Results and Discussion

IV. RESULTS AND DISCUSSION

4.1-Initial and bioresidual toxicity of different pesticides on the cotton leafworm larvae:

a- Laboratory reference strain :

Results in Table (1) demonstrate the percentages of initial and residual larval mortalities occurring after feeding for 2 days on cotton leaves treated with the tested insecticides at different time intervals, following application under field conditions, among the four groups of 4*th* instar larvae of *S. littoralis* laboratory strain.

Data representing initial toxicity for the 1*st* group of larvae which were exposed for 24 h. feeding period on treated cotton leaves collected at zero day and the survivors larvae continued their feeding for another 24 h. on treated cotton leaves collected at 1 day following application are presented in Table (1). The percentage initial mortalities after 48h. feeding on treated cotton leaves and 72h. feeding on untreated cotton leaves reached 100 % for Chromafenozide (400 and 200 ml./fed.) and Ethoxazole (25 and 12.5 ml./fed.) while reached 80 and 70% for Pyriproxyfen (300 and 150 ml./fed.) and 74 and 62% for Azadirachtin (100 and 50 ml./fed.).

The bioresidual toxicity of the tested insecticides on the second group of larvae fed for 48h. on treated cotton leaves collected at 7 and 8 days following application and followed by feeding 3 days on untreated leaves are also presented in Table (1). The larval mortalities reached 82, 76, 74, 73, 73, 68, 63 and 62 % for Chromafenozide 400 ml./fed.), Pyriproxyfen 300 ml/fed., Ethoxazole 25 ml/fed., Chromafenozide 200 ml/fed., Ethoxazole 12.5 ml/fed., Azadirachtin 100 m./fed., Pyriproxyfen 150 ml/fed. And Azadirachtin 50 ml/fed., respectively.

Results of the 3*rd* group of larvae fed for 48h. on treated cotton leaves collected from the field at 14 and 15 days after application and

Table (1). Initial and bioresidual toxicity of different insecticides against the 4^{th} instar larvae of *S. littoralis* (Laboratory reference strain) fed on treated cotton leaves for 48h. followed by 3 days feeding on untreated cotton leaves.

Insecticides	Rate ml/ feddan	% Larval mortality for groups of larvae fed on treated leaves collected at the indicated days					Overall mean* ± S.d.
		Initial toxicity	Bioresidual toxicity				
		1^{st} (0 - 1 day)	2^{nd} (7-8 day)	3^{rd} (14-15 day)	4^{th} (21-22 day)	Mean	
Pyriproxyfen (10% EC)	300	80	76	62	40	59.33	64.5 ± 18.06 ab
	150	70	63	54	39	52.00	56.5 ± 13.37 ab
Chromafenozide (5% EC)	400	100	82	76	70	76.00	82.0 ± 12.96 a
	200	100	73	72	66	70.33	77.75 ± 15.15 ab
Azadirachtin (4.5% EC)	100	74	68	53	40	53.66	58.75 ± 15.3 ab
	50	62	62	51	36	49.66	52.75 ± 12.31 b
Ethoxazole (10% SC)	25	100	74	56	50	60.00	70.00 ± 22.44 ab
	12.5	100	73	48	48	56.33	67.25 ± 24.81 ab
Control	-	2	3	2	4	3.0	2.75 ± c

* Means followed by the same letter are not significantly different according to Duncan's multiple range test.
L.S.D. at 0.05 = 15.9

then fed for 3 days on untreated cotton leaves are presented in Table (1). The residual percentage mortalities reached 76, 72, 62, 56, 54, 53, 51 and 48% for Chromafenozide (400 and 200 ml/fed.,), Pyriproxyfen (300 ml/fed.), Ethoxazole (25 ml/fed.), Pyriproxyfen (150 ml/fed.,), Azadirachtin (100 and 50 ml/fed.) and Ethoxazole (12.5 ml/fed.), respectively.

Following the bioresidual toxicity of the tested insecticides over 21 days, the data obtained for the 4*th* group of larvae (Table 1) demonstrate that the efficacy reached 70, 66, 50, 48, 40, 40, 39 and 36 % for Chromafenozide (400 and 200 ml/fed.), Ethoxazole (25 and 12.5 ml/fed.), Pyriproxyfen (300 ml/fed.), Azadirachtin (100 ml/fed.), Pyriproxyfen (150 ml/fed.) and Azadirachtin (50 ml/fed.), respectively.

The mean residual toxicity of the 2*nd*, 3*rd* and 4*th* groups of larvae are also presented in Table (1). It demonstrated 76.0, 70.3, 60.0, 59.3, 56.3, 53.6, 52.0 and 49.6 % larval mortality for Chromafenozide (400 and 200 ml/fed.), Ethoxazole (25 ml/fed.), Pyriproxyfen (300 ml/fed), Ethoxazole (12.5 m./fed.), Azadirachtin (100 ml/fed.), Pryiproxyfen (150 ml/fed.), Azadirachtin (50 ml/fed.), respectively.

The overall mean larval mortality percentages were 82.0, 77.75, 70.0, 67.25, 64.5, 56.5, 58.75 and 52.75 % for Chromafenozide (400 and 200 ml/fed.), Ethoxazole (25 and 12.5 ml/fed.), Pyriproxyfen (300 and 150 ml/fed.) and Azadirachtin (100 and 50 ml/fed.), respectively.

The statistical analysis of the results showed that Chromafenozide was the most effective compound against the larval population of *S. littoralis* at both rates (400 and 200 ml/fed.), followed by Ethoxazole at the rates of (25 and 12.5 ml/fed.) and Pyriproxyfen at the rates of (300 and 150 ml/fed.) The least toxic compound was Azadirachtin at the rates of (100 and 50 ml/fed.) (Table 1).

b- Early-season field strain (before spraying program) :

Data in Table (2) show the initial and residual percent mortalities of the *4th* instar larvae of *S. littoralis* occurring within 2 days feeding on cotton leaves treated with different insecticides and followed by 3 days feeding on untreated cotton leaves. For the *1st* group of larvae, the initial mortality percentages after 48 h. feeding period on treated cotton leaves collected at zero and 1 day after application, followed by feeding on untreated cotton leaves for 3 days were 100, 77, 67, 66, 63, 61, 57 and 55 % for Chromafenozide 400 ml/fed., Chromafenozide (200 ml/fed.), Ethoxazole (25 ml/fed.), Pyriproxyfen (300 ml/fed.), Azadirachtin (100 ml/fed.), Ethoxazole (12.5 ml/fed.), Pyriproxyfen (150 ml/fed.) and Azadirachtin (50 ml/fed.), respectively.

As for the *2nd* group of larvae (Table 2), the mortality percentages reached 78, 72, 62, 61, 53, 53, 45 and 32 % for Chromafenozide (400 and 200 ml/fed.), Pyriproxyfen (300 ml/fed.), Ethoxazole (25 ml/fed.), Pyriproxyfen (150 ml/fed.), Ethoxazole (12.5 ml/fed.), and Azadirachtin (100 and 50 ml/fed.), respectively.

Results of the *3rd* group of larvae fed for 48h. on treated cotton leaves collected from the field at 14 and 15 days after applications are also presented in Table (2). The data revealed that the accumulative latent toxicity (after 5 days) reached 48, 47, 43, 42, 41, 39, 34 and 20% for Pyriproxyfen (300 ml/fed.), Chromafenozide (400 ml/fed.), Pyriproxyfen (150 ml/fed.), Ethoxazole (25 ml/fed.), Chromafenozide (200 ml/fed.), Ethoxazole (12.5 ml/fed.), and Azadirachtin (100 and 50 ml/fed.), respectively.

For the *4th* group of larvae (Table 2), the resulted percentage mortalities were 45, 36, 35, 34, 33, 30, 21, and 15% for Chromafenozide (400 and 200 ml/fed.), Ethoxazole (25 ml/fed.), Azadirachtin (100 ml/fed.), Ethoxazole (12.5 ml/fed.), Pyriproxyfen (300 and 150 ml/fed.) and Azadirachtin (50 ml/fed.), respectively.

Table (2). **Initial and bioresidual toxicity of different insecticides against the 4^{th} instar larvae of *S. littoralis* early-season field strain (before spraying program) fed on treated cotton leaves for 48h. followed by 3 days feeding on untreated cotton leaves.**

Insecticides	Rate ml/ feddan	% Larval mortality for groups of larvae fed on treated leaves collected at the indicated days					Overall mean* ± S.d.
		Initial toxicity	Bioresidual toxicity				
		1^{st} (0 - 1 day)	2^{nd} (7-8 day)	3^{rd} (14-15 day)	4^{th} (21-22 day)	Mean	
Pyriproxyfen (10% EC)	300	66	62	48	30	46.66	51.5 ± 16.2 ab
	150	57	53	43	21	39.00	43.5 ± 16.11 ab
Chromafenozide (5% EC)	400	100	78	47	45	56.66	67.5 ± 26.41 a
	200	77	72	41	36	49.66	56.5 ± 20.98 ab
Azadirachtin (4.5% EC)	100	63	45	34	34	37.66	44.0 ± 13.68 ab
	50	55	32	20	15	22.33	30.5 ± 7.82 b
Ethoxazole (10% SC)	25	67	61	42	35	46.00	51.2 ± 15.19 ab
	12.5	61	53	39	33	41.66	46.5 ± 12.79 ab
Control	-	2	3	2	4	3.0	2.75 ± c

* Means followed by the same letter are not significantly different according to Duncan's multiple range test.

L.S.D. at 0.05 = 26.11

The mean of bioresidual activity percentages after the insecticidal applications of the *2nd*, *3rd* and *4th* groups of *S. littoralis* larvae were 56.66, 49.66, 46.66, 46.0, 41.66, 39.0, 37.66 and 22.33% for Chromafenozide (400 and 200 ml/fed.), Pyriproxyfen (300 ml/fed.), Ethoxazole (25 ml/fed.), Ethoxazole (12.5 ml/fed., Pyriproxyfen (150 ml/fed.), and Azadirachtin (100 and 50 ml/fed.), respectively.

The overall mean larval mortality percentages of early-season field strain (before spraying program) were 67.5, 56.5, 51.5, 51.2, 46.5, 44.0, 43.5 and 30.5% for Chromafenozide (400 and 200 ml/fed.), Pyriproxyfen (300 ml/fed.), Ethoxazole (25 and 12.5 ml/fed.), Azadirachtin (100 ml/fed.), Pyriproxyfen (150 ml/fed.), and Azadirachtin (50 ml/fed.), respectively.

From the statistical analysis of the results it can be said again that Chromafenozide was the most toxic compound and was superior to the other tested insecticides at both rates 400 and 200 cm^3/fed. It was followed by Ethoxazole and Pyriproxyfen especially at the high rates. The least toxic compound was Azadirachtin.

c- Late-season field strain (after spraying program) :

Data demonstrated in Table (3) indicate the mortality percentages of the *4th* instar larvae of late-season field strain (after spraying program) when fed for 48h. on cotton leaves treated with different insecticides at 0 and 1 day following application. The insecticides can be arranged according to their efficacy in the following descending order, Chromafenozide 400 ml/fed. (81 %), Ethoxazole 25 ml/fed.(80%), Chromafenozide 200 ml/fed. (79 %), Ethoxazole 12.5 ml/fed. (61%), Azadirachtin 100 and 50 ml/fed. (59 and 55 %) and Pyriproxyfen 300 and 150 ml/fed. (52 and 43 %), respectively. As for the *2nd* group of larvae, the percent mortalities demonstrated were 65 % for Chromafenozide (400 ml/fed.) 59 % for Ethoxazole (25 ml/fed.), 57 % for Azadirachtin (100 ml/fed.), 50 % for Chromafenozide (200 ml/fed.), 46 % for Pyriproxyfen (300 ml/fed.), 45 % for Ethoxazole

Table (3). **Initial and bioresidual toxicity of different insecticides against the 4^{th} instar larvae of *S. littoralis* late-season field strain (after spraying program) fed on treated cotton leaves for 48h. followed by 3 days feeding on untreated cotton leaves.**

Insecticides	Rate ml/ feddan	% Larval mortality for groups of larvae fed on treated leaves collected at the indicated days					Overall mean* ± S.d.
		Initial toxicity	Bioresidual toxicity				
		1^{st} (0 - 1 day)	2^{nd} (7-8 day)	3^{rd} (14-15 day)	4^{th} (21-22 day)	Mean	
Pyriproxyfen (10% EC)	300	52	46	33	28	35.66	39.57 ± 11.14 ab
	150	43	28	11	5	14.66	21.75 ± 17.19 b
Chromafenozide (5% EC)	400	81	65	58	42	55.00	61.5 ± 16.17 a
	200	79	50	45	40	45.00	53.5 ± 17.48 a
Azadirachtin (4.5% EC)	100	59	57	43	26	42.00	46.25 ± 15.26 ab
	50	55	40	32	23	31.66	37.5 ± 13.57 ab
Ethoxazole (10% SC)	25	80	59	45	32	45.33	54.0 ± 20.54 a
	12.5	61	45	40	30	38.33	44.0 ± 12.93 ab
Control	-	2	3	2	4	3.0	2.75 ± c

* Means followed by the same letter are not significantly different according to Duncan's multiple range test.

L.S.D. at 0.05 = 11.5

(12.5 ml/fed.), 40 % for Azadirachtin (50 ml/fed.) and 28 % for Pyriproxyfen (150 ml/fed.), respectively. Data in Table (3) also show the mortality percentages of the 3*rd* group of larvae which were fed for 48 h. on treated cotton leaves collected at 14*th* and 15*th* days following insecticidal applications. The mortality percentages were 58, 45, 45, 43, 40, 33, 32 and 11% for Chromafenozide (400 and 200 ml/fed.), Ethoxazole (25 ml/fed.), Azadirachtin (100 ml/fed.), Ethoxazole (12.5 ml/fed.), Pyriproxyfen (300 ml/fed.), Azadirachtin (50 ml/fed.) and Pyriproxyfen (150 ml/fed.), respectively.

The mortality percentages of the 4*th* group of *S. littoralis* late-season field strain (after spraying program) were 42 and 40 % for Chromafenozide (400 and 200 ml/fed.), 32 and 30 % for Ethoxazole (25 and 12.5 ml/fed.), 28% for Pyriproxyfen (300 ml/fed.), 26 and 23% for Azadirachtin (100 and 50 ml/fed.), and 5 % for Pyriproxyfen (150 ml/fed.), respectively.

The mean residual larval mortality percentages were 55.0, 45.0, 45.3, 42.0, 38.3, 35.6, 31.6 and 14.6 % for Chromafenozide (400 and 200 ml/fed.), Ethoxazole (25 ml/fed.), Azadirachtin (100 ml/fed.), Ethoxazole (12.5 ml/fed.), Pyriproxyfen (300 ml/fed.), Azadirachtin (50 ml/fed.), and Pyriproxyfen (150 ml/fed.), respectively.

The statistical analysis of the overall mean larval mortality percentages revealed that Chromafenozide at both rates of 400 and 200 ml/fed. was significantly superior compared with the other tested insecticides. The least toxic compound was Pyriproxyfen and both Ethoxazole and Azadirachtin were moderately toxic in their effects on the larvae of *S. littoralis* (Table 3).

In general, it can be concluded from the prementioned results that feeding period on untreated leaves play an important role in the performance of the toxicity later on, particularly for compounds with new mode of action such as insect growth regulators. However, data of previous work carried out early by **Rizk and Radwan (1975)** indicated that both new chitin biosynthesis inhibitors, PH-6040 and PH-6038

induced justified performance when the tested instar larvae of the cotton leafworm *S. littoralis* were fed continuously for 0-5 days after application. Likewise **Watson (1981)** found that the highest efficacy was achieved when mortality counts were assessed after 48h. exposure or/and feeding on treated leaves.

