chlorpyrifos, Thiodicarb and Hexaflumuron treatments, comparing with control.

The longest pre-oviposition period of (7.17 days) was recorded for Thiodicarb, while the lowest one (5.00 days) was with Esfenvalerate which equal to control (5 days). Increasing the concentration of each compounds induced a gradual prolonged pre-oviposition period.

Table (17): Effect of different concentrations of tested compounds on oviposition periods, number of deposited eggs and hatchability of eggs of adult moths of spiny bollworm, when one- day old eggs were treated using the dipping technique.

Compound	Conc. (ppm)	Pre-oviposition (days)	Oviposition (days)	Post oviposition (days)	Number of laid eggs /females	Incubation period of eggs	% Hatchability of eggs
Insecticides:							
1-Esfenvalerate	0.0732	5.50	1.00d	7.50a	13.00c	4.80	85.00c
	0.0366	5.00	3.25c	6.75ab	15.00c	4.50	88.00bc
	0.0183	4.50	5.00b	6.00b	28.00b	4.35	91.00b
	Mean	5.00C	3.08C	6.75B	18.67BC	4.55	88.00AB
	Control	5.00	9.00a	4.50c	71.00a	4.30	95.00a
	F-test for concentration	N.S.	**	**	**	N.S.	**
2-Chlorpyrifos	0.146	7.00a	6.00b	5.25	37.00c	5.10a	89.00b
	0.073	6.80a	6.20b	5.35	39.00bc	4.80ab	91.00b
	0.036	6.50a	6.50b	5.50	41.00b	4.65bc	94.00a
	Mean	6.76A	6.23B	5.38C	39.00B	4.85	91.33A
	Control	5.00b	9.00a	4.50	71.00a	4.30c	95.00a
	F-test for concentration	*	*	N. S.	**	**	**
3-Thiodicarb	0.976	8.00a	1.00d	9.00a	8.00c	5.00	83.00b
	0.488	7.50a	2.50c	8.50a	11.00b	4.70	85.00b
	0.244	6.00ab	4.00b	8.50a	18.00b	4.40	88.00b
	Mean	7.17A	2.50C	8.67A	12.33C	4.70	85.83AB
	Control	5.00b	9.00a	4.50c	71.00a	4.30	95.00a
	F-test for concentration	*	**	*	**	N.S.	**
IGR's:							
1-Hexaflumuron	0.718	7.00	1.00d	6.00	10.00d	4. 90a	80.00c
	0.391	6.50	3.00c	5.00	25.00c	4.60ab	82.00bc
	0.195	6.00	4.50b	4.50	45.00b	4.20b	85.00b
	Mean	6.50AB	2.83C	5.17C	22.67BC	4.57	82.33B
	Control	5.00	9.00a	4.50	71.00a	4.30b	95.00a
	F-test for concentration	N.S.	**	N.S.	**	*	**
2-Chlorfluazuron	0.781	6.00	4.33b	3.66	16.00d	4.70	81.00b
	0.391	5.50	5.00b	4.50	30.00c	4.50	82.50b
	0.195	5.00	5.50b	5.50	62.00b	4.00	84.00b
	Mean	5.50BC	4.94BC	4.55C	36.BC	4.40	82.42B
	Control	5.00	9.00a	4.50	71.00a	4.30	95.00a
	F-test for concentration	N.S.	**	N.S.	**	N.S.	**
Control		5.00BC	9.00A	4.50C	71.00A	4.30	95.00A
F-test for compounds		**	**	**	**	N.S.	*

L.S.D at 5%

N.S. = non significant * = significant ** = highly significant

Oviposition period:

Table (17) show the effects of tested insecticides and IGR's on oviposition period .It is found that these compounds and their concentrations, were negatively affected on pre-oviposition period. The highest oviposition period (6.23 days) was recorded for Chlorpyrifos, while, the lowest one (2.50 days) was recorded for Thiodicarb, as compared with 9.00 days in check. Increasing the concentration of all compounds induced a gradually shortened oviposition period. Generally, all compounds caused shortened oviposition period.

Post oviposition period:

Data in Table (17) show that the average of post-oviposition periods of spiny bollworm moths resulted from eggs treated with different concentrations of tested compounds were longer than control, and these increases were significant for Esfenvalerate and Thiodicarb. The longest post -oviposition period (8.67 days) was recorded for Thiodicarb, while the lowest one (4.55 days) was recorded for Chlorfluazuron. Increasing the concentration of all compounds induced gradually prolonged post oviposition period, except for Chlorfluazuron concentrations which were caused shortened post oviposition periods.

Number of deposit eggs / female:

Data given in Table (17) indicated that there are highly significant effects of both compounds and its concentrations on number of deposit eggs / female. The highest number of deposit eggs / female (39.00 eggs / female) was recorded with

Chlorpyrifos, while the lowest number (12.33 eggs / female) was recorded for Thiodicarb. This number was (71.00 eggs / female) in the checkl. Also, increasing the concentration of each compound induced a gradual reduction in number of deposit eggs / female.

Incubation period of eggs:

Data presented in Table (17) show that the effects of the concentrations of Chlorpyrifos and Hexaflumuron on incubation period of eggs were highly significant and significant, respectively.While; the other compounds were non-significant.

The highest mean of incubation period of eggs (4.85 days) was recorded with Chlorpyrifos, while, the lowest one (4.40 days) was recorded with Chlorfluazuron, as compared with (4.30 days) of control. Increasing the concentration of each compound induced a gradual increase in incubation period of eggs.

Hatchability of eggs:

Data in Table (17) showed the effect of all tested compounds and their concentrations on hatchability percentages of eggs laid by females resulted from treated eggs. The effects of concentrations of each compound were highly significant in reducing the percent of hatched eggs. Whereas, hatchability percentages were 88.00, 91.33, 85.83, 82.33 and 82.42% for Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron, respectively. Increasing the concentration of each compound induced a gradual decrease in hatchability of eggs.

From the above mentioned results it could be concluded that all tested compounds and their concentrations affected significantly or non significantly on the most biological aspects of pink and

spiny bollworms, when one- day old eggs were treated using the dipping technique.

Whereas, it is appeared that increasing the concentration of all tested compounds induced a gradual increases in mortality of larvae and pupae and a gradual prolonged incubation period of eggs, larval and pupal durations, except that of Esfenvalerate, Thiodicarb and Chlorpyrifos which shortened the pupal duration of pink bollworm. Also, indicated a gradual prolonged pre–oviposition period except Thiodicarb and Chlorfluazuron whereas, they shortened pre-oviposition period for pink bollworm and they prolonged post oviposition period except Chlorpyrifos and Chlorfluazuron whereas, they shortened post-oviposition period for spiny boll worm.

On the other hand, increasing the concentrations of all tested compounds induced a gradual decrease in larval and pupal weight, adult emergence, number of deposit eggs / female and hatchability of eggs and a gradual shortened male and female longevity, except Hexaflumuron, which prolonged pink bollworm male longevity and oviposition period. Also, all tested compounds caused decreased in sex ratio of pink bollworm, while increased that belonging spiny bollworm.

Similar results were obtained by some authors such as; **Hussein *et al.* (1985)** who estimate the ovicidal activity of Chlorfluazuron (IGR), Chlorpyrifos, Cyanophos, Metonym, Fenpropathrin and Fenvalerate against the American bollworm. Data show that the larval duration was prolonged when Chlorfluazuron was treated against eggs, most of the tested insecticide prolonged the pupal period especially Chlorfluazuron ,

the weight of pupae treated in the eggs stage were generally thinner than the check,. The rate of adult emergence and adult longevity were decreased by using Chlorfluazuron. Also **shaaban and Ibrahim (1993)** found that the newly hatched larvae of spiny bollworm which were emerged from the previously treated eggs with three Benzoyl phenyl urea's (IGRs) (using dipping method) had been reduced weights and prolonged life span. As a results of a residual effect of the compounds, the pupation percentage and adult emergence percentage were reduced .The same conclusion was obtained by **Mohamady (2000)** who found that the percentages of pupae and adult emergence of cotton leafworm obtained from the different treatments of insecticides on 1 and 2 day- old eggs were clearly reflected on the total mortality percent. The highest values of total mortality were obtained with Profenofos.

3.2. Newly hatched larvae treated with tested compounds by using direct exposure technique:

2.1. Pink bollworm

Larval duration.

Statistical analysis of variance of data given in Table (18) indicates that effects of both insecticides and concentrations of each were highly significant on the larval duration, with exception of Esfenvalerate, which gave significant differences. The longest average of larval duration period (15.26 days) was obtained with Thiodicarb, while the shortest one (13.78 days) was recorded for Esfenvalerate, as compared with 13.40 days in the check.

Table (18): Effect of different concentrations of tested compounds on duration, weight and mortality percentage of larvae and pupae of pink bollworm, when newly hatched larvae were treated using direct exposure (residual film) technique.

Compound	Conc. (ppm)	Larval duration (days)	Larval weight (gram)	% mortality of larvae	Pupal duration (days)	Pupal weight (gram)	% mortality of pupae
Insecticide							
1-Esfenvalerate	0.292	13.97a	0.0346	40.00a	7.50b	0.0222	12.79a
	0.146	13.82ab	0.0350	23.33ab	8.51a	0.0231	11.06a
	0.073	13.55bc	0.0352	21.67ab	8.51a	0.0238	7.19a
	Mean	13.78C	0.0349B	28.33B	8.17B	0.0232C	10.34
	Control	13.40c	0.0355	5.00b	8.51a	0.0242	5.00b
	F-test for concentration	*	N.S.	*	*	N.S.	**
2-Chlorpyrifos	2.34	14.57a	0.0274b	66.67a	7.67b	0.0211b	10.00a
	1.17	14.52a	0.0286b	55.00b	7.71b	0.0235a	8.00ab
	0.58	14.47a	0.0293b	50.00b	8.21ab	0.0236a	7.56ab
	Mean	14.52B	0.0284D	57.22A	7.86B	0.0227C	8.52
	control	13.40b	0.0355a	5.00c	8.51a	0.0242a	5.00b
	F-test for concentration	**	*	**	*	**	*
3-Thiodicarb	31.25	15.33a	0.0263b	63.33a	8.40	0.0237b	27.38a
	15.62	15.23a	0.0325a	25.00b	8.45	0.0240b	10.55ab
	7.81	15.22a	0.0327a	21.67b	8.50	0.0242a	7.81b
	Mean	15.26A	0.0305CD	46.67AB	8.45B	0.0240BC	15.25
	control	13.40b	0.0355a	5.00c	8.51	0.0242b	5.07b
	F-test for concentration	**	**	**	N.S.	*	*
IGR's							
1-Hexaflumuron	6.25	15.50a	0.0393ab	42.50a	9.60a	0.0260	18.18
	3.12	15.25ab	0.0396ab	28.33b	9.57ab	0.0263	17.42
	1.56	14.98b	0.0450a	28.33b	9.10b	0.0288	16.66
	Mean	15.24A	0.0413A	33.05B	9.36A	0.0270A	17.42
	Control	13.40c	0.0355b	5.00c	8.51c	0.0242	5.00
	F-test for concentration	**	*	**	**	N.S.	N.S.
2-Chlorfluazuron	6.25	14.48a	0.0320	48.33a	9.52a	0.0243	10.56
	3.12	14.61a	0.0339	28.00ab	9.10b	0.0262	9.80
	1.56	14.73a	0.0339	20.00bc	9.05b	0.0260	9.05
	Mean	14.73B	0.0333BC	32.22B	9.22A	0.0255AB	9.80
	Control	13.40b	0.0355	5.00c	8.51c	0.0242	5.00
	F-test for concentration	**	N.S.	*	**	N.S.	N.S.
Control		13.40D	0.0355B	5.00C	8.51B	0.0242BC	5.00
F-test for compounds		**	**	**	**	**	N.S.

L.S.D at 5%

N.S. = non significant * = significant ** = highly significant

Increasing the concentration of Esfenvalerate, Chlorpyrifos, thiodicarb and Hexaflumuron induced gradual prolonged larval duration, inverse trend was observed for Chlorfluazuron compound.

Larval weight:

Data presented in Table (18) indicate that the tested compounds differed in their effect on larval weight. i. e. Chlorpyrifos and Thiodicarb significantly decreased larval weight, while Hexaflumuron increased it significantly. On the other hand, weight of larvae resulted from newly hatched larvae treated with Esfenvalerate and chlorfluazuron was in par with larvae of control. The highest weight of larva was 0.0413 gram/ recorded with larvae fed on the diet treated with Hexaflumuron, while the lowest one (0.0284 gram / larva) was recorded with Chlorpyrifos .

The influence of concentrations of each compound proved to be insignificant for Esfenvalerate and Chlorfluazuron, while it was significant for Chlorpyrifos and Hexaflumuron and highly significant for Thiodicarb.

Increasing the concentrations of all tested compounds induced a gradual decrease in larval weight.

Larval mortality percentage:

Results in Table (18) reveal that the larval mortality percentages of pink bollworm increased as influenced by all tested compounds as compared with untreated larvae (control). The highest average percentage of larval mortality of 57.22 % was recorded for chlorpyrifos, while, the lowest percentage of 28.33 % was recorded with Esfenvalerate but was 5% in control.

The influence of different concentrations of each compound on this biological aspect proved to be highly significant for Chlorpyrifos, Thiodicarb and hexaflumuron and significant for Esfenvalerate and Chlorfluazuron. Increasing the concentration of all tested compounds induced a gradual increase in larval mortality percentages.

Pupal duration:

Analysis of variance of the results in Table (18) proves that pupal period was highly significantly prolonged by Hexaflumuron and Chlorfluazuron treatments. The effect of changing the serial concentrations of each compound varied according to the insecticide, as it was insignificant for Thiodicarb, significant for Esfenvalerate and Chlorpyrifos, and highly significant for Hexaflumuron and Chlorfluazuron. The longest Pupal period was 9.36 days for Hexaflumuron, while, the lowest one (7.86 days) was recorded for Chlorpyrifos, as compared with 8.51 days in check. Generally, it could be concluded that Esfenvalerate, Chlorpyrifos and Thiodicarb caused a highly significant shortened pupal duration, mean while; the inverse is true in case of Hexaflumuron and Chlorfluazuron compounds. Increasing the concentrations of Hexaflumuron and Chlorfluazuron induced a gradually prolonged Pupal duration and inverse trend was observed for Chlorpyrifos, Thiodicarb and Esfenvalerate compounds.

Pupal weight:

Data presented in Table (18) show that all tested compounds were non significant in their effect on pupal weight except Hexaflumuron which was significantly increased pupal weight. The

highest average weight of 0.027gram / larva was recorded with Hexaflumuron compound, while, the lowest weight of 0.0227 gram / larva was recorded with Chlorpyrifos, as compared with 0.0242 gram / larva of control.

The effect of changing their serial concentrations varied according to the compound as it was insignificant with Esfenvalerate, Hexaflumuron and Chlorfluazuron, significant for Thiodicarb and highly significant for Chlorpyrifos.

Generally, Esfenvalerate, Chlorpyrifos and Thiodicarb caused a highly significant reduction in pupal weight, inverse trend was observed for Hexaflumuron and Chlorfluazuron compounds. Increasing the concentrations of Esfenvalerate, Chlorpyrifos, Thiodicarb and Hexaflumuron induced a gradual decrease in pupal weight, while in case of Chlorfluazuron, there is no distinct trend for the effect of concentration on pupal weight.

Pupal mortality percentage:

Statistical analysis of data in Table (18) indicate that the effects of compound on pupal mortality percentage were not significant. The highest average percentage of pupal mortality was 17.42 % for Hexaflumuron, while, the lowest percentage was 8.52% for Chlorpyrifos.

The influence of concentration of each compound proved to be insignificant for Hexaflumuron and Chlorfluazuron, significant for Chlorpyrifos and Thiodicarb and highly significant for Esfenvalerate. Increasing the concentration of all tested compounds induced a gradual increase in pupal mortality percentages.

Percent of adults emergence:

Data in Table (19) indicate that percent of adults emergence from a live pupae was insignificantly affected by different tested compound, whereas Hexaflumuron induced less percent of adults emergence, (82.85 %). Esfenvalerate caused the highest percent of emergence (92.41%), comparing with 95.0 % for untreated larvae .

The effect of changing their serial concentrations varied according to the compound as it was insignificant for chlorpyrifos, hexaflumuron and chlorfluazuron, significant for thiodicarb and highly significant for esfenvalerate. Increasing the concentration of each compound induced a gradual decrease in adults emergence.

Sex ratio of emerged adults:

As shown from data presented in Table (19) the effect of tested compounds on sex ratio were insignificant for the tested compounds and their concentrations except the concentration of thiodicarb, which proved to be significant.

Male longevity:

Statistical analysis of data in Table (19) shows that the effects of both compounds and their concentrations were not significant. Increasing the concentrations of each compound induced a gradual decrease in male longevity.

Female longevity:

Also, data in Table (19) show there are significant effects of Esfenvalerate and Thiodicarb compound on female longevity. The longest longevity (17.17 days) was recorded with Chlorfluazuron, while, the lowest one (13.24 days) was recorded with Esfenvalerate. But, female longevity was 16.25 days in control.

Table (19): Effect of different concentrations of tested compounds on emergence, sex ratio and longevity of adult moths of pink bollworm, resulted from treated newly hatched larvae.

Compound	Conc. (ppm)	% Emergence	% Sex ratio as female	Male longevity (days)	Female longevity (days)
Insecticide					
1-Esfenvalerate	0.292	87.21b	59.80	17.45	11.69b
	0.146	88.97b	51.62	18.45	13.68ab
	0.073	92.81a	57.96	18.80	14.36ab
	Mean	92.41	56.44	18.23	13.24C
	Control	95.00a	47.46	18.87	16.25a
	F-test for concentration	**	N.S.	N.S.	*
2-Chlorpyrifos	2.34	90.00	53.33	17.25	13.65
	1.17	92.00	48.38	18.27	14.75
	0.58	92.44	62.22	18.80	15.63
	Mean	91.48	54.64	18.11	14.68BC
	Control	95.00	47.46	18.87	16.25
	F-test for concentration	N.S.	N.S.	N.S.	N.S.
3-Thiodicarb	31.25	72.62b	44.23b	18.00	13.00b
	15.62	89.45ab	57.55a	18.15	14.00b
	7.81	92.19a	50.00ab	18.80	13.19b
	Mean	84.75	50.59	18.32	13.40C
	Control	95.00a	47.46ab	18.87	16.25a
	F-test for concentration	*	*	N.S.	*
IGR's					
1-Hexaflumuron	6.25	81.82	47.27	18.00	15.85
	3.12	82.58	34.52	18.50	15.53
	1.56	83.34	42.46	18.80	15.72
	Mean	82.58	41.42	18.43	15.70AB
	Control	95.00	47.46	18.87	16.25
	F-test for concentration	N.S.	N.S.	N.S.	N.S.
2-Chlorfluazuron	6.25	89.44	49.84	18.60	17.33
	12	90.20	54.98	18.75	17.31
	1.56	90.95	59.10	18.80	16.88
	Mean	90.20	54.64	18.72	17.17A
	Control	95.00	47.46	18.87	16.25
	F-test for concentration	N.S.	N.S.	N.S.	N.S.
Control		95.00	47.46	18.87	16.25AB
F-test for compounds		N.S.	N.S.	N.S.	**

L.S.D at 5%

N.S. = non significant * = significant ** = highly significant

The influence of concentrations of each compound proved to be insignificant for Chlorpyrifos, Hexaflumuron and Chlorfluazuron and significant for esfenvalerate and Thiodicarb.

Generally, it can be mentioned that Esfenvalerate, Chlorpyrifos, Thiodicarb and Hexaflumuron caused reduction in female longevity, mean while, the inverse is true in case of Chlorfluazuron.

Pre – oviposition period:

Analysis of variance of the results arranged in Table (20) proved that pre-oviposition periods were insignificant affected by different tested compounds except that of thiodicarb which caused significantly prolonged pre-oviposition period. But, the effect of changing their serial concentrations varied according to tested compound as it was insignificant for all tested compounds except Chlorfluazuron, which caused highly significant change. The longest pre-oviposition period (2.90 days) was recorded with thiodicarb, while, the shortest one was (1.66 days) with Hexaflumuron, as compared with 2.10 days in check. Increasing the concentration of Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron induced a gradually prolonged pre-oviposition period, while in case of Esfenvalerate, there is no distinct trend for the effect of concentration on pre-oviposition period.