The lack of food intake by *Schistocerca* nymphs fed on *Melia volkensii*, lead to very poor relative growth and high mortality **(Mwangi, 1982)**. Azadirachtin disrupted growth of young instars of *S. littoralis* than old ones and also affected ecdysis (**Koul, 1985**).

From the results of the present work, the feeding period on treated leaves was significantly effective factor in larval toxicity particularly insect growth regulators having low initial acute toxicity. These results confirm those found by **Ishaaya and Klein (1990)** who found that *S. littoralis* larvae collected from cotton fields in Israel that have been heavily sprayed with conventional insecticides showed strong resistance to organophosphates and pyrethroids and mild tolerance to benzoylphenyl ureas.

Recently, **Smagghe *et al.* (1995)** indicated that variations in toxicity of tebufenozide to laboratory and field strains of *S. littoralis* may be attributed to differences in compound stability and excretion. Further studies carried out by **Smagghe *et al.* (2000)** revealed that methoxyfenozide was the most toxic compound against *S. littoralis* larvae and RH-5849 was the least toxic.

4.2- Latent effect of different pesticides on certain developmental aspects in the cotton leafworm biology :

1- Effect on accumulated larval mortality :

Under laboratory conditions, surviving larvae after feeding on and exposure to residues of certain insecticides on cotton leaves, collected after various periods of spraying, were allowed to complete their larval stage duration. Results of overall accumulated larval mortality are given in Tables (4-6). The tested time intervals at which treated leaves were collected are as follows:

a- Zero and 1st day time interval for the 1st group of larvae.
b- 7*th* and 8*th* day time interval for the 2*nd* group of larvae.
c- 14*th* and 15*th*e days time interval for the 3*rd* group of larvae.
d- 21*st* and 22*nd* day time interval for the 4*th* group of larvae.

a- Laboratory reference strain :

Data in Table (4) elucidate the overall mortality of the larval stage of *S. littoralis* till pupation. The results of the 1*st* group of larvae which were fed on treated cotton leaves collected at 0-1 days after spraying revealed that both Chromafenozide and Ethoxazole caused 100% mortality, Pyriproxyfen caused 81-86% and Azadirachtin exhibited 67-80 % mortality. Regarding the 2*nd* group of larvae, the resulted mortalities were 76-87 %, 76-81 %, 77-79 % and 73-77 % for Chromafenozide, Pyriproxyfen, Ethoxazole and Azadirachtin, respectively. In the 3*rd* group of larvae which were fed on treated cotton leaves collected at 14-15 days after spraying, the accumulated larval mortalities reached 78-81 %, 60-69 %, 54-62 % and 57-61 % for Chromafenozide, Pyriproxyfen, Ethoxazole and Azadirachtin, respectively. In the 4*th* period of exposure the larvae fed on cotton leaves collected after 21-22 days from spraying showed 74-77 %, 55-55 %, 41-50 % and 37-48 % mortalities for Chromafenozide, Ethoxazole, Pyriproxyfen and Azadirachtin, respectively (Table 4). The

Table (4). **Accumalated larval mortality till pupation for groups of 4^{th} instar larvae of *S. littoralis* (Laboratory strain) fed for 48h. on treated leaves collected at different time intervals after applying certain insecticides under field conditions.**

Insecticides	Rate ml/ feddan	Overall % larval mortality till pupation for groups of larvae fed on treated leaves collected at the indicated days				Mean* Larval Mortality ± S.d.
		1^{st} (0 - 1 day)	2^{nd} (7-8 day)	3^{rd} (14-15 day)	4^{th} (21-22 day)	
Pyriproxyfen (10% EC)	300	86	81	69	50	71.5 ± 16.01 ab
	150	81	76	60	41	64.5 ± 18.04 ab
Chromafenozide (5% EC)	400	100	87	81	77	86.25 ± 10.04 a
	200	100	76	78	74	82.0 ± 12.11 ab
Azadirachtin (4.5% EC)	100	80	77	61	48	66.5 ± 14.89 ab
	50	67	73	57	37	58.5 ± 15.78 b
Ethoxazole (10% SC)	25	100	79	62	55	78.5 ± 23.30 ab
	12.5	100	77	54	55	71.5 ± 21.76 ab
Control	-	4	5	5	7	5.25 ± 1.26 c

* Means followed by the same letter are not significantly different according to Duncan's multiple range test.

L.S.D. at 0.05 = 23.29

mean percent accumulated larval mortalities were 82.0-86.2 %, 71.5-78.5 %, 64.5-71.5 % and 58.5-66.5 % for Chromafenozide, Ethoxazole, Pyriproxyfen and Azadirachtin, respectively. Chromafenozide at 400 ml/fed. caused a significant increase in larval mortality (86.2 %) when compared with all other treatments while Azadirachtin at 50 ml/fed. demonstrated the least significant effect on larval mortality (58.5 %).

b- Early-season field strain (before spraying program) :

In the *1st* group of larvae (Table 5) it was obvious that larvae suffered high percentage of mortality after feeding on leaves treated with insecticides reached 83-100 % for Chromafenozide, 64-73 % for Ethoxazole, 63-71 % for Pyriproxyfen and 63-68 % for Azadirachtin.

In the *2nd* period of exposure (7-8 days after spraying), the accumulated larval mortalities reached 78-83 % for Chromafenozide, 60-67 % for Pyriproxyfen, 58-67 % for Ethoxazole and 40-45 % for Azadirachtin.

As for the *3rd* group of larvae, the obtained results of mortalities showed 54-68 %, 48-58 %, 46-50 % and 32-38 % for Pyriproxyfen, Chromafenozide, Ethoxazole and Azadirachtin, respectively.

The results of the *4th* group of larvae indicated that Chromafenozide, Ethoxazole, Pyriproxyfen and Azadirachtin caused 45-51 %, 41-42 %, 27-39 % and 18-38 % mortalities, respectively.

The statistical analysis of the mean accumulated larval mortality percentages demonstrated that Chromafenozide (400 ml/fed.) was the most effective (73.0 %) treatment while Azadirachtin (50 ml/fed.) was the least effective (38.25 %) treatment.

c- Late season field strain (after spraying program) :

The overall larval mortality percentages till pupation for groups of late-season field strain *S. littoralis* larvae fed on treated cotton

Table (5). **Accumalated larval mortality till pupation for groups of 4^{th} instar larvae of *S. littoralis* early-season field strain (before spraying program) fed for 48h. on treated leaves collected at different time intervals after applying certain insecticids under field conditions.**

Insecticides	Rate ml/ feddan	Overall % larval mortality till pupation for groups of larvae fed on treated leaves collected at the indicated days				Mean* Larval Mortality % ± S.d.
		1^{st} (0 - 1 day)	2^{nd} (7-8 day)	3^{rd} (14-15 day)	4^{th} (21-22 day)	
Pyriproxyfen (10% EC)	300	71	67	54	39	57.75 ± 14.45 ab
	150	63	60	68	27	54.5 ± 18.62 ab
Chromafenozide (5% EC)	400	100	83	58	51	73.0 ± 22.64 a
	200	83	78	48	45	63.5 ± 19.77 ab
Azadirachtin (4.5% EC)	100	68	54	38	38	49.5 ± 14.46 ab
	50	63	40	32	18	38.25 ± 18.84 b
Ethoxazole (10% SC)	25	73	67	50	42	58.0 ± 14.45 ab
	12.5	64	58	46	41	52.25 ± 10.59 ab
Control	-	4	5	5	7	5.25 ± 1.26 c

* Means followed by the same letter are not significantly different according to Duncan's multiple range test.

L.S.D. at 0.05 = 23.42

leaves collectd at different time intervals after applying insecticides in the field are presented in Table (6). In the 1*st* groups of larvae, the mortality percentages reached 93, 91, 87-89 and 87-90 % for Chromafenozide, Azadirachtin, Ethoxazole and Pyriproxyfen, respectively. In the 2*nd* tested period, the accumulated larval mortalities were 89-91 % for Chromafenozide, 82-85% for Ethoxazole, 80-89% for Azadirachtin and 84-85% for Pyriproxyfen. In the 3*rd* tested interval, the accumulated larval mortality percentages demonstrated 81-84, 85-88, 81-84 and 82 % for Chromafenozide, Ethoxazole, Azadirachtin and Pyriproxyfen, respectively. The 4*th* group of larvae fed on treated cotton leaves collected at (21-22 days) after spraying insecticides in the field exhibited 79-82, 70-72, 67-76 and 76-78 % mortalities for Chromafenozide, Ethoxazole, Azadirachtin and Pyriproxyfen, respectively, However, the statistical analysis of the mean accumulated larval mortality percentages revealed that while there was significant increase in larval mortality in treatments than control, there was no significant variations between different treatments itself and that Chromafenozide at (400 ml/fed.) caused the highest accumulated larval mortality (86.75 %) while Ethoxazole at 12.5 ml/fed. showed the least mean accumulated larval mortality (81.0 %).

The remarkable high overall larval mortalities 58.5-86.25 % in laboratory strain (Table 4), 38.25-73.0 % in early-season field strain before spraying program (Table 5) and 79.75-86.75 % in late-season field strain after spraying program (Table 6) agreed with the previous findings of **Bayoumi *et al.* (1998)** found that percentage accumulative mortality varied according to the compound, concentration, larval instar and/or strain studied.

Table (6). **Accumalated larval mortality till pupation for groups of 4^{th} instar larvae of *S. littoralis* (late-season field strain) fed for 48h. on treated leaves collected at different time intervals after applying certain insecticids under field conditions.**

Insecticides	Rate ml/ feddan	Overall % larval mortality till pupation for groups of larvae fed on treated leaves collected at the indicated days				Mean* Larval Mortality % ± S.D.
		1^{st} (0 - 1 day)	2^{nd} (7-8 day)	3^{rd} (14-15 day)	4^{th} (21-22 day)	
Pyriproxyfen (10% EC)	300	87	84	82	78	82.75 ± 3.77 a
	150	90	85	82	76	83.25 ± 5.85 a
Chromafenozide (5% EC)	400	93	91	84	79	86.75 ± 6.45 a
	200	93	89	81	82	86.25 ± 5.74 a
Azadirachtin (4.5% EC)	100	91	89	84	76	85.0 ± 6.68 a
	50	91	80	81	67	79.75 ± 9.84 a
Ethoxazole (10% SC)	25	89	85	88	72	83.5 ± 7.85 a
	12.5	87	82	85	70	81.0 ± 7.62 a
Control	-	4	5	5	7	5.25 ± 1.26 b

* Means followed by the same letter are not significantly different according to Duncan's multiple range test.
L.S.D. at 0.05 = 9.50

2- Effect on larval duration :

Tables (7-9) elucidate the duration of *S. littoralis* larval stage till pupation when *4th* instar larvae were allowed to feed for 48 hr. on treated cotton leaves collected at different time intervals after applying the tested insecticides in the field and continue feeding on untreated leaves till death or pupation

a- Laboratory reference strain :

In the 1st group of larvae which were fed on treated cotton leaves collected at 0-1 days after spraying insecticides, Chromafenozide and Ethoxazole at both rates of application caused 100 % larval mortality while an increase in the larval duration reached 67.3-81.3 % and 60.0-62.0 % was recorded for Pyriproxyfen and Azadirachtin, respectively (Table 7).

Regarding the *2nd* group of larvae fed on treated cotton leaves collected at 7-8 days after spraying insecticides, a pronounced increase in the larval period was recorded, 49.3-68.7 % for Pyriproxyfen, 42.0-48.0 % for Azadirachtin, 32.7-36.7 % for Chromafenozide and 18.0-34.0 % for Ethoxazole.

The same trend was also observed in the *3rd* group of *S. littoralis* larvae. The increases in larval periods were 34.7-56.7 % for Pyriproxyfen, 28.7-34.7 % for Azadirachtin, 23.3-36.0 % for Chromafenozide and 23.3-24.0 % for Ethoxazole.

A relatively lower increase in the larval duration of the *4th* group of larvae was observed, 20.6-21.3 % for Pyriproxyfen, 6.9-11.9 % for Chromafenozide, 0.6-1.3 % for Azadirachtin and 0.6 % for Ethoxazole.

b- Early-season field strain (before spraying program) :

Results in Table (8) represent the percent changes in larval durations for groups of early-season larvae of *S. littoralis* fed on treated cotton leaves collected at different time intervals after applying

Table (7). Larval duration for groups of 4^{th} instar larvae of *S. littoralis* (laboratory strain) fed for 48h. on treated leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	Mean larval duration (in days) for groups of larvae survived after feeding on treated leaves collected at the indicated days.							
		1^{st} (0 - 1^{st} day)		2^{nd} (7 - 8^{th} day)		3^{rd} (14 - 15^{th} day)		4^{th} (21 - 22^{th} day)	
		Duration	% Change	Duration	% Change	Duration	% Change	Duration	% Change
Pyriproxyfen (10% EC)	300	27.1	+ 81.3	25.3	+ 68.7	23.5	+ 56.7	19.4	+ 21.3
	150	25.1	+ 67.3	22.4	+ 49.3	20.2	+ 34.7	19.3	+ 20.6
Chromafenozide (5% EC)	400	0.0	-	20.5	+ 36.7	20.4	+ 36.0	17.9	+ 11.9
	200	0.0	-	19.9	+ 32.7	18.5	+ 23.3	17.1	+ 6.9
Azadirachtin (4.5% EC)	100	24.3	+ 62.0	22.2	+ 48.0	20.2	+ 34.7	16.2	+ 1.3
	50	24.0	+ 60.0	21.3	+ 42.0	19.3	+ 28.7	16.1	+ 0.6
Ethoxazole (10% SC)	25	0.0	-	20.1	+ 34.0	18.6	+ 24.0	16.1	+ 0.6
	12.5	0.0	-	17.7	+ 18.0	18.5	+ 23.3	16.1	+ 0.6
Control	-	15.0	-	15.0	-	15.0	-	16.0	-

Table (8). Larval duration for groups of 4^{th} instar larvae of *S. littoralis* early-season field strain (before spraying program) fed for 48h. on treatd leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate ml/ feddan	Mean larval duration (in days) for groups of larvae survived after feeding on treated leaves collected at the indicated days.							
		1^{st} (0 - 1^{st} day)		2^{nd} (7 - 8^{th} day)		3^{rd} (14 - 15^{th} day)		4^{th} (21 - 22^{th} day)	
		Duration	% Change	Duration	% Change	Duration	% Change	Duration	% Change
Pyriproxyfen	300	26.0	+ 73.3	24.1	+ 60.7	20.2	+ 34.7	16.9	+ 6.0
(10% EC)	150	23.3	+ 55.3	21.5	+ 43.3	19.1	+ 27.3	16.4	+ 2.7
Chromafenozide	400	0.0	-	17.1	+ 14.0	16.2	+ 8.0	15.3	- 4.4
(5% EC)	200	21.8	+ 45.3	16.3	+ 8.7	15.4	+ 2.7	11.5	- 28.1
Azadirachtin	100	22.5	+ 50.0	20.4	+ 36.0	15.5	+ 3.3	13.2	- 17.5
(4.5% EC)	50	21.2	+ 41.3	18.4	+ 22.7	15.3	+ 2.0	13.2	- 17.5
Ethoxazole	25	20.1	+ 34.0	18.7	+ 24.7	17.0	+ 13.3	16.4	+ 2.7
(10% SC)	12.5	18.8	+ 25.3	18.0	+ 20.0	15.2	+ 1.3	16.2	+ 1.3
Control	-	15.0	-	15.0	-	15.0	-	16.0	-

insecticides in the field. The treatment of Chromafenozide (400 ml/fed.) demonstrated 100% larval mortality. Larval durations were increased (+25.3-73.3 %) in treatments of all other tested insecticides when the 1*st* group of larvae were exposed and fed on treated leaves collected at 0-1 days after applying insecticides.