Oviposition period:

As shown from the data presented in Table (20) it can be observe that Hexaflumuron and Chlorfluazuron significantly prolonged the oviposition period, while esfenvalerate and thiodicarb significantly shorten it. Whereas, the longest oviposition

Table (20): Effect of different concentrations of tested compounds on oviposition periods, deposited eggs and hatchability of eggs of pink bollworm female resulted from treated newly hatched larvae.

Compound	Conc. (ppm)	Pre-oviposition (days)	Oviposition (days)	Post oviposition (days)	Number of laid eggs /female	Incubation period of eggs	% Hatchability of eggs
Insecticide							
1-Esfenvalerate	0.292	2.10	4.70c	4.89	89.10d	5.33	85.14b
	0.146	2.10	6.79b	4.79	129.96c	5.27	88.74ab
	0.073	2.10	7.52b	7.74	170.64b	5.25	92.51a
	Mean	2.10B	6.34D	5.81A	129.70C	5.28B	88.90BC
	Control	2.10	9.42a	4.73	225.00a	5.12	93.70a
	F-test for concentration	N.S.	**	N.S.	**	N.S.	*
2-Chlorpyrifos	2.34	2.15	8.33	3.17	150.33b	5.71a	84.24b
	1.17	2.12	8.50	4.13	174.22b	5.60a	89.18ab
	0.58	2.10	8.86	4.67	181.75ab	5.55a	89.40ab
	Mean	2.13B	8.56BC	3.99ABC	168.77BC	5.62A	87.61C
	Control	2.10	9.42	4.73	225.00a	5.12b	93.70a
	F-test for concentration	N.S.	N.S.	N.S.	*	*	*
3-Thiodicarb	31.25	3.50	7.00b	2.50b	116.50c	5.00	91.15
	15.62	3.10	8.70a	2.20b	128.10c	5.40	92.00
	7.81	2.10	8.86a	2.23b	167.36b	5.18	93.00
	Mean	2.90A	8.19CD	2.31C	137.32C	5.26B	92.05AB
	Control	2.10	9.42a	4.73a	225.00a	5.12	93.70
	F-test for concentration	N.S.	**	**	**	N.S.	N.S.
IGR's							
1-Hexaflumuron	6.25	1.71	11.43	2.71b	182.57c	5.60a	87.42
	3.12	1.65	10.25	3.63ab	194.50bc	5.51a	91.00
	1.56	1.62	10.25	3.85ab	220.85ab	5.51a	92.00
	Mean	1.66B	10.64AB	3.40BC	199.13AB	5.54A	90.14ABC
	Control	2.10	9.42	4.73a	225.00a	5.12b	93.70
	F-test for concentration	N.S.	N.S.	*	*	*	N.S.
2-Chlorfluazuron	6.25	2.33a	12.00a	3.00b	198.25b	5.69	92.00
	3.12	1.46b	12.00a	3.85ab	220.00a	5.61	93.00
	1.56	1.25b	10.88ab	4.75a	235.63a	5.60	93.00
	Mean	1.68B	11.63A	3.87BC	217.63A	5.63A	92.67AB
	Control	2.10a	9.42b	4.73a	225.00ab	5.12	93.70
	F-test for concentration	**	*	*	**	N.S.	N.S.
Control		2.10B	9.42B	4.73AB	225.00A	5.12B	93.70A
F-test for compounds		*	**	*	**	**	*

L.S.D at 5%

N.S. = non significant * = significant ** = highly significant

period (11.63 days) was recorded with Chlorfluazuron, while, the shortest one (6.34 days) was recorded with esfenvalerate, as compared with 9.42 day in check.

Generally, it was noticed that Esfenvalerate, Chlorpyrifos and Thiodicarb caused a highly significant shortened in oviposition period, mean while, the inverse is true in case of Hexaflumuron and Chlorfluazuron compounds. The influence of concentrations of each compound proved to be insignificant for Chlorpyrifos and Hexaflumuron, significant with Chlorfluazuron and highly significant for Esfenvalerate and Thiodicarb.

Post oviposition period:

Analysis of variance of the results arranged in Table (20) proved that post oviposition period shortened significantly with Thiodicarb. The effect of the to serial concentration was varied according to the insecticide where it was insignificant for Esfenvalerate and Chlorpyrifos, significant with Hexaflumuron and Chlorfluazuron, and highly significant for, Thiodicarb compound.

The longest post oviposition period was 5.81 days with Esfenvalerate, while, the shortest one (2.31 days) was recorded with Thiodicarb, as compared with 4.73 days in check. Generally, it can be mentioned that Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron caused a significant shortened post oviposition period, the inverse is true in case of Esfenvalerate compound.

Number of deposited eggs / female:

Statistical analysis of variance of the data given in Table (20) indicate that all tested compounds decreased the number of deposited eggs / female. These decreases were significant with

esfenvalerate, Chlorpyrifos and Thiodicarb. The effects of concentrations of each compound as compared with control proved to be highly significant for Esfenvalerate, Thiodicarb, and Chlorfluazuron, while it was significant with Chlorpyrifos and Hexaflumuron. Means number of laid eggs / female decreased from 225.0 eggs / female in untreated check to 217.63, 199.13, 168.77, 137.32 and 129.70 eggs / female in Chlorfluazuron, Hexaflumuron, Chlorpyrifos, Thiodicarb and Esfenvalerate treatments, respectively. Increasing the concentrations of each compound induced a gradual reduction in number of deposited eggs / female.

Incubation period of eggs:

Data presented in Table (20) show that all tested compounds induced prolongation in incubation periods comparing with control, which were significant for Chlorpyrifos, Hexaflumuron and Chlorfluazuron. The highest average incubation period of eggs of 5.63 days was recorded with Chlorfluazuron compound, while, the lowest period of 5.26 days was recorded with Thiodicarb compound as compared with 5.12 days in control. The influence of concentrations of each compound proved to be insignificant for Esfenvalerate, Thiodicarb and Chlorfluazuron and significant for Chlorpyrifos and Hexaflumuron. Increasing the concentration of each compound induced a gradual increase in incubation period of eggs.

Hatchability of eggs:

Statistical analysis of variance of the data given in Table (20) show that the percent of eggs hatching was significantly decreased

with Esfenvalerate, Chlorpyrifos and Hexaflumuron compound, but the effect of changing their serial concentrations varied according to tested compound as it was insignificant for Thiodicarb, Hexaflumuron and Chlorfluazuron and significant for Esfenvalerate and Chlorpyrifos.

Generally, it can be conclude that all tested compounds caused a considerable failure of the insect embryonic development showing the lowest average percentages of eggs hatchability comparing with that of untreated larvae. In all tested compounds, hatchability percentages of eggs was the highest in low concentrations of each and gradually decreased by increasing the concentration.

3.2.2. Spiny bollworm

Larval duration:

Data given in Table (21) show that the three tested concentrations of all tested compounds were highly significant prolonged the larval duration but concentrations of Hexaflumuron gave significant differences as compared with untreated check, whereas the shortest duration of larval stage was (15.47 days) recorded in untreated check. The longest larval period (20.34 days) was recorded with Chlorfluazuron, while, the shortest one (16.10 days) was recorded with Chlorpyrifos. Increasing the concentration of any tested compound gradual prolonged the larval duration with highly significant differences between them.

Larval weight:

Data in Table (21) indicate that thiodicarb caused highly significant reduction in larval weight, but Hexaflumuron and Chlorfluazuron showed significant reduction , while Esfenvalerate

Table (21): Effect of different concentrations of tested compounds on duration, weight and %mortality of larvae and pupae of spiny bollworm when newly hatched larvae were treated using direct exposure (residual film) technique.

Compound	Conc. (ppm)	Larval duration (days)	Larval weight (gram)	% mortality of larvae	Pupal duration (days)	Pupal weight (gram)	% mortality of pupae
Insecticide							
1-Esfenvalerate	0.292	17.53a	0.0819	50.00a	10.54	0.0555c	15.00
	0.146	17.45a	0.0830	47.78a	10.65	0.0615bc	11.24
	0.073	17.21a	0.0841	14.33b	10.76	0.0660a	10.00
	Mean	17.40C	0.0830A	37.37A	10.65A	0.0610AB	12.10BC
	Control	15.47b	0.0845	5.00b	10.76	0.0662ab	5.00
	F-test for concentration	**	N.S.	**	N.S.	**	N.S.
2-Chlorpyrifos	2.34	16.27a	0.0790	55.00a	7.80c	0.0539b	16.67a
	1.17	16.00a	0.0810	35.00b	9.19b	0.0562b	10.00b
	0.58	16.00a	0.0814	20.00c	10.70a	0.0662a	9.00b
	Mean	16.10D	0.0801A	36.67A	9.23B	0.0588AB	11.89BC
	Control	15.47b	0.0845	5.00d	10.76a	0.0662a	5.00c
	F-test for concentration	**	N.S.	**	**	**	**
3-Thiodicarb	31.25	17.48a	0.0581b	56.05a	11.46a	0.0466b	16.00
	15.62	17.50a	0.0588b	43.89a	10.66ab	0.0466b	15.00
	7.81	16.72b	0.0698b	36.67a	10.40b	0.0508b	13.89
	Mean	17.23C	0.0622C	45.54A	10.84A	0.0480C	14.69B
	Control	15.47b	0.0845a	5.00b	10.76ab	0.0662a	5.00
	F-test for concentration	**	**	**	*	**	N.S.
IGR's							
1-Hexaflumuron	12.5	18.95a	0.0718b	51.67a	11.33	0.0536b	20.63a
	6.25	18.80a	0.0728b	41.67a	11.15	0.0536b	19.06a
	3.12	18.76a	0.0725b	30.00b	11.05	0.0538b	17.49a
	Mean	18.84B	0.0724B	41.11A	11.17A	0.0537BC	19.06A
	Control	15.47b	0.0845a	5.00c	10.76	0.0662a	5.00b
	F-test for concentration	*	*	**	N.S.	**	*
2-Chlorfluazuron	12.5	20.50a	0.0707b	70.78a	10.83	0.0597	9.53a
	6.25	20.33a	0.0815a	66.71a	10.80	0.0621	9.50a
	3.12	20.20a	0.0792ab	41.67b	10.76	0.0640	9.50a
	Mean	20.34A	0.0771AB	59.46A	10.80A	0.0619A	9.51C
	Control	15.47b	0.0845a	5.00c	10.76	0.0662	5.00b
	F-test for concentration	**	*	**	N.S.	N.S.	*
Control		15.47E	0.0845A	5.00B	10.76A	0.0662A	5.00D
F-test for compounds		**	**	*	*	**	**

L.S.D at 5%

N.S. = non significant * = significant ** = highly significant

and Chlorpyrifos caused non-significant effect. All tested compoundes caused decrease in larval weight indicating averages of 0.0830, 0.0801, 0.0622, 0.0724 and 0.0771 gram / larva for, Esfenvalerate, Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron, respectively as compared with that recorded in check (0.0845 gram / larva). Also, increasing the concentration of each compound induced a gradual decreased in larval weight.

Mortality percentage of larvae:

The presented data in Table (21) show that mortality percentage of larvae of spiny bollworm increased significantly as influenced by tested compound, whereas the concentrations of all compounds caused highly significant increases in larval mortality percentages compared with untreated check. The highest percentage of larval mortality (59.46 %) was recorded with Chlorfluazuron, while, the lowest percentage (36.67 %) was recorded with Chlorpyrifos, while it was 5.00 % in untreated check.

Pupal duration:

Results obtained in Table (21) show that pupal duration of Chlorpyrifos was significantly decreased as compared with check larvae. The influence of different concentrations of each compound compared with control on the base of this biological aspect proved to be highly significant for chlorpyrifos and significant for thiodicarb, but non-significant for Hexaflumuron and chlorfluazuron.

Increasing the concentration of thiodicarb, Hexaflumuron and Chlorfluazuron induced a gradual prolonged Pupal duration, but Esfenvalerate and Chlorpyrifos induced gradual shortened Pupal

duration. The highest mean pupal duration (11.17 days) was recorded for Hexaflumuron, while, the lowest period (9.23 days) was recorded for Chlorpyrifos, as compared with (10.76 days) in control.

Pupal weight:

Data in Table (21) indicate that thiodicarb and hexaflumuron caused a highly significant reduction in pupal weight. From the same data it was noticed that increasing the different concentration of each compound induced a gradual decrease in pupal weight . The lowest mean of 0.0480 gram / pupa was recorded for thiodicarb, while, the highest weight (0.0619 gram / pupa) was recorded for Chlorfluazuron, as compared with 0.0662 gram / pupa in check.

Mortality percentage of pupae:

Results in Table (21) reveal that percentages of pupal mortality increased highly significantly as influenced by the tested compounds formulations as compared with untreated check. The lowest average percentage of pupal mortality (9.51%) was recorded for Chlorfluazuron, while the highest average (19.06%) was recorded for Hexaflumuron, as compared with (5.00%) in control. The three tested concentrations of all tested compounds as compared with untreated check increased mortality. This increase was high significant for Chlorpyrifos and significant for Hexaflumuron and Chlorfluazuron, but non-significant for Esfenvalerate and Thiodicarb.

Percent of adults emergence:

Data given in Table (22) estimate that all tested compounds reduced the moth's emergence as compared with control.

Table (22): Effect of different concentrations of tested compounds on emergence , sex ratio and longevity adult moths of spiny bollworm resulted from treated newly hatched larvae.

Compound	Conc. (ppm)	% Emergence	% Sex ratio as female	Male longevity (days)	Female longevity (days)
Insecticide					
1-Esfenvalerate	0.292	85.00	52.58	10.00	16.33
	0.146	88.76	56.11	10.83	17.00
	0.073	90.00	50.68	12.83	16.93
	Mean	87.92BC	53.12	11.22	16.75A
	Control	95.00	49.21	12.80	17.75
	F-test for concentration	N.S.	N.S.	N.S.	N.S.
2-Chlorpyrifos	2.34	88.33c	37.50	12.40	18.45
	1.17	90.00b	64.26	12.60	18.30
	0.58	91.00b	44.84	12.75	17.95
	Mean	88.11BC	48.87	12.58	18.23A
	Control	95.00a	49.21	12.80	17.75
	F-test for concentration	**	N.S.	N.S.	N.S.
3-Thiodicarb	31.25	84.00	46.99	12.00	13.00
	15.62	85.00	55.56	12.70	13.50
	7.81	86.11	47.69	12.70	14.50
	Mean	85.04C	50.10	12.47	13.67B
	Control	95.00	49.21	12.80	17.75
	F-test for concentration	N.S.	N.S.	N.S.	N.S.
IGR's					
1-Hexaflumuron	12.5	79.37b	25.24b	12.30	11.50b
	6.25	80.94b	47.31ab	12.50	12.26b
	3.12	82.51b	67.12a	12.80	14.25ab
	Mean	80.94D	46.56	12.53	12.67B
	Control	95.0a	49.21ab	12.80	17.75a
	F-test for concentration	*	*	N.S.	*
2-Chlorfluazuron	12.5	90.47b	63.00	12.33	11.00c
	6.25	90.50b	51.59	12.60	13.34bc
	3.12	90.50b	71.11	11.40	14.25b
	Mean	90.49B	61.90	12.11	12.86B
	Control	95.00a	49.21	12.80	17.75a
	F-test for concentration	*	N.S.	N.S.	**
Control		95.00A	49.21	12.80	17.75A
F-test for compounds		**	N.S.	N.S.	**

L.S.D at 5%

N.S. = non significant * = significant ** = highly significant

The highest emergence percentage (95%) was observed in control. Chlorfluazuron induced highest average of adult emergence percentage of (90.49%), while the lowest of 80.94 % was recorded for Hexaflumuron. Also, the obtained result reveal that the influence of concentrations of each compound on this biological aspect proved to be highly significant for Chlorpyrifos and significant for Hexaflumuron and Chlorfluazuron, but non-significant for Esfenvalerate and Thiodicarb. Increasing the concentration of all tested compounds induced a gradual decreased in adult emergence.

Sex ratio of emerged adults:

Analysis of variance of the data given in Table (22) indicate that sex ratio of both all tested compounds and their concentrations gave non significant effect with exception of those regarding Hexaflumuron concentration, which decreased sex ratio significantly. The highest percentage of sex ratio (61.90%) was recorded for Chlorfluazuron, while, the lowest of 46.56% was recorded for Hexaflumuron, as compared with 49.21% in control. In each compound, there are no distinct trends for the effect of concentrations on sex ratio of spiny bollworm.

Male longevity:

Data in Table (22) show that both all tested compounds and their tested concentrations caused non-significant reduction in male longevity.

The highest average of male longevity (12.58 days) was recorded for Chlorpyrifos, while, the lowest longevity (11.22 days) was recorded for Esfenvalerate as compared with control (12.80

days). Increasing the concentration of all tested compounds induced a gradual shortened male longevity.

Female longevity:

Data presented in Table (22) show that Thiodicarb, Hexaflumuron and Chlorfluazuron caused high significant decrease in female longevity developed from treated neonate larvae comparing with control..

Female longevity in control was 17.75 days, while, the highest longevity (18.23 days) was recorded for Chlorpyrifos and the lowest average (12.67 days) was recorded with Hexaflumuron.

The concentrations of each compound caused non-significant effect on female longevity with exception for those regarding Hexaflumuron, which caused significant while Chlorfluazuron caused highly significant, decreasing in female longevity.

Pre-oviposition period:

Table (23) reveal that esfenvalerate and Thiodicarb significantly prolonged Pre-oviposition period as compared with control.

All tested compounds and their concentrations caused in prolongation of pre-oviposition periods.

Oviposition period:

Table (23) show that all tested compounds decreased oviposition periods more less than that of control, which this decrease was significant for all tested compounds except that of Chlorpyrifos.

Table (23): Effect of different concentrations of tested compounds on oviposition periods, no. of deposited eggs and hatchability of eggs of spiny bollworm females resulted from treated newly hatched larvae.

Compound	Conc. (ppm)	Pre-oviposition (days)	Oviposition (days)	Post oviposition (days)	Number of laid eggs /female	Incubation period of eggs	% Hatchability of eggs
Insecticide							
1-Esfenvalerate	0.292	8.33a	1.00c	7.00	7.00c	5.50a	60.00b
	0.146	8.33a	2.17bc	6.50	16.0c	5.00ab	63.21b
	0.073	7.60ab	3.33b	6.00	38.17b	4.75bc	91.64a
	Mean	8.10A	2.17C	6.50A	20.39	5.10A	71.62B
	Control	5. 25b	6.50a	6.0	61.20a	4.50c	97.50a
	F-test for concentration	*	**	N.S.	**	**	**
2-Chlorpyrifos	2.34	6.89	6.00	5.56	35.67b	5.21	95.56
	1.17	6.00	6.30	6.00	35.0b	4.90	96.00
	0.58	5.50	6.45	6.0	40.00ab	4.82	97.00
	Mean	6.13BC	6.25A	5.85A	36.89	4.98AB	96.19A
	Control	5.25	6.50	6.00	61.20a	4.50	97.50
	F-test for concentration	N.S.	N.S.	N.S.	*	N.S.	N.S.
3-Thiodicarb	31.25	8.00a	3.00b	2.0b	9.50c	4.67	87.50
	15.62	7.00ab	4.00ab	2.50b	15.0bc	4.65	89.00
	7.81	6.00ab	5.00ab	3.50b	21.75b	4.60	92.71
	Mean	7.00AB	4.00B	2.67B	15.42	4.64BC	89.74A
	Control	5. 25b	6.50a	6.00a	61.20a	4.50	97.50
	F-test for concentration	*	*	*	**	N.S.	N.S.
IGR's							
1-Hexaflumuron	12.5	6.00	2.67b	2.83	11.33b	5.10a	90.00b
	6.25	5.50	3.38ab	3.38	16.25b	5.00a	95.00ab
	3.12	5.25	5.00ab	4.00	48.50a	4.73b	94.96ab
	Mean	5.58C	3.68BC	3.40B	22.03	4.94AB	93.32A
	Control	5.25	6.50a	6.00	61.20a	4.50c	97.50a
	F-test for concentration	N.S.	*	N.S.	**	**	*
2-Chlorfluazuron	12.5	7.00	3.00	1.00c	10.0c	5.30	92.00
	6.25	6.00	4.67	2.67bc	24.00b	5.00	94.00
	3.12	5.75	4.75	3.75b	57.00a	4.80	94.44
	Mean	6.25BC	4.14B	2.47B	30.33	5.03AB	93.48A
	Control	5.25a	6.50	6.00a	61.20a	4.50	97.50
	F-test for concentration	N.S.	N.S.	**	**	N.S.	N.S.
Control		5.25C	6.50A	6.00A	61.20	4.50C	97.50A
F-test for compounds		**	**	**	N.S.	*	*

L.S.D at 5%

N.S. = non significant * = significant ** = highly significant

Increasing the concentration of all compounds induced gradual shortened oviposition period. The mean of oviposition periods were 2.17, 3.68, 4.00, 4.14, 6.25 and 6.50 days for Esfenvalerate, Thiodicarb, Hexaflumuron, Chlorfluazuron, Chlorpyrifos and control, respectively.