In the 2*nd* and 3*rd* groups of larvae an increase of 14.0-60. 7% and 1.3-34.7 %, respectively in larval duration was observed by the use of all insecticides.

Regarding the 4*th* group of larvae which were fed on treated cotton leaves collected at 21-22 days after spraying insecticides in the field, different reactions in the larval periods were achieved. Pyriproxyfen and Ethoxazole resulted in slight increase in the larval periods, 2.7-6.0 % and 1.3-2.7 % respectively, while Chromafenozide and Azadirachtin exhibited a decrease in the larval periods by 4.4-28.1 % and 17.5 % respectively.

c- Late-season field strain (after spraying program) :

Data demonstrated in Table (9) illustrate the larval duration till pupation when larvae were fed on cotton leaves treated with insecticides for 48h. and allowed to continue feeding till pupation on untreated leaves.

In the 1*st* group of larvae which were fed at the first testing interval (0-1 days after spraying), the larval durations in Pyriproxyfen, Chromafenozide and Ethoxazole treatments where remarkably longer than control, the percent changes were +6.7-20.0 %, while in Azadirachtin treatment no changes were observed in larval period.

In the 2*nd* group of larvae, there were no changes in the larval duration except for Chromafenozide treatment which caused an increase of 6.7 %.

In the 3*rd* group of larvae which were fed on treated cotton leaves collected 14-15 days after spraying insecticides, there were no changes in the larval period in all treatments.

Table (9). **Larval duration for groups of 4^{th} instar larvae of *S. littoralis* Late-season field strain (after spraying program) fed for 48h. on treated leaves collected at different time intervals after applying insecticides under field conditions.**

Insecticides	Rate ml/ feddan	Mean larval duration (in days) for groups of larvae survived after feeding on treated leaves collected at the indicated days.							
		1^{st} (0 - 1^{st} day)		2^{nd} (7 - 8^{th} day)		3^{rd} (14 - 15^{th} day)		4^{th} (21 - 22^{th} day)	
		Duration	% Change	Duration	% Change	Duration	% Change	Duration	% Change
Pyriproxyfen (10% EC)	300	18	+ 20	15	0	15	0	16	0
	150	18	+ 20	15	0	15	0	16	0
Chromafenozide (5% EC)	400	18	+ 20	16	+ 6.7	15	0	15	- 6.3
	200	16	+ 6.7	16	+ 6.7	15	0	15	- 6.3
Azadirachtin (4.5% EC)	100	15	0	15	0	15	0	15	- 6.3
	50	15	0	15	0	15	0	15	- 6.3
Ethoxazole (10% SC)	25	18	+ 20	15	0	15	0	16	0
	12.5	16	+ 6.7	15	0	15	0	16	0
Control	-	15	-	15	-	15	-	16	-

In the *4th* group of larvae, a decrease in the larval duration (6.3 %) was observed in the treatments of both Chromafenozide and Azadirachtin at both rates of application.

In this respect, the increase in larval duration which was observed in the treatments of Pyriproxyfen and Chromafenozide agreed with the previous findings of **Moustafa and Attal (1985)** who found that the chitin inhibitor triflumuron at low concentration produced significant prolongation in *S. littoralis* larval period.

3- Effect on larval weight :

a- Laboratory reference strain :

Results illustrated in Table (10) show that all insecticides at both rates caused a decrease in the larval weight of *S. littoralis* for the four groups of larvae by 1.2-57.8 %, 28.7-85.9 %, 29.5-76.8 % and 27.2-76.8 % for Pyriproxyfen, Chromafenozide, Azadirachtin and Ethoxazole respectively.

b- Early-season field strain (before spraying program) :

Data in Table (11) revealed slight increases in larval weights compared with that of the control by 4.3, 2.3 and 0.4 % for Pyriproxyfen at 150 ml/fed. for 0-1 days, 7-8 days and 14-15 days after treatment, whereas a pronounced decrease (-50.4 %) in the larval weight was recorded in the *4th* group, fed on treated leaves at 21-22 days after treatment (Table 11). A considerable reductions in the larval weights were demonstrated in treatments of Chromafenozide, Azadirachtin and Ethoxazole, the reduction percentages were between 17.5-78.2 %, 28.7-42.6 % and 25.1-48.9 %, respectively during the four testing intervals. The results showed in general that all insecticides at both rates decreased the larval weight of *S. littoralis* fed on treated cotton leaves collected at different time intervals, the decrease was remarkable in the treatments of Chromafenozide, Azadirachtin and Ethoxazole, while it was of low magnitude in the Pyriproxyfen treatment.

Table (10). Mean larval weight (till 8 days) of *S. littoralis* (Laboratory reference strain) for groups of 4^{th} instar larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate ml/ feddan	Mean weight of larvae (mg.) till 8 days for groups of larvae fed on treated leaves collected at the indicated days.							
		1^{st} ($0 - 1^{st}$ day)		2^{nd} ($7 - 8^{th}$ day)		3^{rd} ($14 - 15^{th}$ day)		4^{th} ($21 - 22^{th}$ day)	
		Weight	% Change	Weight	% Change	Weight	% Change	Weight	% Change
Pyriproxyfen	300	192.9	- 13.2	128.7	- 42.0	112.3	- 50.1	95.8	- 57.8
(10% EC)	150	220.3	- 9.4	219.2	- 1.2	208.9	- 7.3	206.1	- 9.4
Chromafenozide	400	31.3	- 85.9	82.4	- 62.9	112.4	- 50.2	114.7	- 49.6
(5% EC)	200	41.7	- 81.2	109.8	- 50.5	160.7	- 28.7	161.9	- 28.8
Azadirachtin	100	51.5	- 76.8	81.3	- 63.4	91.4	- 59.5	136.8	- 39.9
(4.5% EC)	50	59.0	- 73.5	104.6	- 52.9	150.1	- 33.4	160.5	- 29.5
Ethoxazole	25	51.6	- 76.8	110.5	- 50.2	111.1	- 50.7	140.7	- 38.2
(10% SC)	12.5	52.3	- 76.5	116.7	- 47.3	155.5	- 31.0	165.7	- 27.2
Control	-	222.4	-	221.9	-	225.5	-	227.5	-

Table (11). Mean larval weight (till 8 days) of *S. littoralis* early-season field strain (before spraying program) for groups of 4^{th} instar larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	Mean weight of larvae (mg.) till 8 days for groups of larvae fed on treated leaves collected at the indicated days.							
		1^{st} ($0 - 1^{st}$ day)		2^{nd} ($7 - 8^{th}$ day)		3^{rd} ($14 - 15^{th}$ day)		4^{th} ($21 - 22^{th}$ day)	
		Weight	% Change	Weight	% Change	Weight	% Change	Weight	% Change
Pyriproxyfen (10% EC)	300	205.1	- 7.7	204.4	- 7.8	201.9	- 10.4	109.2	- 52.0
	150	231.9	+ 4.3	227.2	+ 2.3	226.3	+ 0.4	112.8	- 50.4
Chromafenozide (5% EC)	400	48.6	- 78.2	121.4	- 45.3	158.8	- 29.6	163.0	- 28.4
	200	105.5	- 52.6	136.8	- 38.4	165.3	- 26.6	187.6	- 17.5
Azadirachtin (4.5% EC)	100	127.6	- 42.6	130.2	- 41.3	135.3	- 40.0	141.2	- 37.9
	50	136.3	- 38.7	142.1	- 36.0	152.7	- 32.3	162.2	- 28.7
Ethoxazole (10% SC)	25	113.6	- 48.9	120.5	- 45.7	141.3	- 37.3	145.4	- 36.1
	12.5	120.0	- 46.0	127.6	- 42.5	158.0	- 29.9	170.4	- 25.1
Control	-	222.4	-	221.9	-	225.5	-	227.5	-

c- Late-season field strain (after spraying program) :

The results concerning the effect of the tested insecticides on the larval weight of *S. littoralis*, late-season field strain (after spraying program) are presented in Table (12). A decrease in the larval weight was obtained in all treatments and rates of applications. The highest decrease was demonstrated by Ethoxazole at 25 ml/fed. (68.6 %) while the least one (29.4 %) was obtained by Ethoxazole at 12.5 ml/fed. for the 1st group of larvae. The highest decrease in larval weight during the *2nd* group of larvae was 46.6% by the treatment of Azadirachtin at 100 ml/fed., while the least one (12.2 %) was found by the treatment of Ethoxazole at 12.5 ml/fed. The highest decrease in larval weight was recorded for Pyriproxyfen (30.8 %) at 300 ml/fed. during the *3rd* testing interval while it was 27.7 % for Azadirachtin at 100 ml/fed. during the *4th* testing interval, however, the lowest decrease was obtained by the treatment of Ethoxazole (10.1 %) at 12.5 ml/fed. for the *3rd* group of larvae and the treatment of Ethoxazole at 300 ml/fed. (9.1 %) for the *4th* group of larvae.

The obtained data are in agreement with **Ascher and Nemney (1976a)** who found that *S. littoralis* larvae weighting 150 mg when fed on diflubenzuron-treated alfalfa, while it reached 222.4 mg in control. **Asher *et al.* (1984)** revealed that larvae of *S. littoralis* taken from field-treated plants weighting 30-50 mg but the untreated of the same age (weighting 100-200 mg).

Podoler *et al.* (1985) indicated a remarkable increase in the final weight of the last instar larvae of *S. littoralis* with the use of the hormone analogue (ZR-619).

Dimetry and Abdalla (1988) showed that larval weights of *S. littoralis* were reduced by extracts of seeds of *Abrus precatorius*.

4- Effect on pupation and pupal malformation :

Data in Tables (13-15) demonstrate pupation percentage and pupal abnormality resulted after feeding groups of the *4th* instar larvae

Table (12). **Mean larval weight (till 8 days) of *S. littoralis* late-season field strain (after spraying program) of 4th instar larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.**

Insecticides	Rate (ml)/ feddan	Mean weight of larvae (mg.) till 8 days for groups of larvae fed on treated leaves collected at the indicated days.							
		1st (0 - 1st day)		2nd (7 - 8th day)		3rd (14 - 15th day)		4th (21 - 22th day)	
		Weight	% Change	Weight	% Change	Weight	% Change	Weight	% Change
Pyriproxyfen	300	116.8	- 47.4	135.1	- 39.1	155.9	- 30.8	171.0	- 24.8
(10% EC)	150	152.9	- 31.3	162.9	- 26.6	182.2	- 19.2	186.3	- 18.1
Chromafenozide	400	71.4	- 67.9	139.9	- 36.9	161.4	- 28.4	178.1	- 21.7
(5% EC)	200	91.3	- 58.9	155.7	- 29.8	166.6	- 26.1	180.6	- 20.6
Azadirachtin	100	96.4	- 56.7	118.4	- 46.6	163.8	- 27.4	164.5	- 27.7
(4.5% EC)	50	115.5	- 48.1	135.9	- 38.8	189.7	- 15.9	196.3	- 13.7
Ethoxazole	25	69.8	- 68.6	184.8	- 16.7	198.0	- 12.2	205.5	- 9.7
(10% SC)	12.5	157.1	- 29.4	194.8	- 12.2	202.8	- 10.1	206.7	- 9.1
Control	-	222.4	-	221.9	-	225.5	-	227.5	-

on insecticide-treated leaves collected at different time intervals after application of insecticides under field conditions.

a- Laboratory reference strain :

Survivors after feeding or exposure of the 4*th* instar larvae for 48h. to insecticide-treated leaves were allowed to pupate as shown in Table (13). Pupation percentages revealed that at the 1st testing interval (0-1 day) no pupation percent was recorded in Chromafenozide and Ethoxazole treatments where accumulated larval mortality reached 100 %. Also, it was obvious that the highest pupation percentage (33 %) in the 1*st* interval (0-1 day) was recorded in Azadirachtin (50 ml/200l) and that 27 % out of them were abnormal (malformed) while 6 % were healthy. The normal pupation ranged between 4 % and 19 % in the 2*nd* interval (7-8 day) and between 10 % and 20 % in the 3*rd* interval (14-15 days) while it ranged between 10 % and 19 % in the 4*th* testing interval (21-22 day).

Generally, it was obvious that all insecticidal treatments resulted in remarkable reduction percentages in pupation in compare with control. The highest reduction in pupation was recorded by Chromafenozide treatments.

Regarding the latent effects on percent pupal abnormality (malformed) it was obvious that it ranged between 7 and 27% in the 1*st* testing interval (0-1 day), between 2 and 20 % in the 2*nd* testing interval (7-8 day), and between 3 and 30 % in the 3*rd* testing interval (14-15 day) while it was between 13 and 44 % in the 4*th* testing interval (21-22 day).

However, it was obvious in general that the highest abnormality (malformation) percentages were mostly resulted in the low rates of Azadirachtin (50 ml/200 L) followed by Pyriproxyfen (150 ml/200 L) in most testing intervals, respectively.

Table (13). **Pupational and pupal abnormality percentages of *S. littoralis* (laboratory strain) for groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying certain insecticides under field conditions.**

Insecticides	Rate ml/ feddan	% Pupation for groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1^{st} (0 - 1^{st} day)		2^{nd} (7 - 8^{th} day)		3^{rd} (14 - 15^{th} day)		4^{th} (21 - 22^{th} day)	
		Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
Pyriproxyfen (10% EC)	300	7	7	17	2	20	11	12	38
	150	5	14	14	10	17	23	16	43
Chromafenozide (5% EC)	400	-	-	6	7	16	3	10	13
	200	-	-	4	20	18	4	11	15
Azadirachtin (4.5% EC)	100	10	10	12	11	14	25	13	39
	50	6	27	12	15	13	30	19	44
Ethoxazole (10% SC)	25	-	-	15	6	10	28	14	31
	12.5	-	-	19	4	17	29	12	33
Control	-	96	-	95	-	95	-	93	-

b- Early-season field strain (before spraying program) :

Data in Table (14) revealed that the highest pupation percentage (37%) in the 1*st* testing interval (0-1 day) was recorded in Azadirachtin at 50 ml/fed. and that 19 % out of them were abnormal while 18 % were healthy. The normal pupation ranged between 14 and 29 % in the 1*st* testing interval (0-1 day, between 7 and 30 % in the 2*nd* testing interval (7-8 day), and between 13 and 29 % in the 3*rd* testing interval (14-15 day) while it was between 4 and 25 % in the 4*th* testing interval (21-22 day) versus 93-96 % normal pupation in control. Comparison between mean normal pupation in different treatments within the four testing intervals and control, it was obvious that all insecticides resulted in remarkable reduction in normal pupation, and the highest reduction or/and the least mean normal pupation was recorded mostly in Chromafenozide treatments.

As for the abnormality in pupation, it was obvious that it ranged between 5 and 20 % in the 1*st* testing interval, between 6 and 35 % in the 2*nd* testing interval and between 15 and 45 % in the 3*rd* testing interval while it ranged between 39 and 60 % in the 4*th* testing interval (21-22 day). However, it was obvious that percent abnormal pupation increased remarkably at the later testing intervals where insecticide residues were at its lower level (sublethal). Also, it was obvious that the highest abnormality percentage 16-19 %, 22-35 %, 39-45 % and 58-60 % were recorded in Azadirachtin treatments at 1st, 2*nd*, 3*rd* and 4*th* testing intervals, respectively.

c- Late-season field strain (after spraying program) :

Data in Table (15) elucidate pupation percentages either normal (healthy) or abnormal (malformed) for individuals that survived and tolerated feeding and exposure of the 4*th* instar larvae to treated cotton leaves collected at different time intervals after spray.

Healthy pupation percentages reached 3-8 %, 4-12 %, 5-13 % and 6-18 % for the 1*st*, 2*nd*, 3*rd* and 4*th* testing intervals versus 93-96

Table (14). **Pupation and pupal abnormality percentages of *S. littoralis* early-season field strain (before spraying program) for group of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.**

Insecticides	Rate (ml)/ feddan	% Pupation for groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1^{st} (0 - 1^{st} day)		2^{nd} (7 - 8^{th} day)		3^{rd} (14 - 15^{th} day)		4^{th} (21 - 22^{th} day)	
		Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
Pyriproxyfen	300	14	15	20	13	28	18	22	39
(10% EC)	150	17	20	22	18	17	15	25	48
Chromafenozide	400	-	-	8	9	13	29	4	45
(5% EC)	200	17	-	7	15	27	25	7	48
Azadirachtin	100	16	16	24	22	23	39	2	60
(4.5% EC)	50	18	19	25	35	23	45	24	58
Ethoxazole	25	22	5	27	6	22	28	18	40
(10% SC)	12.5	29	7	30	12	29	25	9	50
Control	-	96	-	95	-	95	-	93	-

Table (15). **Pupation and pupal abnormality percentages of *S. littoralis* late-season field strain (after spraying program) for groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.**

Insecticides	Rate (ml)/ feddan	% Pupation for groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1^{st} (0 - 1^{st} day)		2^{nd} (7 - 8^{th} day)		3^{rd} (14 - 15^{th} day)		4^{th} (21 - 22^{th} day)	
		Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
Pyriproxyfen (10% EC)	300	5	8	7	9	10	8	12	10
	150	8	2	9	6	13	5	13	11
Chromafenozide (5% EC)	400	4	3	5	4	5	11	6	15
	200	3	4	4	7	6	13	9	9
Azadirachtin (4.5% EC)	100	6	3	7	4	7	9	13	11
	50	4	5	12	8	12	7	18	15
Ethoxazole (10% SC)	25	5	6	8	7	10	2	12	16
	12.5	8	5	9	9	11	4	12	18
Control	-	96	-	95	-	95	-	93	-

% for control while the pupal abnormality percent reached 2-8 %, 4-9 %, 2-13 % and 9-18 % for the same testing intervals, respectively versus no abnormality percent in control. It was worthy mentioning that the abnormality recorded ca. 40-50 % of the overall pupation percentages in all treatments and that the highest abnormality percent was recorded remarkably in Pyriproxyfen, Chromafenozide and Ethoxazole during the 1*st*, 2*nd*, 3*rd* and 4*th* testing intervals, respectively.

Reviewing the literature, similar low level of normal pupation was recorded when studying the latent effect of feeding *S. littoralis* larvae on Pyriproxyfen **(Moawad *et al.* 1996)** or on IKI-7899 **(Abdel Mageed *et al.*, 1986)**. Likewise, **El-Badawy (1979)** indicated that percentages of pupation and adult eclosion decrease significantly with the increase of diflubenzuron (IGR) doses as well as the treated instar of *S. littoralis*. Also, a positive correlation was recorded between the age of the residues of emulsion of seed kernels of *Azadirachtin indica* and the pupation rate **(Meisner *et al.*, 1983)**.

Recently, **Antonious and Rizk (1994)** found that larval treatment with a high concentration of neem seed oil resulted in larvae being highly impaired at ecdysis as exhibited by various deformities (malformation) in the formed pupae.

5- Effect on pupal duration :

Data in Tables (16-18) demonstrate the pupal duration of *S. littoralis* after feeding the 4*th* instar larvae for 48 h. on treated cotton leaves, collected at four time intervals (0-1 days, 7-8 days, 14-15 days and 21-22 days) after spraying different pesticides, followed by feeding three days on untreated leaves.

a- Laboratory reference strain :

The effect of the tested insecticides on the pupal duration of *S. littoralis* (laboratory strain) are presented in Table (16). A pronounced

decrease in the pupal duration was recorded in all treatments in pupae resulted from the four groups of larvae, ranged between 33.3 and 72.2 %, 18.2 and 60.0 %, 5.6 and 44.4 % and 8.3 and 33.3 % in the 1*st* (0-1 day), 2*nd* (7-8 day), 3*rd* (14-15 day) and 4*th* (21-22 day) testing intervals, respectively.

However, the highest reduction in pupal duration was recorded in Pyriproxyfen treatments whereas the least was recorded in Ethoxazole treatments.

b- Early-season field strain (before spraying program) :

The results illustrated in Table (17) show that the pupal durations in control were 5.4, 5.5, 5.5 and 6.0 days for the 1*st*, 2*nd*, 3*rd* and 4*th* groups of larvae, the mean pupal duration was 5.6 days. All insecticidal treatments caused considerable decrease in the pupal durations, of Pyriproxyfen (2.0-6.0 days), Chromafenozide (3.0-5.5 days), Azadirachtin (3.0-6.0 days) and Ethoxazole (3.3-5.5 days) during all testing intervals.

The calculated reduction in pupal duration relative to untreated control reached 22.2-62.9 %, 27.3-45.9 %, 14.6-45.5 % and 8.3 % for treatment of the 1*st*, 2*nd*, 3*rd* and 4*th* testing intervals, respectively. However, the highest reduction in pupal duration was recorded for Pyriproxyfen treatments while the least was recorded for Ethoxazole.

c- Late-season field strain (after spraying program) :

The data representing the pupal duration of *S. littoralis* after the feeding of 4*th* instar larvae on treated cotton leaves collected at different time intervals are presented in Table (18). These data revealed that the 1*st* group of larvae which were fed on treated cotton leaves collected at 0 and 1 days from application was remarkably affected by the treatments of insecticides, the pupal durations were 3.0-3.5, 0, 4.5-5.0 and 4.8-5.2 days for Pyriproxyfen, Chromafenozide, Azadirachtin

Table (16). Pupal duration of *S. littoralis* (Laboratory strain) for groups of larvae fed for 48 h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	Mean pupal duration (in days) resulted from groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1st (0 - 1st day)		2nd (7 - 8th day)		3rd (14 - 15th day)		4th (21 - 22th day)	
		Duration	% Change	Duration	% Change	Duration	% Change	Duration	% Change
Pyriproxyfen (10% EC)	300	1.5	- 72.2	2.2	- 60.0	3.0	- 44.4	5.5	- 8.3
	150	1.8	- 66.7	2.4	- 56.4	3.0	- 44.4	5.5	- 8.3
Chromafenozide (5% EC)	400	0	-	4.0	- 27.3	4.1	- 24.1	4.0	- 33.3
	200	0	-	4.4	- 20.0	5.0	- 7.4	4.0	- 33.3
Azadirachtin (4.5% EC)	100	3.5	- 35.2	4.1	- 25.5	4.8	- 11.1	6.0	0
	50	3.6	- 33.3	4.5	- 18.2	5.1	- 5.6	6.0	0
Ethoxazole (10% SC)	25	0	-	3.7	- 32.7	4.5	- 16.7	5.5	- 8.3
	12.5	0	-	4.5	- 18.2	4.6	- 14.8	5.5	- 8.3
Control	-	5.4	-	5.5	-	5.5	-	6.0	-

Table (17). Pupal duration of *S. littoralis* early-season field strain (before spraying program) for groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	Mean pupal duration (in days) resulted from groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1^{st} (0 - 1^{st} day)		2^{nd} (7 - 8^{th} day)		3^{rd} (14 - 15^{th} day)		4^{th} (21 - 22^{th} day)	
		Duration	% Change	Duration	% Change	Duration	% Change	Duration	% Change
Pyriproxyfen (10% EC)	300	2.0	- 62.9	3.0	- 45.9	4.5	- 18.2	6.0	0
	150	2.5	- 53.7	3.2	- 41.8	4.7	- 14.6	6.0	0
Chromafenozide (5% EC)	400	0	-	3.0	- 45.5	3.0	- 45.5	5.5	- 8.3
	200	0	-	3.5	- 36.4	3.4	- 38.2	5.5	- 8.3
Azadirachtin (4.5% EC)	100	3.0	- 44.4	3.6	- 34.6	3.5	- 36.4	6.0	0
	50	3.5	- 35.2	4.0	- 27.3	4.0	- 27.3	6.0	0
Ethoxazole (10% SC)	25	3.3	- 38.9	3.5	- 36.4	4.5	- 18.2	5.5	- 8.3
	12.5	4.2	- 22.2	4.2	- 27.3	4.5	- 18.2	5.5	- 8.3
Control	-	5.4	-	5.5	-	5.5	-	6.0	-

Table (18). **Pupal duration of *S. littoralis* late-season field strain (after spraying program) for groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.**

Insecticides	Rate (ml)/ feddan	Mean pupal duration (in days) resulted from groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1^{st} (0 - 1^{st} day)		2^{nd} (7 - 8^{th} day)		3^{rd} (14 - 15^{th} day)		4^{th} (21 - 22^{th} day)	
		Duration	% Change	Duration	% Change	Duration	% Change	Duration	% Change
Pyriproxyfen	300	3.0	- 44.4	5.5	0	5.5	0	6.0	0
(10% EC)	150	3.5	- 35.2	5.5	0	5.5	0	6.0	0
Chromafenozide	400	0	-	5.4	- 1.8	5.5	0	6.0	0
(5% EC)	200	0	-	5.4	- 1.8	5.5	0	6.0	0
Azadirachtin	100	4.5	- 16.7	5.5	0	5.5	0	6.0	0
(4.5% EC)	50	5.0	- 7.4	5.5	0	5.5	0	6.0	0
Ethoxazole	25	4.8	- 11.1	5.4	- 1.8	5.5	0	6.0	0
(10% SC)	12.5	5.2	- 3.7	5.4	- 1.8	5.5	0	6.0	0
Control	-	5.4	-	5.5	-	5.5	-	6.0	-

and Ethoxazole, respectively, whereas pupal period in control was 5.4 days. It is obvious from Table (18) that the feeding of the *2nd*, *3rd* and *4th* groups of larvae on treated cotton leaves collected at 7-8, 14-15 and 21-22 days, respectively did not affect the pupal duration of *S. littoralis*.

In conclusion, it could be said that all treatments decreased the pupal duration of *S. littoralis* within the three tested strains, the highest decrease was recorded in laboratory and early-season strain particularly in Chromafenozide (400 ml/fed. followed by Pyriproxyfen (300 ml/fed.). In agreement, **Moawad *et al.* (1996)** found that pyriproxyfen at 10 ppm cause lifetime of larvae being longer than control and reduced pupal duration.

6- Effect on pupal weight :

Data presented in Tables (19-21) the effect of tested insecticides on the pupal weight of the three different *S. littoralis* strains after feeding four groups of *4th* instar larvae on treated cotton leaves collected at different time intervals after spray.

a- Laboratory reference strain :

The obtained data in Table (19) expressed as percent changes in pupal weight showed that the highest decrease was recorded in the 1st interval by the higher rate of Pyriproxyfen (-62.8 %), in the *2nd* interval by the higher rate of Azadirachtin (-49.8 %), in the *3rd* interval by Chromafenozide (-37.6 %) while it was (-29.9 %) for the same treatment at the *4th* testing interval. In general it was obvious that Pyriproxyfen at 300 ml/fed. resulted in remarkably the least mean pupal weight (85.7 mg/pupa) when compared with the control (230.7 mg/pupa) which was obviously higher than other treatments.

Table (19). Pupal weight (mg.) of *S. littoralis* (laboratory strain) for groups of larvae fed for 48 h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	Mean weight of pupae (mg.) resulted from groups of larvae survived after feeding on treated cotton leaves collected at indicated days.							
		1^{st} ($0 - 1^{st}$ day)		2^{nd} ($7 - 8^{th}$ day)		3^{rd} ($14 - 15^{th}$ day)		4^{th} ($21 - 22^{th}$ day)	
		Weight (mg)	% Change	Weight (mg)	% Change	Weight (mg.)	% Change	Weight (mg.)	% Change
Pyriproxyfen (10% EC)	300	85.7	- 62.8	135.4	- 43.5	182.3	- 24.1	195.3	- 21.9
	150	90.0	- 60.9	148.9	- 37.9	201.6	- 16.1	225.2	- 9.9
Chromafenozide (5% EC)	400	-	-	143.1	- 40.3	150.0	- 37.6	175.2	- 29.9
	200	-	-	186.3	- 22.3	200.1	- 16.7	233.3	- 6.7
Azadirachtin (4.5% EC)	100	100.0	- 56.7	120.4	- 49.8	170.8	- 28.9	201.2	- 19.5
	50	140.1	- 39.3	152.5	- 36.4	182.9	- 23.9	202.3	- 19.1
Ethoxazole (10% SC)	25	-	-	150.0	- 37.4	177.3	- 26.2	242.2	3.1
	12.5	-	-	188.1	- 21.5	195.0	- 18.9	242.3	- 3.1
Control	-	230.7	-	239.7	-	240.3	-	250.0	-

b- Early-season field strain (before spraying program) :

As shown in Table (20) it was obvious that all tested insecticides exhibited considerable reduction in pupal weight ranged between-16.0 and -38.8 % in the 1*st* testing interval, between -16.6 and -41.4 % in the 2*nd* testing interval and between -4.3 and -24.3 % in the 3*rd* testing interval while the reduction was between -2.0 and -7.2% in the 4*th* testing interval. The highest reduction in pupal weight was recorded for Pyriproxyfen (38.8 %) at the rate of 300 ml/fed. in the 1*st* testing interval., and for Chromafenozide (41.4 %) at the rate of 400 ml/fed. at the 2*nd* testing interval and for Azadirachtin (24.3 %) at rate of 100 ml/fed. in the 3*rd* testing interval. However, based on comparison between all testing intervals it was obvious that the least mean pupal weight (140.4 mg/pupa) was recorded for Chromafenozide treatment (400 ml/fed.) which was remarkably lower than other treatments including control.

c- Late-season field strain (after spraying program) :

The obtained data in Table (21) expressed a percent change in pupal weight revealed that all insecticidal treatments during the 3 first testing intervals resulted in remarkable reduction in pupal weight ranged between 56.6 and 30.3 % in the 1st testing interval (0-1 day), 55.3 and 19.9 % in the 2*nd* testing interval (7-8 day) and 54.1 and 16.7 % in the 3*rd* testing interval (14-15 day). Chromafenozide at 400 ml/ fed. recorded the highest reduction in pupal weight in the first three testing intervals. As for the 4*th* testing interval similar trend was achieved but of less magnitude except in case of both treatments of Pyriproxyfen and Ethoxazole where considerable increase of +20.2 and 24.1 % was recorded for the former and +32.2 and 40.0 % was recorded for the later.