Post- oviposition period:

Data in Table (23) show that all tested compounds shortened post oviposition period except Esfenvalerate which prolonged this biological aspect.

Increasing the concentration of all compounds induced gradual shortened post oviposition period with exception for those regarding Esfenvalerate which prolonged the post oviposition period.

Post oviposition period was highly significant affected with Thiodicarb, Hexaflumuron and Chlorfluazuron as compared with control, but the effect of changing their serial concentrations varied according to the insecticide as it was non-significant for Esfenvalerate, Chlorpyrifos and Hexaflumuron and highly significant for Chlorfluazuron, but significant for Thiodicarb.

Number of deposited eggs / female:

Table (23) show that the effects of tested compounds compare with control were non-significant, but the effect of the three concentrations of each compound compare with control were highly significant for Esfenvalerate, Thiodicarb, Hexaflumuron and Chlorfluazuron, whereas it was significant for Chlorpyrifos.

All tested compounds caused reduction in egg laying rate especially Thiodicarb that had the highest reduction rate compared with the other tested compounds.

Incubation period of eggs:

Data presented in Table (23) show that the incubation periods of eggs laid by emerged females resulted from larvae treated with tested compounds compared with untreated ones were significant except that of Thiodicarb.

The impact of different concentrations of each insecticide on this biological aspect was highly significant for Esfenvalerate and Hexaflumuron, but non-significant for Chlorpyrifos, Thiodicarb and Chlorfluazuron. As clearly shown from the present results, it could concluded that the tested compounds prolonged the duration of egg stage, indicating averages of 5.10, 4.98, 4.64, 4.94 and 5.03 days for the insecticides, Esfenvalerate, Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron, respectively, as compared with that recorded with check treatment (4.50 days). Increasing the concentration of each compound induced a gradual increase in incubation period of eggs.

Hatchability of eggs:

Results in Table (23) reveal that all tested insecticides and IGR's under study reduced the rate of hatchability percentage, whereas the Esfenvalerate gave highly delayed effect against rate of hatchability in spiny bollworm (71.628), but Chlorpyrifos had the least delayed effect on rate of hatchability (96.19 %), as compared with (97.50 %) in control.

The percent of egg hatching for Esfenvalerate treatment was significantly decreased compared with control, but the concentrations of each compound comparing to control caused highly significant for Esfenvalerate and significant for Hexaflumuron, but non-significant for Chlorpyrifos, Thiodicarb and Chlorfluazuron.

Increasing the concentration of each compound induced gradual decreasing in hatchability of eggs.

The results obtained revealed that both five tested compounds and the three concentrations of each compound affected significantly or non-significantly on the most biological aspects of pink and spiny bollworms when newly hatched larvae were treated using residual film technique. Increasing the concentration of all tested compounds induced a gradual increase in mortality of larvae and pupae and a gradual prolonged pre-oviposition period, with the exception of Hexaflumuron (IGR's) and Chlorfluazuron (IGR's) which caused shortened of pre-oviposition period, incubation period and larval duration with exception of Chlorfluazuron in pink bollworm which caused a gradual shortened larval duration.

Also pupal duration was gradually prolonged with hexaflumuron and Chlorfluazuron, but gradually shortened was recorded for Esfenvalerate; (Synthetic pyrethroid) Chlorpyrifos Organophosphorous) and Thiodicarb (Carbamate).

Also increasing the concentration of all tested compounds caused a gradual decrease in larval and pupal weight with the exception of Hexaflumuron and Chlorfluazuron which caused increasing in pupal weight, number of laid eggs/ female,

hatchability of eggs, adults emergence and a gradual shortened of oviposition period with the exception of Hexaflumuron and Chlorfluazuron which prolonged the oviposition period for pink bollworm and post oviposition period with the exception for Esfenvalerate in spiny bollworm which caused a gradual prolonged post oviposition periods, male longevity and female longevity with exception Chlorpyrifos in spiny bollworm that caused gradual prolonged in female longevity. All tested compounds caused increasing in sex ratio which was non-significant for pink bollworm and spiny bollworm.

The obtained these results are in similar with those obtained by **Rashad *et al.* (1993)** who found that the IGR compounds, S: 31183, Pyriproxyfen (JHA) and Precocene I and II greatly altered the development of treated larvae of pink and spiny bollworms.Also, **Abdel –Geliel (1997)** found that Fenpropathrin gave highest effect on larval duration, total larval and pupal duration, pupal weight, and adult longevity. On the other hand, **Abdel–Sattar** and **El-Guindy (1988)** indicated that triprene (ZR-619) applied to larvae of pink bollworm, increased the pupal duration, while duration of adult stage decreased. **Hegab (2002)** found that S-fenvalerate shortened oviposition, post oviposition, the larval weight and adult stage. **Amer (2004)** found that chinmix had highly effect on different biological aspects of pink and spiny bollworms.

3.3. Adult stage.

3.3.1. Pink bollworm.

Pre-oviposition period:

Analysis of variance of the data given in Table (24) indicate that Thiodicarb, Hexaflumuron and Chlorfluazuron significantly prolonged pre-oviposition period. The longest mean pre-oviposition period of (3.78 days) was recorded for Chlorfluazuron, while, the shortest period (1.00 day) was recorded for Chlorpyrifos, as compared with 2.00 days of control .

Increasing the concentration of all insecticides and IGR's induced a gradual prolonged pre-oviposition period, except that of Chlorpyrifos which all their tested concentrations gave pre-oviposition periods of (1day).

Oviposition period:

Table (24) show that all tested insecticides compared with control caused shortened oviposition period, which was significant only with Thiodicarb. The three concentrations of each insecticide caused highly significant with exception for Chlorfluazuron, which caused significant shorten.

Post oviposition period:

Data presented in Table (24) indicate that Thiodicarb and Hexaflumuron significantly increased post-oviposition period.

The highest average of 8.39 days was recorded for thiodicarb, while the lowest of 2.73 days was recorded for Chlorpyrifos, as compared with 3.00 days in control. Increasing the concentration of all compounds induced a gradual prolonged post oviposition period.

Table (24): Effect of different concentrations of tested compounds on biological aspects of adult stage of pink bollworm when treated by using direct exposure (the dry film techniques).

Compound	Conc. (ppm)	Pre-oviposition (days)	Oviposition (days)	Post-oviposition (days)	Female longevity (days)
Insecticide					
1-Esfenvalerate	0.146	3.00a	10.00c	4.00a	17.00b
	0.0732	2.50b	12.00b	3.50ab	18.00ab
	0.0366	2.00c	13.75a	3.25b	19.00a
	Mean	2.50BC	11.92A	3.58BC	18.00
	Control	2.00c	14.00a	3.00b	19.00a
	F-test for concentration	**	**	*	*
2-Chlorpyrifos	0.585	1.00	8.00c	2.50	11.50d
	0.292	1.00	12.50b	2.80	16.00c
	0.146	1.00	14.00a	2.90	17.90b
	Mean	1.00D	11.50A	2.73C	15.13
	Control	2.00	14.00a	3.00	19.00a
	F-test for concentration	N.S.	**	N.S.	**
3-Thiodicarb	1.953	4.33a	5.67c	8.67a	18.67
	0.976	3.50b	7.00c	8.50a	19.00
	0.488	2.00c	9.00b	8.00a	19.00
	Mean	3.11AB	7.22B	8.39A	18.89
	Control	2.0c	14.00a	3.00b	19.00
	F-test for concentration	**	**	**	N.S.
IGR's					
1-Hexaflumuron	3.125	3.33a	10.33c	4.33a	17.99
	1.563	3.33a	11.67bc	3.33b	18.33
	0.781	3.00b	12.50b	3.10b	18.60
	Mean	3.22AB	11.50A	3.59B	18.31
	Control	2.00c	14.00a	3.00b	19.00
	F-test for concentration	**	**	**	N.S.
2-Chlorfluazuron	3.125	4.33a	11.00c	3.50	18.83
	1.563	4.00a	12.00bc	3.00	19.00
	0.781	3.00b	13.00ab	3.00	19.00
	Mean	3.78A	12.00A	3.10BC	18.94
	Control	2.00c	14.00a	3.17	19.00
	F-test for concentration	**	*	N.S.	N.S.
Control		2.00CD	14.00A	3.00BC	19.00
F-test for compounds		**	*	**	N.S.

L.S.D at 5%
N.S. = non significant * = significant ** = highly significant

Table (24): Cont'd Effect of different concentrations of tested compounds on biological aspects of adult stage of pink bollworm when treated by using direct exposure (the dry film techniques).