In agreement, **Zidan *et al.* (1996)** recorded a high reduction in pupal weight of *S. littoralis* when larvae were treated with Pyriproxyfen, Dipel 2X and mineral oil. It is suggested by the authors

Table (20). **Pupal weight (mg.) of *S. littoralis* early-season field strain (before spraying program) for groups of larvae fed for 48 h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.**

Insecticides	Rate (ml)/ feddan	Mean weight of pupae (mg.) resulted from groups of larvae survived after feeding on treated cotton leaves collected at indicated days.							
		1^{st} ($0 - 1^{st}$ day)		2^{nd} ($7 - 8^{th}$ day)		3^{rd} ($14 - 15^{th}$ day)		4^{th} ($21 - 22^{th}$ day)	
		Weight (mg)	% Change	Weight (mg)	% Change	Weight (mg.)	% Change	Weight (mg.)	% Change
Pyriproxyfen (10% EC)	300	141.2	- 38.8	146.0	- 39.1	199.7	- 16.9	232.1	- 7.2
	150	156.7	- 32.1	169.6	- 29.3	220.0	- 8.5	233.3	- 6.7
Chromafenozide (5% EC)	400	-	-	140.4	- 41.4	195.0	- 18.9	233.0	- 6.8
	200	193.8	- 16.0	200.0	- 16.6	220.0	- 8.5	234.2	- 6.3
Azadirachtin (4.5% EC)	100	161.2	- 30.1	178.9	- 25.4	182.0	- 24.3	233.3	- 6.7
	50	182.5	- 20.9	184.0	- 23.2	211.0	- 12.2	245.0	- 2.0
Ethoxazole (10% SC)	25	180.0	- 21.9	186.1	- 22.4	199.5	- 17.0	250.0	0
	12.5	182.7	- 20.8	189.5	- 20.9	230.0	- 4.3	250.0	0
Control	-	230.6	-	239.7	-	240.3	-	250.0	-

Table (21). Pupal weight (mg.) of *S. littoralis* late-season field strain (after spraying program) for groups of larvae fed for 48 h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	Mean weight of pupae (mg.) resulted from groups of larvae survived after feeding on treated cotton leaves collected at indicated days.							
		1^{st} (0 - 1^{st} day)		2^{nd} (7 - 8^{th} day)		3^{rd} (14 - 15^{th} day)		4^{th} (21 - 22^{th} day)	
		Weight (mg)	% Change	Weight (mg)	% Change	Weight (mg.)	% Change	Weight (mg.)	% Change
Pyriproxyfen (10% EC)	300	112.7	- 51.1	115.4	- 51.9	120.7	- 49.8	300.5	+ 20.2
	150	140.3	- 39.2	190.6	- 20.5	200.3	- 16.7	310.3	+ 24.1
Chromafenozide (5% EC)	400	100.1	- 56.6	107.2	- 55.3	110.3	- 54.1	200.8	- 19.6
	200	160.8	- 30.3	192.1	- 19.9	120.3	- 49.9	200.6	- 19.7
Azadirachtin (4.5% EC)	100	119.6	- 48.1	129.7	- 45.9	140.2	- 41.7	200.4	- 19.8
	50	122.3	- 46.9	132.6	- 44.7	160.3	- 33.3	240.1	- 4.0
Ethoxazole (10% SC)	25	132.7	- 42.5	143.1	- 40.3	150.2	- 37.5	330.5	+ 32.2
	12.5	140.6	- 39.0	152.4	- 36.4	160.1	- 33.4	350.1	+ 40.0
Control	-	230.7	-	239.7	-	240.3	-	250.0	-

that the little weight of pupa could be due to lower total protein content in treated larvae as compared with control ones. Likewise, the highly pronounced reduction in mean pupal weight recorded for Pyriproxyfen in the present study are in agreement with findings of **Kelany *el al.* (1991)** indicating that the mean weight of *Musca domestica* pupae reared on medium treated with aqueous extract of neem seed kernel were about one half of those obtained from untreated medium.

7- Effect on pupal mortality :

Data in Tables (22-24) indicate the latent effects on the pupal morality when the 4*th* instar larvae were fed for 48 hr. on treated leaves collected at different time intervals after insecticides application.

a- Laboratory reference strain :

Data in Table (22) revealed slight latent pupal mortality ranged between 2-4 % in 1*st* testing interval (0-1 day) and between 4-7 % in the 2*nd* testing interval (7-8 day) whereas relatively low latent pupal mortality of 4-18% and 4-14 % was recorded at the 3*rd* (14-15 day)and 4*th* (21-22 day) testing intervals, respectively. However, the highest pupal mortality was recorded in Chromafenozide (16-18%) at the 3*rd* testing interval and in Azadirachtin (13-19 %) at the 4*th* testing interval.

b- Early-season strain (before spraying program) :

Data in Table (23) revealed slight increase in latent pupal mortality relative to laboratory reference strain. The recorded latent pupal mortality ranged between 8-21% in 1*st* testing interval (0-1 day), 4-22 % in the 2*nd* testing interval (7-8 day) and 3-27 % in the 3*rd* testing interval (14-15 day) while it reached 2-18% in the 4*th* testing interval (21-22 day). However, the highest pupal mortality percentages were recorded by Ethoxazole treatments (13 and 21 %) in the 1*st*

Table (22). Pupal mortality of *S. littoralis* (Laboratory strain) for groups of larvae fed for 48 h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	% Pupal mortality resulted from groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.			
		1^{st} ($0 - 1^{st}$ day)	2^{nd} ($7 - 8^{th}$ day)	3^{rd} ($14 - 15^{th}$ day)	4^{th} ($21 - 22^{th}$ day)
Pyriproxyfen (10% EC)	300	3	5	13	6
	150	2	5	11	8
Chromafenozide (5% EC)	400	-	6	16	10
	200	-	4	18	11
Azadirachtin (4.5% EC)	100	4	6	14	13
	50	3	4	13	19
Ethoxazole (10% SC)	25	-	5	4	4
	12.5	-	7	5	6
Control	-	9	11	12	13

Table (23). Pupal mortality of *S. littoralis* early-season field strain (before spraying program) for groups of larvae fed for 48 h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	% Pupal mortality resulted from groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.			
		1^{st} (0 - 1^{st} day)	2^{nd} (7 - 8^{th} day)	3^{rd} (14 - 15^{th} day)	4^{th} (21 - 22^{th} day)
Pyriproxyfen	300	9	5	10	10
(10% EC)	150	13	4	3	11
Chromafenozide	400	-	8	13	4
(5% EC)	200	14	7	27	7
Azadirachtin	100	8	19	23	2
(4.5% EC)	50	13	22	23	18
Ethoxazole	25	13	10	3	15
(10% SC)	12.5	21	8	11	2
Control	-	9	11	12	13

testing interval, by Azadirachtin treatments (19 and 22 %) in the 2*nd* testing interval, by Chromafenozide treatments (13 and 27 %) in the 3*rd* testing interval.

Comparison between different treatments revealed that the highest pupal mortality during all testing intervals was recorded for Chromafenozide (13 and 27 %) and Azadirachtin (23 and 23 %) at the 3*rd* testing interval (14-15 day).

c- Late-season strain (after spraying program) :

Data in Table (24) revealed slight percent of latent pupal mortality relative to both laboratory reference strain (Table 22) and the control of same strain (Table 24). The recorded low latent pupal mortality percentages averaged 1-8 %, 1-8 %, 1-5 % and 1-6 % in different treatments at 1*st* , 2*nd* , 3*rd* and 4*th* resting intervals versus 9,11,12 and 13 % for the control at same prementioned intervals. However, the least pupal mortality was recorded for Pyriproxyfen at 300 ml/fed. And Azadirachtin at 100 ml/fed., recording 1.5 and 1.75 % for both, respectively versus 11.25 % for control.

Such relatively low percentages of pupal mortality recorded her for the tested pesticides could be explained in view of the natural accumulated mortality through out larval and prepupal stages where the differences between treatments and the control were relatively slight.

El-Sayed and Sayed (1982) found that feeding 1*st* -5*th* instar larvae of *S. littoralis* on leaves treated with 0.2-0.5% suspension of *Azadirachta indica* caused 100% larval mortality by the end of larval stage and also caused high pupal mortality.

Recently **Zidan *et al.* (1998)** found that Ethoxazole (10 % SC) at 31.01 ppm reduced pupal weight. The latent effect of the compound caused 45.9 % pupal mortality.

Table (24). **Pupal mortality of *S. littoralis* late-season field strain (after spraying program) for groups of larvae fed for 48 h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.**

Insecticides	Rate (ml)/ feddan	% Pupal mortality resulted from groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.			
		1^{st} ($0 - 1^{st}$ day)	2^{nd} ($7 - 8^{th}$ day)	3^{rd} ($14 - 15^{th}$ day)	4^{th} ($21 - 22^{th}$ day)
Pyriproxyfen (10% EC)	300	1	2	1	2
	150	8	3	5	4
Chromafenozide (5% EC)	400	2	5	1	1
	200	3	4	2	3
Azadirachtin (4.5% EC)	100	2	2	1	2
	50	-	5	2	6
Ethoxazole (10% SC)	25	1	8	3	3
	12.5	3	1	4	2
Control	-	9	11	12	13

8- Effect on adult emergence :

Data in Tables (25-27) illustrate the latent effects on adult emergence following feeding 4*th* instar larvae for 48h on cotton leaves treated with certain insecticides, followed by feeding for 3 days on untreated leaves.

a- Laboratory reference strain :

As shown in Table (25) it was obvious that the adult emergence was highly affected as demonstrated by the remarkably low percent of adult emergence which averaged 3-6, 6-12, 6-12 and 6-10 % in 1*st* (0-1 day) 2*nd* (7-8 day), 3*rd* (14-15 day) and 4*th* (21-22 day) testing intervals, respectively. However, it is of interest to note that no adults were obtained in Chromafenozide at different testing intervals, Azadirachtin at the 3*rd* and 4*th* testing intervals and in Ethoxazole at the 1st testing interval (0-1 day). In contrast, control treatment resulted in 80-87 % adult emergence.

Comparison between treatments in concern with adult emergence revealed that while control treatment resulted in the highest adult emergence (80-87 %), Chromafenozide treatments were the least (Zero %) and other treatments were considerably different than both prementioned ones.

b- Early-season field strain (before spraying program) :

Data in Table (26) indicate in general that adult emergence percentages were slightly higher than in case of laboratory strain, recording averages of 3-9, 3-22, 14-19 and 3-14 % for the 1*st* (0-1 day), 2*nd* (7-8 day), 3*rd* (14-15 day) and 4*th* (21-22 day) testing intervals, respectively. However, Chromafenozide and Azadirachtin exhibited almostly results similar to those recorded for the laboratory strain where no adult emergence was recorded at the same testing intervals. Comparison between different treatments revealed that the highest adult emergence (80-87 %) was recorded for control treatment and came apart Ethoxazole (3-22 %) and Pyriproxyfen (4-18 %) while

Table (25). Adult emergence percentage of *S. littoralis* (Laboratory reference strain) for groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	% Adult emergence resulted from groups of larvae survived after 48h. feeding on treated cotton leaves collected at the indicated days.			
		1^{st} ($0 - 1^{st}$ day)	2^{nd} ($7 - 8^{th}$ day)	3^{rd} ($14 - 15^{th}$ day)	4^{th} ($21 - 22^{th}$ day)
Pyriproxyfen (10% EC)	300	4	12	7	6
	150	3	9	6	8
Chromafenozide (5% EC)	400	0	0	0	0
	200	0	0	0	0
Azadirachtin (4.5% EC)	100	6	6	0	0
	50	3	8	0	0
Ethoxazole (10% SC)	25	0	10	6	10
	12.5	0	12	12	6
Control	-	87	84	83	80

Table (26). Adult emergence percentage of *S. littoralis* early-season field strain (before spraying program) for groups of larvae fed for 48 h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	% Adult emergence resulted from groups of larvae survived after 48h. feeding on treated cotton leaves collected at the indicated days.			
		1^{st} ($0 - 1^{st}$ day)	2^{nd} ($7 - 8^{th}$ day)	3^{rd} ($14 - 15^{th}$ day)	4^{th} ($21 - 22^{th}$ day)
Pyriproxyfen (10% EC)	300	5	15	18	12
	150	4	18	14	14
Chromafenozide (5% EC)	400	0	0	0	0
	200	3	0	0	0
Azadirachtin (4.5% EC)	100	8	5	0	0
	50	5	3	0	6
Ethoxazole (10% SC)	25	9	17	19	3
	12.5	8	22	18	7
Control	-	87	84	83	80

both of Chromafenozide (0.0-3.0 %) and Azadirachtin (3-8 %) being remarkably the least in this respect.

c- Late-season field strain (after spraying program) :

Data in Tale (27) illustrate the adult emergence percentages of late-season field strain in response of feeding *4th* instar larvae on cotton leaves treated with the tested insecticides. It was obvious that adult emergence percentages in treatments was remarkably low in compare to control treatment (80-87%) and averaged 2-5 %, 5-8 %, 4-10 % and 5-12 % for the *1st* (0-1 day), *2nd* (7-8 day), *3rd* (14-15 day) and *4th* (21-22 day) testing intervals, respectively. Comparison between treatments revealed that Chromafenozide treatments was the least and differences between all treatments were negligible but were severely lower than control treatment.

Our data agreed in general with findings of **Loke *et al.* (1992)** concerning the toxicity of neem oil *Azadirachta indica* against larvae of *Plutella xylostella* where it caused growth disruptive effects, delayed adult emergence and abnormal adults were observed with sublethal concentrations.

9- Effect on adult longevity :

The latent effect of feeding *4th* larval instar larvae on cotton leaves treated with insecticides are shown in Tables (28-30) when adult longevity was concerned.

a- Laboratory reference strain:

Data in Table (28) revealed remarkable decrease than control in adult longevity by 35.3-46.7 % for Azadirachtin and by 17.7-25.3 % for Ethoxazole during different testing interval. In contrast adult longevity in Pyriproxyfen treatments increased by 5.8-86.7 % during the first three testing intervals. Comparison between different treatments revealed that variations between treatments and control

Table (27). Adult emergvence percentage of *S. littoralis* late-season field strain (after spraying program) for groups of larvae fed for 48 h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	% Adult emergence resulted from groups of larvae survived after 48h. feeding on treated cotton leaves collected at the indicated days.			
		1^{st} ($0 - 1^{st}$ day)	2^{nd} ($7 - 8^{th}$ day)	3^{rd} ($14 - 15^{th}$ day)	4^{th} ($21 - 22^{th}$ day)
Pyriproxyfen (10% EC)	300	4	5	9	10
	150	0	6	8	9
Chromafenozide (5% EC)	400	2	0	4	5
	200	0	0	4	6
Azadirachtin (4.5% EC)	100	4	5	6	11
	50	4	7	10	12
Ethoxazole (10% SC)	25	4	0	7	9
	12.5	5	8	7	10
Control	-	87	84	83	80

Table (28). Adult longevity of *S. littoralis* (Laboratory strain) for groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	Adult longevity (in days) resulted from groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1st (0 - 1st day)		2nd (7 - 8th day)		3rd (14 - 15th day)		4th (21 - 22th day)	
		Duration	% Change	Duration	% Change	Duration	% Change	Duration	%
Pyriproxyfen (10% EC)	300	11.5	+ 53.3	10.3	+ 5.8	9.2	+ 5.8	5.1	- 43.3
	150	14.0	+ 86.7	12.5	+ 33.3	11.6	+ 33.3	5.2	- 42.2
Chromafenozide (5% EC)	400	-	-	-	-	-	-	-	-
	200	-	-	-	-	-	-	-	-
Azadirachtin (4.5% EC)	100	4.0	- 46.7	5.4	- 36.5	-	-	-	-
	50	4.4	- 41.3	5.5	- 35.3	-	-	-	-
Ethoxazole (10% SC)	25	-	-	6.5	- 23.5	6.5	- 25.3	7.3	- 18.9
	12.5	-	-	7.0	- 17.7	7.0	- 19.5	7.4	17.8
Control	-	7.5	-	8.5	-	8.7	-	9.0	-

in adult longevity were almostly of low magnitude, and the treatments could be arranged descendingly as follow: Pyriproxyfen, Control, Ethoxazole, Azadirachtin and Chromafenozide, respectively.

b- Early-season field strain (before spraying program) :

Results tabulated in Table (29) revealed that the longevity of the resulted adults was mostly similar to control except in case of Pyriproxyfen low rate (150 ml/fed) and both rates of Chromafenozide where the adult longevity was remarkably longer in the former and shorter in the later, respectively. During the 1st testing interval (0-1) the lower rate of Chromafenozide (200 ml/fed) while the least reduction in adult longevity (-2.7 %) was recorded in Ethoxazole (12.5 ml/fed) whereas Pyriproxyfen treatments resulted in 14.7 and 80.0 % increase in adult longevity at 300 and 150 ml/fed., respectively. The latent effect fall down with time elapse where the change in adult longevity reached-16.7, zero, -27.8 and -5.6 % decrease in adult longevity for the prementioned treatments, respectively.

c- Late-season field strain (after spraying program) :

Data in Table (30) revealed that the late-season field strain which tolerate several insecticides in the spraying program, exhibited also tolerance to the tested untraditional treatments tested in the present study which reflexed in negligible increase in adult longevity of +5.3, + 4.0 and +4.4 % for Pyriproxyfen at 300 ml/fed., Azadirachtin at 100 and 50 ml/fed., respectively at the first testing interval (0-1 day) where the tested compounds were at its powerful concentration. No remarkable latent effect was recorded during the other three testing intervals where the adult longevity was almostly similar as control.

Our results agreed with findings of **Moawad *et al.*(1996)** that Pyriproxyfen at LC_{50} level in leaf dipping experiments against larval

Table (29). **Adult longevity of *S. littoralis* early-season field strain (before spraying program) for groups of larvae fed for 48 h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.**

Insecticides	Rate (ml)/ feddan	Adult longevity (in days) resulted from groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1^{st} ($0 - 1^{st}$ day)		2^{nd} ($7 - 8^{th}$ day)		3^{rd} ($14 - 15^{th}$ day)		4^{th} ($21 - 22^{th}$ day)	
		Duration	% Change	Duration	% Change	Duration	% Change	Duration	% Change
Pyriproxyfen (10 % EC)	300	8.6	+ 14.7	8.5	0	7.5	- 13.8	6.5	- 27.8
	150	13.5	+ 80.0	11.5	+ 35.3	8.7	0	8.5	- 5.6
Chromafenozide (5% EC)	400	-	-	-	-	-	-	-	-
	200	4.1	- 45.3	-	-	-	-	-	-
Azadirachtin 4.5% EC)	100	5.4	- 28.0	7.6	- 10.6	-	-	-	-
	50	5.5	- 26.7	7.9	- 7.1	-	-	9.0	0
Ethoxazole (10% SC)	25	7.2	- 4.0	8.0	-5.9	8.0	- 8.0	8.5	- 5.6
	12.5	7.3	- 2.7	8.5	0	8.5	- 2.3	9.0	0
Control	-	7.5	-	8.5	-	8.7	-	9.0	-

Table (30). **Adult longevity of *S. littoralis* late-season field strain (after spraying program) for groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.**

Insecticides	Rate (ml)/ feddan	Adult longevity (in days) resulted from groups of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1^{st} (0 - 1^{st} day)		2^{nd} (7 - 8^{th} day)		3^{rd} (14 - 15^{th} day)		4^{th} (21 - 22^{th} day)	
		Duration	% Change	Duration	% Change	Duration	% Change	Duration	% Change
Pyriproxyfen (10% EC)	300	7.9	+ 5.3	8.5	0	8.7	0	9.0	0
	150	-	-	8.5	0	8.7	0	9.0	0
Chromafenozide (5% EC)	400	6.3	- 16.0	-	-	8.5	- 2.3	9.0	0
	200	-	-	-	-	8.6	- 1.2	9.0	0
Azadirachtin (4.5% EC)	100	7.8	+ 4.0	8.5	0	8.7	0	9.0	0
	50	7.8	+ 4.0	8.5	0	8.7	0	9.0	0
Ethoxazole (10% SC)	25	7.5	-	-	-	8.7	0	9.0	0
	12.5	7.5	0	8.5	0	8.7	0	9.0	0
Control	-	7.5	-	8.5	-	8.7	-	9.0	-

stage caused prolongation in adult stage lately. Also are in agreement with data concerning feeding larval stage on sublethal concentrations of 1GR such as Diflubenzuron and Triflumuron (**Attia and Ghattas, 1985**) or/and Chlorfluazuron and Flufenoxuron (**Hossain *et al.*, 1996**) where adult longevity was remarkably shortened.

10- Effect on adult fecundity :

Data in Tables (31-33) elucidate the latent indirect effects on fecundity of adults obtained when the 4*th* instar larvae of *S. littoralis* survived exposure and feeding on treated cotton leaves collected at different time intervals after application of insecticides under field conditions.

a- Laboratory reference strain :

Data recorded in Table (31) indicate the latent effects of the tested insecticide on adult fecundity when 4*th* instar larvae were fed and exposed to insecticide-treated cotton leaves collected at different time intervals after application. It was obvious that highly pronounced reduction in fecundity (100 %) was recorded at the 1*st* testing interval (0-1 day), in treatment of Pyriproxyfen at 300 ml/fed., whereas at the 2*nd* testing interval (7-8 day) 100% reduction in fecundity was recorded in both treatments of Ethoxazole (25 and 12.5 ml/fed.). However, at the 3*rd* (14-15 day) and 4*th* (21-22 day) testing intervals the maximum reduction in adult fecundity 91.7% and 80.0% was recorded for Ethoxazole at 25 ml/fed., respectively. However, it was of interest to note that due to no adults emerged at different testing intervals and treatments of Chromafenozide, the 3*rd* and 4*th* testing intervals of Azadirachtin treatments and the 1*st* testing interval of Ethoxazole, there was no deposited eggs entirely at these treatments.

Comparison based on number deposited eggs/ female revealed that the highest number (700 egg/female) was deposited in control treatment while the least deposited eggs/female was recorded in both

Table (31). Adult fecundity of *S. littoralis* (Laboratory reference strain) for groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	Average no. of eggs/female resulted from group of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1^{st} ($0 - 1^{st}$ day)		2^{nd} ($7 - 8^{th}$ day)		3^{rd} ($14 - 15^{th}$ day)		4^{th} ($21 - 22^{th}$ day)	
		Eggs no.	% Change	Eggs no.	% Change	Eggs no.	% Change	Eggs no.	% Change
Pyriproxyfen	300	0	- 100	39	- 94.4	100	- 83.3	175	- 65.0
(10% EC)	150	25	- 96.4	78	- 88.9	200	- 66.7	350	- 30.0
Chromafenozide	400	-	-	-	-	-	-	-	-
(5% EC)	200	-	-	-	-	-	-	-	-
Azadirachtin	100	30	- 95.7	120	- 82.9	-	-	-	-
(4.5% EC)	50	120	- 82.9	150	- 78.5	-	-	-	-
Ethoxazole	25	-	-	0	- 100	50	- 91.7	100	- 80.0
(10% SC)	12.5	-	-	0	- 100	100	- 83.3	150	- 70.0
Control	-	700	-	700	-	600	-	500	-

treatments of Chromafenozide (zero), Azadirachtin at 100 ml/fed. (30 eggs) and Ethoxazole at 25 ml/fed. (50 eggs). Other treatments recorded mean number of eggs inbetween.

b- Early-season field strain (before spraying program) :

As shown in Table (32), it was obvious that all tested insecticides performed similarly and resulted in reducing insect fecundity by averages of 52.9-83.6 %, 50.0-78.6 %, 50-75 % and 24.0-68.0% for adults resulted from groups of 1*st* , 2*nd* , 3*rd* and 4*th* testing intervals, respectively.

Comparison on the basis of mean eggs/female revealed that Chromafenozide resulted in remarkably the least number of deposited eggs/female. Considerable reduction in rate of eggs/female was recorded between other treatments including control where means eggs/female were lower than control treatment. The different insecticides could be arranged descendingly in this respect as follow: Pyriproxyfen, Ethoxazole and Azadirachtin, respectively.

c- Late-season field strain (after spraying program) :

Data in Table (33) demonstrate that Chromafenozide at 400 ml/fed. and Ethoxazole at 25 ml/fed. resulted complete reduction (100 %) in deposited eggs at the 1st testing interval. The reduction in fecundity recorded averages of 78.6-100 %, 75-87.1 %, 60-93 % and 24-50 % for adults resulted from larval groups of 1*st* , 2*nd* , 3*rd* and 4*th* testing intervals. Comparison based on mean of eggs/females revealed remarkable reduction in fecundity between different treatment (40-380 eggs/female) and control treatment (500-700 eggs/female).

11- Effect on eggs viability :

Data in Tables (34-36) demonstrate the latent effect of different treatments on viability of eggs deposited by adults resulted after exposure and feeding of groups of 4*th* instar larvae to insecticide-treated cotton leaves collected at different testing intervals.

Table (32). Adult fecundity of *S. littoralis* early-season field strain (before spraying program) for groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	Average no. of eggs/female resulted from group of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1^{st} (0 - 1^{st} day)		2^{nd} (7 - 8^{th} day)		3^{rd} (14 - 15^{th} day)		4^{th} (21 - 22^{th} day)	
		Eggs no.	% Change	Eggs no.	% Change	Eggs no.	% Change	Eggs no.	% Change
Pyriproxyfen	300	120	- 82.9	150	- 78.6	150	- 75.0	160	- 68.0
(10% EC)	150	135	- 80.7	250	- 64.3	270	- 55.0	310	- 38.0
Chromafenozide	400	-	-	-	-	-	-	-	-
(5% EC)	200	115	- 83.6	-	-	-	-	-	-
Azadirachtin	100	280	- 60.0	300	-57.1	-	-	-	-
(4.5% EC)	50	330	- 52.9	350	- 50.0	-	-	380	- 24.0
Ethoxazole	25	185	- 73.6	200	- 71.4	230	- 61.7	250	- 50.0
(10% SC)	12.5	255	- 63.6	270	- 61.4	300	- 50.0	320	- 36.0
Control	-	700	-	700	-	600	-	500	-

Table (33). **Adult fecundity of *S. littoralis* late-season field strain (after spraying program) for groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.**

Insecticides	Rate (ml)/ feddan	Average no. of eggs/female resulted from group of larvae survived after feeding on treated cotton leaves collected at the indicated days.							
		1^{st} ($0 - 1^{st}$ day)		2^{nd} ($7 - 8^{th}$ day)		3^{rd} ($14 - 15^{th}$ day)		4^{th} ($21 - 22^{th}$ day)	
		Eggs no.	% Change	Eggs no.	% Change	Eggs no.	% Change	Eggs no.	% Change
Pyriproxyfen (10% EC)	300	60	- 91.4	85	- 87.9	210	- 65.0	280	- 44.0
	150	-	-	90	- 87.1	240	- 60.0	310	- 38.0
Chromafenozide (5% EC)	400	0	- 100	-	-	40	- 93.3	250	- 50.0
	200	-	-	-	-	75	- 87.5	270	- 46.0
Azadirachtin (4.5% EC)	100	100	- 85.7	130	- 81.4	150	- 75.0	320	- 36.0
	50	150	- 78.6	175	- 75.0	200	- 66.7	380	- 24.0
Ethoxazole (10% SC)	25	0	- 100	-	-	100	- 83.3	300	40.0
	12.5	70	- 90.0	100	- 85.7	130	- 78.3	350	- 30.0
Control	-	700	-	700	-	600	-	500	-

a- Laboratory reference strain :

Data in Table (34) revealed that the eggs deposited by adult females produced from different groups of susceptible strain larvae were susceptible to the latent effect of the tested insecticides. The inhibition in egg hatch reached 100 %, 100 %, 99-100 % and 98.6-100 %. In 1*st* (0-1 day), 2*nd* (7-8 day), 3*rd* (14-15 day) and 4*th* (21-27 day) testing intervals, respectively. However, in Chromafenozide no eggs were deposited where no adults resulted from the larval treatments in all testing intervals. Similarly, no deposited eggs was recorded in Ethoxazole's 1*st* and 2*nd* testing intervals and in the 3*rd* and 4*th* testing intervals of Azadirachtin treatments.

b- Early-season field strain (before spraying program) :

As shown in Table (35) the latent effects of the tested compounds on eggs deposited laterly by adults produced from larval treatments of early-season field strain was relatively less susceptible than that for the laboratory reference strain. The recorded inhibition in eggs hatch reached 90.3-100 %, 86-98.6 %, 85-96 % and 75.7-95.2% at the 1*st* (0-1 day), 2*nd* (7-8 day), 3*rd* (14-15 day) and 4*th* (21-22 day), respectively. Comparison between different testing intervals revealed that the highest latent effect on eggs hatch inhibition was recorded in the 1*st* (0-1 day) testing interval and in general the maximum effect was recorded by Pyriproxyfen treatments (99.9-100 %) and was followed closely by Ethoxazole treatments (95.2-98.9 % and laterly came Azadirachtin treatments (90.3-95 %). However, it was worthy mentioning that no data was recorded in Chromafenozide treatments where no adult emerged from larval treatments.

c- Late-season field strain(after spraying program):

Data in Table (36) indicate in general that the late-season field strain performed slightly different than either laboratory or/and early-season field strains where it tolerate more the insecticidal treatments which in turn reflex on the latent effects. It was obvious that the latent

Table (34). Eggs viability deposited by females of *S. littoralis* (Laboratory strain) resulted from groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	% Sterility in eggs deposited by females resulted from groups of larvae survived after feeding on treated leaves collected at indicated days.			
		1^{st} ($0 - 1^{st}$ day)	2^{nd} ($7 - 8^{th}$ day)	3^{rd} ($14 - 15^{th}$ day)	4^{th} ($21 - 22^{th}$ day)
Pyriproxyfen (10% EC)	300	-	100	100	100
	150	100	100	100	100
Chromafenozide (5% EC)	400	-	-	-	-
	200	-	-	-	-
Azadirachtin (4.5% EC)	100	100	100	-	-
	50	100	100	-	-
Ethoxazole (10% SC)	25	-	-	100	100
	12.5	-	-	99.0	98.6
Control	-	0	0	0	0

Table (35). Eggs viability deposited by females of *S. littoralis* early-season field strain (before spraying program) resulted from groups of larvae fed for 48 h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditions.

Insecticides	Rate (ml)/ feddan	% Sterility in eggs deposited by females resulted from groups of larvae survived after feeding on treated leaves collected at indicated days.			
		1^{st} (0 - 1^{st} day)	2^{nd} (7 - 8^{th} day)	3^{rd} (14 - 15^{th} day)	4^{th} (21 - 22^{th} day)
Pyriproxyfen (10% EC)	300	100	98.6	95.0	90.6
	150	99.9	95.6	90.7	85.4
Chromafenozide (5% EC)	400	-	-	-	-
	200	100	-	-	-
Azadirachtin (4.5% EC)	100	95.0	90.0	-	-
	50	90.3	86.0	-	75.7
Ethoxazole (10% SC)	25	98.9	98.0	96.0	95.2
	12.5	95.2	90.0	85.0	80.0
Control	-	0	0	0	0

Table (36). Eggs viability deposited by females of *S. littoralis* late-season field strain (after spraying program) resulted from groups of larvae fed for 48h. on treated cotton leaves collected at different time intervals after applying insecticides under field conditons.