Compound	Conc. (ppm)	Male longevity (days)	No. of laid eggs/female	Incubation period of eggs	% Hatchability of eggs
Insecticide					
1-Esfenvalerate	0.146	9.00d	105.33c	7.60a	81.00b
	0.0732	12.50c	129.33b	7.40a	82.00b
	0.0366	16.00b	153.33b	7.10a	84.00b
	Mean	12.50B	129.33BC	7.37A	82.33
	Control	21.00a	225.33a	5.50b	92.50a
	F-test for concentration	**	**	**	**
2-Chlorpyrifos	0.585	2.50c	107.00c	6.90a	82.00
	0.292	3.50b	205.00b	6.50ab	83.50
	0.146	4.00b	215.00ab	6.12b	84.80
	Mean	3.33C	175.67ABC	6.51B	83.43
	Control	21.00a	225.33a	5.50c	92.50
	F-test for concentration	**	**	**	N.S.
3-Thiodicarb	1.953	14.33	33.33d	8.50a	71.00c
	0.976	17.00	104.33c	8.03a	81.11b
	0.488	21.00	205.44b	7.96a	91.67a
	Mean	17.44A	114.37C	8.16A	81.26
	Control	21.00a	225.33a	5.50b	92.50a
	F-test for concentration	N.S.	**	**	**
IGR's					
1-Hexaflumuron	3.125	18.00c	201.00	6.76a	84.69b
	1.563	19.33b	212.00	5.27b	84.10b
	0.781	20.50a	220.00	5.13b	85.00b
	Mean	19.28A	211.00AB	5.72BC	84.60
	Control	21.00a	225.33	5.50b	92.50a
	F-test for concentration	**	N.S.	**	**
2-Chlorfluazuron	3.125	16.50c	208.00b	6.00	83.82c
	1.563	18.00bc	220.00ab	5.50	85.00c
	0.781	19.00ab	225.00a	5.50	88.54b
	Mean	17.83A	217.67A	5.67BC	85.79
	Control	21.00a	225.33a	5.50	92.50a
	F-test for concentration	**	*	N.S.	**
Control		21.00A	225.33A	5.50C	92.50
F-test for compounds		**	*	**	N.S.

L.S.D at 5%

N.S. = non significant * = significant ** = highly significant

Female longevity:

Data in Table (24) show that both compounds and concentrations caused non-significant shortened female longevity, except Esfenvalerate and Chlorpyrifos, which caused significant and highly significant decrease in female longevity, respectively, comparing with control. Increasing the concentration of each compound induced a gradual shortened female longevity indicating averages of 18.00, 15.13, 18.89, 18.31 and 18.94h days for the insecticides Esfenvalerate, Chlorpyrifos, Thiodicarb, and IGR's Hexaflumuron and Chlorfluazuron, respectively as compared with that recorded in check (19.00 days).

Male longevity:

Analysis of variance of the data given in Table (24) showed that the insecticides formulations of Esfenvalerate and Chlorpyrifos compared with control had highly significant effect on the longevity of male developed from treated adults.

Three concentrations of each insecticide compared with control caused highly significant reduction in longevity with exception for Thiodicarb which caused non significant effect. All insecticides shortened the longevity of male resulted from treated adults with means of 12.50, 3.33, 17.44, and 19.28 and 17.83 days for Esfenvalerate, Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron, respectively comparing with control (21.00 days). Increasing the concentration of each compound induced a gradual shortened in male longevity.

Number of deposited eggs / female:

Data in Table (24) indicate that most of the tested compounds caused reduction in the rate of laying eggs / female, which was significant with all compounds except Hexaflumuron and Chlorfluazuron.

Means number of deposited eggs / female decreased from 225.33 eggs / female in untreated check to 129.33, 175.67, 114.37, 211.00 and 217.67 eggs / female for Esfenvalerate, Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron, respectively.

Increasing the concentration of tested compounds induced a gradual reduction in number of laid eggs / female.

The effects of both compounds and concentrations on the number of laid eggs / female were significant for Chlorfluazuron, but Esfenvalerate, Chlorpyrifos and Thiodicarb caused highly significant with exception for Hexaflumuron which was non significant.

Incubation period of eggs:

Table (24) show that most of the tested compounds increased the incubation period of eggs laid by treated adults, this increase was significant with Esfenvalerate, Chlorpyrifos and Thiodicarb. The longest average incubation period was (8.16 days) for Thiodicarb, while the shortest of 5.67 days) was obtained in case of Chlorfluazuron as comparing with control (5.50 days).

Increasing the concentration of the tested compounds caused a gradual prolongation in incubation period.

Hatchability of eggs:

Results in Table (24) cont'd reveal that all tested insecticides nonsignificantly reduced the rate of hatchability percentage in all treatments. Thiodicarb gave highly delayed effect against rate of hatchability (81.26%), but lowest delayed effect (85.79%) caused by Chlorfluazuron, as compared with 92.50% in control. Increasing the concentration of tested insecticides induced gradual decrease percentages of egg hatching.

The percent of eggs hatching with different concentrations was non significant for chlorpyrifos, but Esfenvalerate, Thiodicarb, Hexaflumuron and Chlorfluazuron caused highly significant.

3.3.2. Spiny bollworm.

Pre-oviposition period:

Statistical analyses the data in Table (25) indicate that Esfenvalerate has a high effect on the prolongation of pre-oviposition period of all treatments, followed by Chlorpyrifos.

The effects of three concentrations of each compound were highly significant on prolonged pre-oviposition period, but Hexaflumuron and Chlorfluazuron caused non significant effect.

Increasing the concentration of insecticides induced prolonged pre oviposition period, with exception for Hexaflumuron, which induced shortened.

Mean of pre oviposition periods were 2. 25 days in untreated check, but in treated replicates the means were 6.17, 5.00, 3.17, 1.92 and 2.25 for Esfenvalerate, Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron, respectively.

Table (25): Effect of different concentrations of tested compounds on biological aspects of adult stage of spiny bollworm when treated by using direct exposure (the dry film techniques).

Compound	Conc. (ppm)	Pre-oviposition (days)	Oviposition (days)	Post-oviposition (days)	Female longevity (days)
Insecticide					
1-Esfenvalerate	0.146	7.00a	5.00	4.00c	16.00
	0.0732	6.00ab	6.00	5.00c	17.00
	0.0366	5.50b	6.50	8.50b	20.50
	Mean	6.17A	5.83AB	5.67AB	17.83AB
	Control	2.25c	5.00	6.50a	21.00
	F-test for concentration	**	N.S.	**	N.S.
2-Chlorpyrifos	2.343	6.00a	5.00	2.00c	13.00b
	1.171	5.00b	7.00	3.00c	15.00b
	0.585	4.00c	8.00	4.00b	16.00b
	Mean	5.00AB	6.67A	3.00C	14.67B
	Control	2.25d	5.00	6.50a	21.00a
	F-test for concentration	**	N.S.	**	*
3-Thiodicarb	1.953	4.00a	4.00b	7.00	15.00
	0.976	3.00b	6.00ab	8.00	17.00
	0.488	2.50b	7.00a	9.00	18.50
	Mean	3.17C	5.67AB	8.00A	16.83AB
	Control	2.25b	5.00ab	6.50	21.00
	F-test for concentration	**	*	N.S.	N.S.
IGR's					
1-Hexaflumuron	25.00	1.50	3.00	7.00	11.50c
	12.50	2.00	4.00	8.00	14.00bc
	6.25	2.25	4.50	9.00	15.75b
	Mean	1.92C	3.83B	8.00A	13.75BC
	Control	2.25	5.00	6.50	21.00a
	F-test for concentration	N.S.	N.S.	N.S.	**
2-Chlorfluazuron	25.00	4.00	1.00b	4.00b	9.00b
	12.50	3.50	1.50b	4.50ab	9.50b
	6.25	3.00	2.00b	5.50b	10.50b
	Mean	3.50BC	1.50C	4.67BC	9.67C
	Control	2.25	5.00a	6.50a	21.00a
	F-test for concentration	N.S.	**	*	**
Control		2.25C	5.00AB	6.50AB	21.00A
F-test for compounds		**	**	**	**

L.S.D at 5%

N.S. = non significant * = significant ** = highly significant

Table (25): Cont'd Effect of different concentrations of tested compounds on biological aspects of adult stage of spiny bollworm when treated by using direct exposure (the dry film techniques).

Compound	Conc. (ppm)	Male longevity (days)	No. of laid eggs/female	Incubation period of eggs	% Hatchability of eggs
Insecticide					
1-Esfenvalerate	0.146	14.00b	12.59b	4.80a	70.00d
	0.0732	16.00ab	13.50b	4.60ab	80.00c
	0.0366	19.00a	15.00b	4.45b	88.00b
	Mean	16.33AB	13.70DE	4.62A	79.33B
	Control	19.00a	59.00a	4.12c	94.00a
	F-test for concentration	*	**	**	**
2-Chlorpyrifos	2.343	8.00c	19.0c	4.20	82.00b
	1.171	12.50b	23.33bc	4.15	89.00b
	0.585	17.00a	27.00b	14.13	93.00a
	Mean	12.50BC	23.11CD	4.16B	88.00AB
	Control	19.00a	59.00a	4.12	94.00a
	F-test for concentration	**	**	N.S.	**
3-Thiodicarb	1.953	18.00	5.00c	4.17	65.00c
	0.976	18.50	9.67bc	4.15	69.42bc
	0.488	19.00	18.67b	4.12	73.00b
	Mean	18.50A	11.11E	4.15B	69.14C
	Control	19.00	59.00a	4.12	94.00a
	F-test for concentration	N.S.	**	N.S.	**
IGR's					
1-Hexaflumuron	25.00	11.50b	32.83c	4.24	85.00c
	12.50	12.00b	43.00b	4.20	89.00bc
	6.25	12.50b	55.16a	4.17	93.00ab
	Mean	12.00BC	43.66B	4.20B	89.00AB
	Control	19.00a	59.00a	4.12	94.00a
	F-test for concentration	**	**	N.S.	**
2-Chlorfluazuron	25.00	8.00b	28.00c	4.30	84.00c
	12.50	9.00b	32.00bc	4.25	90.00b
	6.25	11.00b	35.00 b	4.19	91.00b
	Mean	9.33C	31.67C	4.25B	88.33AB
	Control	19.00a	59.00a	4.12	94.00a
	F-test for concentration	**	**	N.S.	**
Control		19.00A	59.00A	4.12B	94.00A
F-test for compounds		**	**	**	**

L.S.D at 5%
N.S. = non significant * = significant ** = highly significant

Oviposition period:

Data in Table (25) show that, the Chlorfluazuron is the most effective chemical in decreasing the oviposition period in all treatments, followed by Hexaflumuron. Increasing the concentration of all insecticides induced gradual shortened oviposition period.

The average of oviposition periods was changed from 5.00 days in control to 5.83, 6.67, 5.67, 3.83 and 1.50 days with Esfenvalerate, Chlorpyrifos, Thiodicarb, Hexaflumuron and Chlorfluazuron, respectively. The effect of insecticide concentrations on oviposition period was highly significant with Chlorfluazuron but concentrations of Thiodicarb was significant, Esfenvalerate, Chlorpyrifos, and Hexaflumuron were non significant.

Post oviposition period:

Table (25) indicates that Chlorpyrifos and Chlorfluazuron significantly shorted post oviposition period, while Esfenvalerate, Thiodicarb and Hexaflumuron caused non –significant prolongation of this period. Increasing the concentration of all compounds induced a gradual shortened post oviposition period.

Female longevity:

The recorded data in Table (25) show that all compounds and their concentrations shortened female longevity. Increasing the concentration of all compounds induced a gradual shortened in female longevity, which was highly significant with Hexaflumuron and Chlorfluazuron, but Chlorpyrifos caused significant effect with the exception for Esfenvalerate and Thiodicarb which were non significant.

Male longevity:

Analysis of variance of the data given in Table (25) cont'd indicate that all compounds significantly shortened male longevity. Except Thiodicarb was non- significantly shortened male longevity. Concentrations of inseectecides caused highly significant shortened male longevity, but Esfenvalerate caused significant with the excepting for Thiodicarb, which caused non significant. Increasing the concentration of insecticides induced shortened male longevity.

Number of deposited eggs / female:

All the tested compounds as shown in Table (25) cont'd caused significant reduction in egg laying rate. Whereas, Thiodicarb caused the highest reduction, while Hexaflumuron caused the least reduction in number of eggs.

Increasing the concentration of each compound induced a gradual reduction in number of laid eggs / female.

Incubation period of eggs:

Data in Table (25) cont'd indicate that all tested compounds were not significant comparing with control, except Esfenvalerate treatment which significantly prolonged incubation period. Increasing the concentration caused a gradual prolongation in incubation period.

Hatchability of eggs:

Data in Table (25) cont'd show that the thiodicarb gave highly delayed effect against rate of hatchability (69.14%), but lowest delayed effect (89.00 %) for Hexaflumuron, as compared with (94.00 %) in check. All the tested compounds reduced the rate of hatchability percentage in all treatments. Increasing the

concentration of tested compounds induced gradual decrease in percentages of egg hatching.

The results obtained clearly show that both tested insecticides and concentrations of each insecticide were significantly effected or non significantly on the most biological aspect of pink and spiny bollworms, when adults were treated using the dry film techniques. Increasing the concentration of all tested insecticides induced a gradual prolonged incubation period, pre- oviposition period with the exception of Hexaflumuron in spiny bollworm which induced a gradual shortened and post oviposition period exception Chlorpyrifos in pink bollworm and all tested insecticides in spiny bollworm induced shortened. On the other hand, increasing the concentration induced a gradual decrease in number of deposited eggs/female and hatchability of eggs and shortened oviposition period and male & female longevity.

Similer result was obtained by **Flint and smith (1977)** who found that adults of *Pectinophora gossypiella* exposed to Thompson- Hayward TH 6040 either in diet or on treated surfaces caused a gradual loss of fertility during 4 – 6 days period.**Bariola (1984)** showed that adults of the cotton pest *Pectinophora gossypiella* treated with low doses of certain insecticides had laid fewer eggs and in some cases, had a reduced level of egg hatch. The insecticides also reduced the number of eggs laid and oviposition. **Mohamady (2000)** indicated that feeding moth of *S. littoralis* on sugar treated with LC_{50} of profenofos, Fenvalerate and Chlorfluazuron caused high reduction in egg laying rate.

B- Field experiments:

1- Effect of different sprayers and different recommended compounds against pink bollworm.

An experiment was conducted in Sharkia region during 2002 and 2003 cotton seasons to study the effect of different sprayers and different recommended compounds on the number of infested bolls caused by pink bollworm.

In this part of study, three known pesticides namely, Esfenvalerate, Chlorpyrifos and Thiodicarb were evaluated in the field against pink bollworm using three different types of sprayers. The tested equipments of spraying were knapsack motor sprayer (solo) with micronor, knapsack motor sprayer (solo) and conventional motor sprayer.

During 2002 season:

Data in Table (26) show that the numbers of infested bolls with pink bollworm per 100 green bolls before and after insecticides application. These data clearly indicated that although the infested bolls before application were nearly in par for all treatments, but it gradually increased weekly after Chlorpyrifos application with all different sprayers used, whereas Esfenvalerate and Thiodicarb, resulted in numbers of infested bolls with pink bollworm which were about their number before application, comparing with control which although it had the least number of infested bolls (3 bolls) before application but this number sharply increased weekly through the season.

Table (26): Numbers of infested bolls with pink bollworm/ 100 green cotton bolls before and after spraying cotton fields with some insecticides at – Sharkia Governorate during 2002 season.

Treatment (Insecticide)	Rate / fed.	Type of Sprayer	Before spray	after the 1st spray		after the 2nd spray		after the 3rd spray	
				1 week	2 weeks	1 week	2 weeks	1 week	2 weeks
Esfenvalerate	600 ml	Knapsack motor sprayer (solo) with micronor	4	4	3	1	2	3	1
		Knapsack motor sprayer(solo)	6	7	9	2	5	3	2
		Conventional motor sprayer	5	6	7	2	3	4	5
Thiodicarb	500 g	Knapsack motor sprayer(solo) with micronor	7	9	5	4	1	3	7
		Knapsack motor sprayer(solo)	5	7	5	6	2	6	1
		Conventional motor sprayer	9	7	14	2	1	3	8
Chlorpyrifos	1000 ml	Knapsack motor sprayer (solo) with micronor	4	7	11	16	19	37	40
		Knapsack motor sprayer (solo)	6	18	31	16	24	36	35
		Conventional motor sprayer	5	14	24	13	19	37	39
Control			3	19	30	39	46	55	69

Statistical analysis of data in Table (27) illustrate the differences between percent reductions of infestation with pink bollworm for the tested insecticides, as well as the efficiency of each sprayer with each insecticide.

Belonging the efficiency of tested insecticides in reducing the infestation in cotton fields with pink bollworm, it is clear that Esfenvalerate and Thiodicarb were have a powerful efficiency against pink bollworm, which caused average seasonal reductions of 94.51, 92.40 and 91.89% for esfenvalerate, and 93.43, 91.44 and 94.00% for Thiodicarb, comparing with Chlorpyrifos which had a moderate effect and resulted in reductions of 64.87, 66,05 and 64.79% with knapsack motor sprayers (solo) with micronor, knapsack motor sprayer (solo) and conventional motor sprayer.

Statistical analysis of data clearly indicate that there are highly significant difference between Esfenvalerate and thiodicarb as comparing with Chlorpyrifos in reducing the bollworm infestation in cotton fields, which the mean average of the seasonal reductions of pink bollworm with the three different sprayers were 92.93, 92.96 and 65.24% for Esfenvalerate, Thiodicarb and Chlorpyrifos, respectively.

According the efficiency of the different sprayers used in application of insecticides, it is clear from Table (27) that the reductions of pink bollworm infestation perfumed for any used insecticide with the three different sprayers were nearly in par with each others.

The mean average reduction of pink bollworm for all the three tested insecticides with each tested sprayer alone, were 84.27,

Table (27): Percent of reduction in infestation with pink bollworm after spraying cotton fields with some insecticides at – Sharkia Governorate during 2002 season.

Treatments (Insecticide)	Rate of application/ fed.	Type of Sprayer	after the1st spray		after ther2nd spray		after the 3rd spray		Mean Pesticides X Sprayers	Mean Pesticides irrespective sprayers	Mean Sprayers irrespective pesticides
			1 week	2 weeks	1 week	2 weeks	1 week	2 weeks			
Esfenvalerate	600 ml	Knapsack motor sprayer (solo) with micronor	84.21	92.50	98.81	96.74	95.91	98.91	94.51	92.93a	Knapsack motor sprayer (solo) with micronor 84.27
		Knapsack motor sprayer (solo)	81.58	85.00	97.44	94.57	97.27	98.55	92.40		
		Conventional motor sprayer	81.05	86.00	96.92	96.09	95.64	95.65	91.89		
F. test sprayers									N.S.		N.S.
Thiodicarb	500 g	Knapsack motor sprayer (solo) with micronor	79.70	92.86	95.60	99.07	97.66	95.65	93.43	92.96a	Knapsack motor sprayer (solo) 83.30
		Knapsack motor sprayer (solo)	77.90	90.00	90.77	97.39	93.45	99.13	91.44		
		Conventional motor sprayer	87.73	84.44	98.29	99.28	98.18	96.14	94.00		
F. test sprayers									N.S.		N.S.
Chlorpyrifos	1000 ml	Knapsack motor sprayer (solo) with micronor	72.37	72.50	69.24	69.02	49.55	56.53	64.87	65.24b	Conventional motor sprayer 83.56
		Knapsack motor sprayer (solo)	52.63	48.33	79.49	73.91	67.27	74.64	66.05		
		Conventional motor sprayer	55.79	52.00	80.00	75.22	59.64	66.09	64.79		

83.30 and 83.56% for knapsack motor sprayers (solo) with micronor, knapsack motor sprayer (solo) and conventional motor sprayer, respectively, with non significant differences between them.

During 2003 season:

Results in Table (28) show the numbers of infested bolls with pink bollworm per 100 green bolls before and after insecticides application. These data clearly indicated that infested bolls before application were nearly in par with that after Esfenvalerate and thiodicarb application weekly during the season, but it gradually increased weekly after Chlorpyrifos application with all different sprayers used.

Data in Table (29) show that the mean percent reductions of infestation with pink bollworm in case of Esfenvalerate treatment with knapsack motor sprayer (solo) with micronor, knapsack motor sprayer (solo) and conventional motor sprayer were 93.46, 91.02 and 90.09%, respectively. While, Thiodicarb with abovementioned sprayers caused reduction of 90.14, 87.34 and 90.37%, respectively. Also, chlorpyrifos with abovementioned sprayers induced 51.37, 54.74 and 52.03% of reduction, respectively, with non significant differences between the tested sprayers and tested insecticides.

Statistical analysis in Table (29) estimated that there is highly significant differences between Esfenvalerate and Thiodicarb as comparing with Chlorpyrifos in reducing the bollworm infestation in cotton fields, which the average of the seasonal reductions of pink bollworm infestation with the three different sprayers were 91.52, 89.28 and 52.71% for Esfenvalerate, Thiodicarb and Chlorpyrifos, respectively.

Table (28): Numbers of infested bolls with pink bollworm/ 100 green cotton bolls before and after spraying cotton fields with some insecticides at– Sharkia Governorate throughout 2003 season.