Insecticides	Rate (ml)/ feddan	% Sterility in eggs deposited by females resulted from groups of larvae survived after feeding on treated leaves collected at indicated days.			
		1^{st} ($0 - 1^{st}$ day)	2^{nd} ($7 - 8^{th}$ day)	3^{rd} ($14 - 15^{th}$ day)	4^{th} ($21 - 22^{th}$ day)
Pyriproxyfen (10% EC)	300	100	90.5	84.7	80.3
	150	-	80.0	75.0	75.4
Chromafenozide (5% EC)	400	-	-	90.0	90.0
	200	-	-	80.0	80.7
Azadirachtin (4.5% EC)	100	80	75.3	70.0	70.0
	50	71.3	65.7	60.0	60.5
Ethoxazole (10% SC)	25	-	-	85.0	75.0
	12.5	90	85.0	70.7	70.0
Control	-	0	0	0	0

effect on eggs hatch inhibition reached 71.3-100 %, 65.7-90.5 %, 60-90 % and 60.5-90 % in the 1*st* (0-1 day), 2*nd* (7-8 day), 3*rd* (14-15 day) and 4*th* (21-22 day) testing intervals, respectively. No data was recorded only in the 1*st* and 2*nd* testing intervals of both treatments of Chromafenozide and the higher rate (25 ml/fed) of Ethoxazole which confirmed the relatively lower latent effect on the more tolerant late-season field strain. Data of eggs hatch inhibition in the 3*rd* and 4*th* testing intervals indicate that Chromafenozide (80-90 % and 80.7-90 %) was the first in this respect and was followed by the Pyriproxyfen (75-84.7 % and 75.4-80.3 %), Ethoxazole (70.7-85 % and 70-75 %) and Azadirachtin (60-70 % and 60.5-70 %), respectively.

In previous studies **Schmidt *et al.* (1997)** found that at concentrations of 10, 15 and 25 ppm *Melia* extract (*Azadirachta indica*) caused no adult emerged from pupae, fecundity and fertility were drastically reduced. Likewise, **Sammour and Abdalla (1989)** found that treatment of last instar larvae of *Heliothis armigera* with sublethal doses of Teflubenzuron caused considerable reduction in fecundity and fertility of the emerged adults with sterilizing effects amounted to ca. 91 %. In this respect. **Gelbic and Matiola (1984)** found the Juvenile hormone analogue (JHA) caused reduction in rate of eggs hatch and demonstrating that this performance could be due to numerous disorders in embryonic development. Recently, **Aldebis *et al.* (1994)** indicated that feeding on Fenoxycarb (JHA)-treated leaves resulted in alteration in the development of germinal cells ending in either malformed spermatozoa or eupyrene bundles.

4.3- The effect of non-traditional pesticides on feeding activity and nutritional indices :

4.3.1- Food consumption (C.W.) :

On the basis of the overall mean weight of food consumed by early-season 4*th* instar larvae of *S. littoralis*, data in Table (37) indicate that the feeding ability of the larvae was significantly affected by insecticidal treatments, except for pyriproxyfen at the high rate, resulting in great and significant decrease in overall mean weight of food consumed. The overall weight of consumed food reached 144.3± 23.1 mg by pyriproxyfen (150 ml/200 L), 107.5±15.8 and 110.5±19.2 mg by Chromafenozide (at 400 and 200 ml/200 L, respectively), 116.87±12.4 and 126.62±12.6 mg by Azadirachtin (at 100 and 50 ml/200 L, respectively) and 124.64±11.5 and 134.34±12.4 mg by Ethoxazole (at 25 and 12.5 ml/200 L, respectively) versus 154.16±1.62 mg for control larvae. However, the reduction in overall mean consumed food was in general positively correlated in most treatments with the concentration level, regardless of the tested insecticide.

Regarding the change in mean consumed food relative to the control larvae in details during different testing intervals, it was of interest to note that pyriproxyfen at 300 and 150 ml/200 L resulted in increase of +38.62 and +2.25 % in mean food consumed per larvae per day at the 1*st* (initial) testing interval whereas other treatments of Chromafenozide at 400 and 200 ml/200 L, Azadirachtin at 100 and 50 ml/200 L and Ethoxazole at 25 and 12.5 ml/200 L resulted in remarkable percent decrease of -41.34, -42.12; -36.58, -29.49; and -30.6, -24.5 % for the prementioned treatments, respectively. Also, it was obvious that the percent decrease in mean food consumed was gradually decline with time elapse where the least decrease recorded at the 4*th* testing intervals (21-22 day posttreatment) where the residues of sprayed insecticide was at its least level on treated leaves. However, the maximum reduction in mean food consumed (-24.49 and -26.32 %) was recorded by Pyriproxyfen 10 % EC at 300 and 150 ml/200 L whereas the least mean reduction (-11.49 and -3.37 %) was recorded

Table (37) : Mean daily weight of consumed food (C.W.) for groups of early season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Mean daily weight of consumed food (mg/larva) at the indicated testing intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		mg/ larva	% change	mg/ larva	% change	mg/ larva	% change	mg/ larva	% change	
Pyriproxyfen (10 % EC)	300	216.93	+38.62	167.87	+9.74	166.05	+7.80	115.65	-24.49	166.63±41.36 a
	150	160.01	+2.25	162.96	+6.59	141.42	-8.19	112.85	-26.32	144.33±23.05 abc
Chromafenozide (5 % EC)	400	91.79	-41.34	101.38	-33.72	107.99	-29.89	129.11	-15.71	107.57±15.83 d
	200	90.57	-42.12	105.62	-30.95	109.19	-29.11	136.63	-10.79	110.50±19.20 d
Azadirachtin (4.5 % EC)	100	99.25	-36.58	119.05	-22.17	120.54	-2.17	128.62	-16.03	116.87±12.47 cd
	50	110.33	-29.49	125.20	-18.15	130.35	-15.37	140.61	-8.20	126.62±12.61 bcd
Ethoxazole (10 % SC)	25	108.60	-30.60	120.05	-21.52	125.33	-18.64	135.57	-11.49	124.64±11.50 bcd
	12.5	118.95	-24.50	130.20	-14.88	140.81	-8.58	147.39	-3.77	134.34±12.47 bcd
Control	-	156.49	-	152.96	-	154.03	-	153.17	-	154.16±1.62 ab
L.S.D.$_{0.05}$:										28.47

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

for Ethoxazole 10 % SC at 25 and 12.5 ml/200 L during the 4*th* testing interval (21-22 day posttreatment).

In respect to the late season *S. littoralis* strain, data presented in Table (38) revealed slight and insignificant decrease in overall mean weight of food consumed when different treatments were compared with control treatment.

Regarding the detailed change in mean consumed food relative to control during different testing intervals, it was obvious that the highest decrease at the 1*st* (initial) testing interval (-35.09 and -33.28 %) was recorded for Azadirachtin 45 % EC at 100 and 50 ml/200 L, respectively; while the least (-20.33 and -16.75 %) was recorded for Chromafenozide 5 % EC at 400 and 200 ml/200 L, respectively.

Also, it was obvious that the percent decrease in mean food consumed was gradually declined with time elapse to reach its least value at the 3*rd* testing interval at 14-15 day posttreatment, then a sudden increase in mean food consumed was exhibited at the 4*th* testing interval at 21-22 day posttreatment. However, the highest mean food consumed (+34.16 and +33.68 %) was recorded by Azadirachtin treatments (100 and 50 ml/200 L), while the least increase of +17.45 and +5.09 % was recorded for Pyriproxyfen 10 % EC at 300 and 150 ml/200 L, respectively.

Such performance of insignificant variations in response of larvae of late season strain between treatments and control larvae could be explained in view of the larvae being more tolerant to insecticidal treatments which reflect in their low response to insecticides particularly at the last (4*th*) testing interval where sublethal low residues of insecticides at such time on leaves exhibited stimulatory effect as manifested by increase in mean food consumed, reached its maximum (+34.16 and +33.68 %) by both treatments of Azadirachtin.

As for the laboratory strain (Table 39), its response to different treatments was almostly similar to the early-season strain in respect to mean food consumed.

Table (38) : Mean daily weight of consumed food (C.W.) for groups of late season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Mean daily weight of consumed food (mg/larva) at the indicated testing intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		mg/ larva	% change	mg/ larva	% change	mg/ larva	% change	mg/ larva	% change	
Pyriproxyfen (10 % EC)	300	117.87	-24.18	118.32	-22.65	129.11	-16.18	179.91	+17.45	136.32±29.57 a
	150	116.26	-25.71	119.36	-21.97	133.43	-13.37	160.97	+5.09	132.51±20.40 a
Chromafenozide (5 % EC)	400	124.67	-20.33	137.43	-10.15	145.98	-5.23	173.92	+13.55	145.5±20.87 a
	200	130.28	-16.75	135.55	-11.38	146.65	-4.79	197.23	+28.77	152.43±30.64 a
Azadirachtin (4.5 % EC)	100	101.57	-35.09	127.37	-16.73	131.19	-14.83	205.49	+34.16	141.41±44.0 a
	50	104.14	-33.28	136.32	-10.88	146.88	-4.64	204.76	+33.68	148.09±41.87 a
Ethoxazole (10 % SC)	25	111.22	-28.93	137.37	-10.19	146.67	-4.78	175.21	+14.38	142.62±26.71 a
	12.5	111.12	-28.93	142.17	-3.79	146.69	-4.77	181.47	+18.47	145.36±28.80 a
Control	-	156.49	-	152.96	-	154.03	-	153.17	-	154.16±1.62 a
L.S.D.$_{0.05}$:										43.11

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

Table (39) : Mean daily weight of consumed food (C.W.) for groups of *S. littoralis* laboratory strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Mean daily weight of consumed food (mg/larva) at the indicated testing intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		mg/ larva	% change	mg/ larva	% change	mg/ larva	% change	mg/ larva	% change	
Pyriproxyfen (10 % EC)	300	228.49	+46.01	181.97	+18.97	16.67	+8.21	137.25	-10.39	178.60±38.09 a
	150	209.03	+33.57	164.78	+7.73	145.50	-5.53	141.36	-7.71	165.28±31.19 a
Chromafenozide (5 % EC)	400	81.78	-47.74	89.38	-41.56	94.74	-38.49	105.23	-31.29	92.78±9.86 b
	200	85.14	-45.59	102.74	-32.83	102.74	-33.29	105.23	-31.29	98.80±9.20 b
Azadirachtin (4.5 % EC)	100	98.94	-36.78	113.23	-25.97	113.26	-26.47	127.22	-16.94	113.16±11.55 b
	50	105.69	-32.46	115.18	-24.69	116.49	-24.37	136.56	-10.84	118.46±12.98 b
Ethoxazole (10 % SC)	25	104.16	-33.44	119.50	-33.46	119.87	-22.11	132.55	-13.46	119.05±11.62 b
	12.5	104.65	-33.13	127.20	-16.84	127.20	-17.42	135.75	-11.33	123.54±13.63 b
Control	-	156.49	-	152.96	-	154.03	-	153.17	-	154.16±1.62 a
L.S.D.$_{0.05}$:										27.49

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

4.2.2- Consumption index (C.I.) :

Data indicating consumption index (C.I.) values for the three tested strains (early-season, late-season and laboratory strains) are shown in Tables (40, 41 & 42). The data obviously indicate that C.I. was found to be associated with the amount of food consumed and though showed in general the same trend.

Data in Table (40) show that the overall mean of consumption index (C.I.) of the early-season strain larvae was significantly decreased below that of control in all treatments, except for those of Pyriproxyfen where C.I. recorded was insignificantly similar to control. Both treatments of Chromafenozide (400 and 200 ml/200 L) resulted in significantly the least C.I. values.

Regarding the detailed data at different testing intervals, a remarkable decline in C.I. values was recorded with time elapse where the longer the period after treatment the higher the C.I. value although it was still less than those recorded for control.

In respect to the late-season *S. littoralis* larvae, data shown in Table (41) revealed slight and insignificant decrease in overall mean C.I. for larvae in all treatments and control. However, regarding the change in detailed data during different testing intervals, it was obvious that the highest reduction in C.I. values (-48.48 and -45.45 %) at the 1*st* (initial) testing interval was recorded for Ethoxazole at 25 and 12.5 ml/200 L, respectively, while the least reduction in C.I. values (-21.21 and -21.21 %) was recorded for Chromafenozide at rate of 400 and 200 ml/200 L, respectively.

As for the overall mean of C.I. values for laboratory strain larvae, data in Table (42) revealed a trend of reduction similar to that recorded for larvae of early-season strain where Pyriproxyfen at the two tested rates exhibited almostly an overall mean similar and insignificant when compared with control. However, the other three insecticides Chromafenozide, Azadirachtin and Ethoxazole exhibited

Table (40) : Consumption index (C.I.) for groups of early season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Mean C.I. values at the indicated testing intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		C.I.	% change	C.I.	% change	C.I.	% change	C.I.	% change	
Pyriproxyfen (10 % EC)	300	0.47	+42.42	0.37	+5.71	0.36	+2.86	0.30	-9.09	0.37±0.70 a
	150	0.41	-24.24	0.36	+2.86	0.31	-11.43	0.30	-9.03	0.35±0.50 a
Chromafenozide (5 % EC)	400	0.19	-42.42	0.21	-40.0	0.21	-40.0	0.23	-3.30	0.24±0.02 d
	200	0.21	-36.36	0.21	-40.0	0.23	-34.29	0.28	-15.15	0.23±0.03 d
Azadirachtin (4.5 % EC)	100	0.25	-24.24	0.28	-20.0	0.29	-17.14	0.29	-12.12	0.28±0.02 bc
	50	0.26	-21.21	0.29	-17.14	0.29	-17.14	0.30	-9.09	0.28±0.02 bc
Ethoxazole (10 % SC)	25	0.26	-21.21	0.29	-17.14	0.29	-17.14	0.29	-12.12	0.28±0.01 bc
	12.5	0.26	-21.21	0.29	-17.14	0.30	-14.29	0.31	-6.06	0.29±0.02 b
Control	-	0.33	-	0.35	-	0.35	-	0.33	-	0.34±0.01 a
L.S.D.$_{0.05}$:										0.07

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

Table (41) : Consumption index (C.I.) for groups of late season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Mean C.I. values at the indicated testing intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		C.I.	% change	C.I.	% change	C.I.	% change	C.I.	% change	
Pyriproxyfen (10 % EC)	300	0.22	-33.33	0.22	-37.14	0.23	-34.29	0.34	+30.30	0.25±0.06 a
	150	0.22	-33.33	0.23	-34.29	0.25	-28.57	0.36	+9.09	0.26±0.06 a
Chromafenozide (5 % EC)	400	0.26	-21.21	0.26	-25.71	0.26	-25.71	0.39	+18.18	0.29±0.06 a
	200	0.26	-21.21	0.26	-25.71	0.27	-22.86	0.39	+18.18	0.29±0.08 a
Azadirachtin (4.5 % EC)	100	0.21	-36.36	0.26	-25.71	0.27	-22.86	0.39	+18.18	0.28±0.08 a
	50	0.19	-42.42	0.26	-25.71	0.26	-25.71	0.38	+15.15	0.27±0.07 a
Ethoxazole (10 % SC)	25	0.17	-48.48	0.26	-25.71	0.29	-17.14	0.34	+30.30	0.26±0.07 a
	12.5	0.18	-45.45	0.26	-25.71	0.28	-20.0	0.35	+6.06	0.27±0.07 a
Control	-	0.33	-	0.35	-	0.35	-	0.33	-	0.34±0.01 a
L.S.D.$_{0.05}$:										0.09

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

Table (42) : Consumption index (C.I.) for groups of *S. littoralis* laboratory strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Mean C.I. values at the indicated testing intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		C.I.	% change	C.I.	% change	C.I.	% change	C.I.	% change	
Pyriproxyfen (10 % EC)	300	0.55	+66.67	0.38	+8.57	0.38	+8.57	0.29	-12.12	0.40±0.11 a
	150	0.45	+36.36	0.36	+2.86	0.31	-11.92	0.28	-15.15	0.35±0.07 a
Chromafenozide (5 % EC)	400	0.15	-54.55	0.20	-42.86	0.20	-42.86	0.22	-33.33	0.19±0.03 b
	200	0.17	-48.49	0.20	-42.86	0.21	-40.0	0.24	-27.27	0.20±0.03 b
Azadirachtin (4.5 % EC)	100	0.19	-42.42	0.21	-40.0	0.22	-37.14	0.25	-24.24	0.22±0.02 b
	50	0.21	-36.36	0.21	-40.0	0.22	-37.14	0.28	-15.15	0.23±0.03 b
Ethoxazole (10 % SC)	25	0.21	-36.36	0.21	-40.0	0.23	-34.29	0.28	-15.15	0.23±0.03 b
	12.5	0.25	-24.24	0.25	-28.57	0.26	-25.71	0.30	-9.09	0.26±0.02 b
Control	-	0.33	-	0.35	-	0.35	-	0.33	-	0.34±0.01 a
L.S.D.$_{0.05}$:										0.07

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

overall mean C.I. values insignificant between each other, while significantly lower than Pyriproxyfen and control. Also, the initial effect (at 1*st* testing interval) demonstrate the positive effect of Pyriproxyfen, manifested as highly pronounced increase in C.I. values (+66.67 and +36.36 %) for both rates tested, compared with the remarkable decrease in C.I. value (-54.55 and -48.49, -42.42 and -36.36, 36.36 and 24.24 %) for the high and low rates of each of Chromafenozide, Azadirachtin and Ethoxazole, respectively.