Treatment (Insecticide)	Rate / fed.	Type of Sprayer	Before spray	after the 1st spray		after the 2nd spray		after the 3rd spray	
				1week	2 weeks	1week	2 weeks	1 week	2 weeks
Esfenvalerate	600 ml	Knapsack motor sprayer (solo) with micronor	5	4	3	2	1	3	2
		Knapsack motor sprayer(solo)	7	6	8	5	4	3	3
		Conventional motor sprayer	6	5	9	4	3	4	3
Thiodicarb	500 g	Knapsack motor sprayer (solo) with micronor	6	5	8	5	4	3	3
		Knapsack motor sprayer (solo)	4	3	7	6	3	3	4
		Conventional motor sprayer	7	6	8	7	4	3	4
Chlorpyrifos	1000 ml	Knapsack motor sprayer (solo) with micronor	4	8	12	15	18	36	39
		Knapsack motor sprayer (solo)	6	16	30	16	24	35	34
		Conventional motor sprayer	5	14	23	13	19	36	38
Control			4	18	28	37	45	54	68

Table (29): Percent of reduction in infestation with pink bollworm after spraying cotton fields with some insecticides at– Sharkia Governorate throughout 2002 season.

Treatment (Insecticide)	Rate of application/ fed..	Type of Sprayer	after the 1st spray		after the 2nd spray		after the 3rd spray		Mean Pesticides X Sprayers	Mean Pesticides irrespective sprayers	Mean Sprayers irrespective pesticides
			1 week	2 weeks	1 week	2 weeks	1 week	2 weeks			
Esfenvalerate	600 ml	Knapsack motor sprayer (solo) with micronor	82.22	91.43	95.68	98.22	95.56	97.65	93.46	91.52a	Knapsack motor sprayer (solo) with micronor 78.32
		Knapsack motor sprayer (solo)	80.95	83.67	92.28	94.92	96.83	97.48	91.02		
		Conventional motor sprayer	81.48	78.57	92.79	95.56	95.06	97.06	90.09		
F. test sprayers									N.S.		N.S.
Thiodicarb	500 g	Knapsack motor sprayer (solo) with micronor	81.48	80.95	90.99	94.07	96.30	97.06	90.14	89.28a	Knapsack motor sprayer (solo) 77.50
		Knapsack motor sprayer (solo)	83.34	75.00	83.79	93.33	94.44	94.12	87.34		
		Conventional motor sprayer	80.95	83.67	89.19	94.93	96.83	96.64	90.37		
F. test sprayers									N.S.		
Chlorpyrifos	1000 ml	Knapsack motor sprayer (solo) with micronor	55.56	57.15	59.46	60.04	33.34	42.65	51.37	52.71b	Conventional motor sprayer 77..50
		Knapsack motor sprayer (solo)	40.75	28.58	71.17	64.45	56.79	66.67	54.74		
		Conventional motor sprayer	37.78	34.29	71.89	66.23	46.67	55.30	52.03		
F. test sprayers									N.S.	**	N.S.

In case of knapsack motor sprayer (solo) with micronor, knapsack motor sprayer (solo) and conventional motor sprayer with irrespective tested pesticides, the average reductions of pink bollworm infestation were 78.32, 77.50 and 77.50%, respectively.

From the above mentioned data it can be conclude that. The present results are in accordance with those obtained by **Dabalbaje and Deshpande (1985)** who observed that there is non-significant differences between the different spray volumes used against *Pectinophora gossypiella*.**Vadivelu *et al.* (1986)** indicated that there was little differences between the incidences of bollworms between the plots treated with the various sprayer types. **Javaid (1991)** reported that insecticides application techniques on cotton were compared different sprayers gave similar yields and control of insect pests.

Ali *et al.* (1995) showed that insecticides applied by knapsack sprayers, low volume and ultra low volume sprayers were equally effective against insect pests of cotton.

2- Effect of some insect growth regulators on pink bollworm infestation:

This experiment, was conducted to study the effect of some insect growth regulators alone, comparing with the recommended insecticide, chlorpyrifos, on pink bollworm infestation, during 2002 and 2003 cotton.

During 2002 season

Data presented in Table (30) show the number of infested bolls / 100 green cotton bolls, before and after application. Data reveal that although the number of infested bolls in control plots was less than that in treated plots, but it gradually increased weekly to reach the highest number of 74 infested bolls comparing with 47, 54 and 24 infested bolls at the end of the season, for hexaflumuron, chlorfluazuron and chlorpyrifos, respectively.

Seasonal averages of the number of infested bolls/100 green cotton bolls with pink bollworm, were 30.17, 32.67 and 15.67 infested bolls for hexaflumuron, chlorfluazuron and chlorpyrifos respectively, comparing with control (45.33 infested bolls). It is means that the seasonal averages of both the two tested IGRs and the recommended insecticides were less than that of control, also the recommended insecticide was less than that of IGRs.

Data represented in Table (31) illustrate the percent reductions of infestation with pink bollworm after spray cotton fields with these two IGRs with reference to the recommended insecticide Chlorpyrifos. Data indicate that Hexaflumuron efficient against pink bollworm than Chlorfluazuron. Both Hexaflumuron and Chlorfluazuron were less active than recommended insecticide Chlorpyrifos.

Table (30): Numbers of infested bolls with pink bollworm/ 100 green cotton bolls before and after spraying cotton fields with insect growth regulators at– Sharkia Governorate during 2002 season.

Treatment	Rate of application / fed.	Number of infested bolls/ 100 green bolls							Seasonal average
		Before application	after the 1st spray		after the 2nd pray		after the 3rd spray		
			1 week	2 weeks	1 week	2 weeks	1 week	2weeks	
Hexaflumuron	200 ml	5	11	23	25	34	41	47	30.17
Chlorfluazuron	400 ml	5	10	23	27	37	45	54	32.67
Chlorpyrifos	1000 ml	4	7	12	13	16	22	24	15.67
Control		3	16	34	41	49	58	74	45.33

Table (31): Percent of reduction in infestation with pink bollworm after spraying cotton fields with insect growth regulators at– Sharkia Governorate during 2002 season.

Treatment	Rate of application / fed.	after 1st spray		mean	after 2nd spray		mean	after 3rd spray		Mean	Seasonal average
		1 week	2weeks		1 week	2weeks		1 week	2weeks		
Hexaflumuron	200 ml	58.75	59.41	59.08	63.41	58.36	60.89	57.58	61.89	59.74	59.90
Chlorfluazuron	400 ml	62.5	59.41	60.96	60.48	54.69	57.59	53.44	56.21	54.83	57.79
Chlorpyrifos	1000 ml	67.18	73.52	70.35	76.21	75.51	75.86	71.55	75.67	73.61	73.27

The seasonal averages reduction for pink bollworm infestations, were 59.90, 57.79 and 73.27% for hexaflumuron, chlorfluazuron and chlorpyrifos respectively.

During 2003 season:

Data presented in Table (32) illustrate the number of infested bolls / 100 green cotton bolls, before and after application. These data reveal that although the number of infested bolls in control plots were less than that in treated plots, but it gradually increased weekly to reach the highest number of 58, 46 and 39 infested bolls at the end of the season, for hexaflumuron, chlorfluazuron and chlorpyrifos, respectively, comparing with control (71 infested bolls).

Data in Table (33) show that percent of reduction in infestation with pink bollworm after Hexaflumuron and Chlorfluazuron treatment were 60.05% and 56.83%, respectively, comparing with of reduction in infestation with Chlorpyrifos (65.67%).

Looking for the results obtained in the two seasons, it can be noticed that the arrangement of the tested compounds as according to their efficiency against pink bollworm were the same, which the most efficient one was chlorpyrifos, followed by hexaflumuron, and then the least effective one, chlorfluazuron. On the other hand, the two tested IGR's, as well as the recommended insecticide induced moderate reductions against pink bollworm infestation .

Also, There are little differences in the efficacy between the two tested IGRs, as well as between the IGR's and recommended insecticides. **Natarajan *et al.* (1985)** showed that Diflubenzuron at

Table (32): Numbers of infested bolls with pink bollworm/ 100 green cotton bolls before and after spraying cotton fields with insect growth regulators during 2003 season at – Sharkia Governorate.

Treatment	Rate of application / fed.	Number of infested bolls/ 100 green bolls							Seasonal average
		Before application	after the 1st spray		after the 2nd pray		after the 3rd spray		
			1 week	2 weeks	1 week	2 weeks	1 week	2 weeks	
Hexaflumuron	200 ml	7	19	24	40	42	48	58	38.50
Chlorfluazuron	400 ml	5	14	25	27	30	35	46	29.50
Chlorpyrifos	1000 ml	5	11	18	18	26	33	39	24.17
Control		3	18	30	34	47	56	71	42.67

Table (33): Percent of reduction in infestation with pink bollworm after spraying cotton fields with insect growth regulators during 2003 season at – Sharkia Governorate.

Treatment	Rate of application / fed.	after 1st spray		mean	after 2nd spray		mean	after 3rd spray		mean	Seasonal average
		1 week	2weeks		1 week	2weeks		1 week	2weeks		
Hexaflumuron	200 ml	54.76	65.71	60.24	49.57	61.70	55.63	63.26	64.98	64.12	60.05
Chlorfluazuron	400 ml	53.33	50.00	51.67	52.35	61.70	57.02	62.50	61.13	61.82	56.83
Chlorpyrifos	1000 ml	63.33	64.00	63.67	68.23	66.80	67.51	64.64	67.04	65.84	65.67

400 g.a.i. / ha. gave effective control for the pink and spiny bollworms. Also, **Simwat and Dhawan (1992),** found that Diflubenzuron alone, was less effective than combination with Phenthoate, Endosulfan, Quinalphos and Fenvalerate in controlling *Pectinophora gossypiella.*

Although these field experiments reflected the differences in the efficiency of the tested toxicants represented different chemical groups in controlling the pink bollworm, *Pectinophora gossypiella,* but it is important to employ all of them in toxicant factor of integrated pest management for this pest.

Concerning the efficiency of the different sprayers used in spray cotton fields, there was no significant differences between them in increasing or decreasing the efficiency of insecticides used in the experiment, these results clearly showed that the efficiency of insecticide not depending on the sprayer, but depend mainly on the handle of the sprayer. Also, the results pointed to a economical factor, which we must use sprayers suitable for the area, amount of water in this area, the number of trained man and their price, and how many feddans needed to spray.