The present results (Tables 37-42), generally show an inhibitory action of the tested compounds on the food consumption whether its determination was estimated as amount in mg (C.W.) or % (C.I.). Such an observations are in agreement with earlier reports which indicated that insect growth disruptors interfere with feeding **(Mulder and Giswijt, 1973; Ascher and Nemny, 1976; Abid *et al.*, 1978)**. Moreover, previous reports have also confirmed that diflubenzuron acts on the peritrophic membrane by affecting its chitin-protein structure, hindering its role in protecting secreting cells from any damage **(Clarke *et al.*, 1977)**.

Also, our findings agree with results recorded for several insect species such as *S. littoralis* fed on diflubenzuron-treated castor leaves **(Sundaramurthy, 1977 and Radwan *et al.*, 1986)**, *S. littoralis* fed on fenarimol or nuarimol (fungicides with anti-ecdysone activity)-treated cotton leaves **(Farag, 1991)**. Also, **Schmidt *et al.* (1997)** found that a methanol extract of *Melia azedarach* fruits reduced food consumption. Furthermore **Salama and Ahmed (1997)** found that methanol extract, *Melia azedarach* exhibited decrease in respiration quotient (OR) and destroyed epithelial cells, the peritrophic membrane and basement membrane of the midgut of the tested larvae with 100 ppm. Outside Lepidoptera, **Ismail (1995)** recorded various reductions of relative consumption rate (RCR), consumed food amounts (C.W.) and faeces after topical application of fenoxycarb (a juvenoid) onto newly moulted last instar nymphs of *S. gregaria*. **Ghoneim (1994)**, also

applied topically various doses of Pyriproxyfen onto newly moulted last instar nymphs of *S. gregaria*, a dose level of 10 µg/nymph gave an inhibitory effect of this juvenoid and 100 and 150 µg/nymph gave a reverse effect on food ingestion and consumption.

4.3.3- Growth Rate (G.R.) :

The effect on growth rate (G.R.) after feeding 4*th* instar larvae of the three tested strains (early-season strain, late-season strain and laboratory strain) on cotton leaves at specific intervals after spraying of the four tested pesticides is demonstrated in Tables (43, 44 & 45).

Data in Table (43) representing the response of early-season larvae after feeding on treated cotton leaves collected at 0-1 day (initial) posttreatment revealed remarkable decrease in larval growth by percentage ranged between -51.66 % and -32.0 % for Chromafenozide, Azadirachtin and Ethoxazole whereas Pyriproxyfen at both rates tested resulted in highly pronounced increase in G.R. values of +122.6 % and +41.33 % for 300 and 150 ml/200 L, respectively.

Comparison on the basis of statistical analysis of the overall mean during the whole experimental periods indicate a remarkable reduction in overall mean growth rate (G.R.) in all treatments except both rates of Pyriproxyfen where a considerable and significant increase (0.425±0.1 and 0.33±0.09) relative to control (0.3±0.05) was recorded. Also, it was obvious that the lowest G.R. value (0.189±0.04) was recorded for larvae fed leaves treated with Chromafenozide at 400 ml/200 L, while the highest G.R. value (0.425±0.1) was recorded when the 4*th* instar larvae were fed on leaves treated with Pyriproxyfen at 300 ml/200 L which was also significantly higher than other treatments including the control (0.309±0.05).

As for the late-season *S. littoralis* strain (Table, 44), it was obvious that all tested treatments during the first three testing intervals exhibited G.R. values remarkably lower than the control. The reduction

Table (43) : Growth rate (G.R.) for groups of early season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Mean growth rate values (G.R.) at the indicated testing intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		G.R.	% change	G.R.	% change	G.R.	% change	G.R.	% change	
Pyriproxyfen	300	0.668	+122.6	0.411	+30.47	0.406	+30.96	0.216	-30.99	0.425±0.1 a
(10 % EC)	150	0.424	+41.33	0.397	+26.03	0.282	-9.03	0.219	-30.03	0.330±0.09 ab
Chromafenozide	400	0.145	-51.66	0.164	-47.93	0.202	-34.83	0.247	-21.08	0.189±0.04 c
(5 % EC)	200	0.149	-50.33	0.189	-40.00	0.205	-33.87	0.265	-15.33	0.202±0.05 bc
Azadirachtin	100	0.158	-47.33	0.206	-34.60	0.223	-28.06	0.263	-15.97	0.212±0.04 bc
(4.5 % EC)	50	0.177	-41.00	0.240	-23.80	0.262	-15.48	0.287	-8.31	0.241±0.04 bc
Ethoxazole	25	0.185	-38.33	0.230	-26.98	0.250	-19.35	0.273	-12.78	0.234±0.03 bc
(10 % SC)	12.5	0.204	-32.00	0.255	-19.04	0.277	-10.64	0.297	-5.11	0.258±0.04 bc
Control	-	0.300	-	0.315	-	0.310	-	0.313	-	0.309±0.05 b
L.S.D.$_{0.05}$:										0.06

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

Table (44) : Growth rate (G.R.) for groups of late season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Mean growth rate values (G.R.) at the indicated testing intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		G.R.	% change	G.R.	% change	G.R.	% change	G.R.	% change	
Pyriproxyfen	300	0.201	-33.0	0.223	-28.98	0.254	-18.06	0.412	+31.63	0.272±0.09 a
(10 % EC)	150	0.198	-34.0	0.224	-28.66	0.256	-17.42	0.401	+28.11	0.269±0.09 a
Chromafenozide	400	0.228	-24.0	0.274	-12.73	0.294	-5.16	0.451	+44.09	0.311±0.09 a
(5 % EC)	200	0.236	-21.33	0.271	-13.69	0.293	-5.48	0.513	+63.89	0.328±0.01 a
Azadirachtin	100	0.183	-39.0	0.235	-25.15	0.261	-15.8	0.523	+67.09	0.301±0.02 a
(4.5 % EC)	50	0.179	-40.33	0.265	-15.6	0.287	-7.42	0.511	+63.26	0.310±0.01 a
Ethoxazole	25	0.188	-37.33	0.239	-23.88	0.265	-1452	0.451	+44.09	0.382±0.01 a
(10 % SC)	12.5	0.177	-41.0	0.242	-22.92	0.296	-4.52	0.477	+52.39	0.298±0.01 a
Control	-	0.300	-	0.314	-	0.310	-	0.313	-	0.309±0.06 a
L.S.D.$_{0.05}$:										0.08

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

percentages in G.R. values were higher at the 1*st* testing interval (ranged between -41.0 and -21.33 %) and declined gradually by time elapse to reach the minimum level of reduction in G.R. values (ranged between -18.06 and -4.52 %) at the 3*rd* (14-18 day) testing interval. In contrast, the G.R. values at the 4*th* testing interval (21-22 day), where the pesticides residues (or metabolites) on leaves were at its lowest level, stimulate the growth rate and resulted in considerable increase in G.R. values ranged between +67.09 and +28.11 %. However, comparison on the basis of the overall means during the 4 testing intervals revealed insignificant differences between all treatments including the control.

Data in Table (45) demonstrate the response of laboratory-strain larvae of *S. littoralis* concerning the G.R. when larave were fed and subjected to insecticides-treated leaves, collected at specific testing intervals.

Generally, all treatments, except Pyriproxyfen, resulted in remarkable reduction in G.R. values which was at its highest level initially (during the 1*st* testing interval) then decreased gradually with progress in time after spraying. The percent reduction in G.R. values ranged between -40.67 and -65.67 % at the 1*st* (0-1 day) testing interval, -21.38 and -60.51 % at the 2*nd* (7-8 day) testing interval, -19.35 and -58.93 % at the 3*rd* (14-15 day) testing interval, while ranged between -9.9 and -40.25 % at the 4*th* (21-22 day) testing interval. On contrary, the G.R. values increased remarkably in most testing intervals of Pyriproxyfen treatments by percent ranged between +141.0 % and +30.0 %.

Comparison based on the overall mean during the whole experimental period revealed that G.R. values in different treatments could be arranged statistically in three categories, the first higher than control (GR = 0.471-0.39) which includes only Pyriproxyfen both treatments, the second include control only (GR = 0.309), while the third having GR values lower than control (GR = 0.235-0.138) and include treatments of the other three pesticides.

Table (45) : Growth rate (G.R.) for groups of *S. littoralis* laboratory strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Mean growth rate values (G.R.) at the indicated testing intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		G.R.	% change	G.R.	% change	G.R.	% change	G.R.	% change	
Pyriproxyfen	300	0.723	+141.0	0.478	+52.23	0.403	+30.0	0.279	-9.90	0.471±0.18 a
(10 % EC)	150	0.576	+92.0	0.419	+33.44	0.292	-5.81	0.274	-12.46	0.390±0.13 ab
Chromafenozide	400	0.103	-65.67	0.124	-60.51	0.139	-55.16	0.187	-40.25	0.138±0.03 d
(5 % EC)	200	0.115	-61.67	0.169	-46.18	0.183	-58.93	0.215	-31.31	0.170±0.04 d
Azadirachtin	100	0.140	-53.33	0.170	-45.86	0.171	-44.84	0.203	-35.46	0.171±0.02 d
(4.5 % EC)	50	0.169	-43.67	0.172	-45.22	0.187	-39.68	0.268	-14.38	0.199±0.04 cd
Ethoxazole	25	0.168	-44.0	0.229	-27.07	0.230	-25.81	0.257	-17.89	0.221±0.03 cd
(10 % SC)	12.5	0.178	-40.67	0.247	-21.38	0.250	-19.35	0.267	-14.70	0.235±0.03 cd
Control	-	0.300	-	0.314	-	0.310	-	0.313	-	0.309±0.05 bc
L.S.D.$_{0.05}$:										0.04

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

It was rationally accepted that the larval growth had been hindered by the inhibitory action of these compounds on feeding and the metabolic abilities of *S. littoralis* larvae. In this respect, **Radwan *et al.* (1986)** found that larvae of *S. littoralis* fed on diflubenzuron and triflumuron-treated leaves have shown a proportional relationship between food consumed and values of both consumption index and growth rate throughout the study course and that both treatments showed considerable decrease in growth rate. Likewise, **Woodring *et al.* (1978)** and **Sundramurthy (1977)** indicated that the amount of growth reduction in *S. littoralis* was proportional in general to reduced food consumption. Similar results had been found by other authors after applying different IGRs against various insect species such as *Agrotis ipsilon* **(Reese and Beck, 1976a, b & c)**, *Manduca sexta* **(Dahlman, 1977)**, and *S. gregaria* **(Ghoneim, 1994)**.

However, several authors explained the depressed G.R. or depleted R.W.G. by the decreasing amounts of food consumed. This interpretation may be also suggested in the present study because the data of Tables (37, 38 & 39) clearly show detrimentally reduced food consumed (C.W.).

4.3.4- Approximate Digestibility (A.D.) :

Data in Tales (46, 47 & 48) reveals the approximate digestibility (A.D.) of food in larvae of *S. littoralis* representing the three different tested strains. As shown in Table (46), it was obvious that the overall mean of A.D. in control larvae of early-season strain was 87.65±1.48 %. Feeding the 4*th* instar larvae on leaves treated with different pesticides resulted in either decrease or increase in A.D. depending on the pesticide or/and the concentration used. Feeding the larvae on Chromafenozide-treated leaves increased significantly the percentage of digestibility, recording 92.3 % and 92.07 % at both tested rates of 400 and 200 ml/200 L, respectively. Other treatments except Pyriproxyfen (300 ml/200 L) came significantly next and no significant

Table (46) : Approximate digestibility (A.D.) for groups of early season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Approximate digestibility (A.D. %) for *4th* instar larvae fed for 48 h on treated leaves collected at the indicated intervals								Mean ± S.D.
		1st interval 0-1 day		*2nd* interval 7-8 day		*3rd*interval 14-15 day		*4th* interval 21-22 day		
		A.D. %	% change	A.D. %	% change	A.D. %	% change	A.D. %	% change	
Pyriproxyfen	300	82.48	-4.56	84.37	-6.03	84.72	-3.13	88.61	+1.89	85.05±2.57 c
(10 % EC)	150	25.23	-1.38	87.44	-3.72	90.81	+3.84	90.84	+4.46	88.33±2.92 bc
Chromafenozide	400	97.15	+12.42	91.62	+2.05	90.48	+3.47	89.93	+3.42	92.30±3.31 a
(5 % EC)	200	95.26	+10.23	92.85	+3.42	90.19	+3.13	89.97	+3.46	92.07±2.50 a
Azadirachtin	100	93.12	+7.76	90.43	+0.72	89.32	+2.64	89.33	+2.73	90.55±1.79 ab
(4.5 % EC)	50	91.36	+5.72	90.50	+0.80	89.75	+2.63	89.36	+2.76	90.24±0.88 ab
Ethoxazole	25	90.36	-4.56	90.12	+0.38	89.29	+2.10	87.28	+0.37	89.26±1.40 ab
(10 % SC)	12.5	91.45	+5.82	90.59	+0.80	89.89	+0.50	87.32	+0.41	89.31±2.02 ab
Control	-	86.42	-	89.78	-	87.45	-	86.96	-	87.65±1.48 bc.
L.S.D.$_{0.05}$:										3.23

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

Table (47) : Approximate digestibility (A.D.) for groups of late season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Approximate digestibility (A.D. %) for *4th* instar larvae fed for 48 h on treated leaves collected at the indicated intervals								Mean ± S.D.
		1st interval 0-1 day		*2nd* interval 7-8 day		*3rd*interval 14-15 day		*4th* interval 21-22 day		
		A.D. %	% change	A.D. %	% change	A.D. %	% change	A.D. %	% change	
Pyriproxyfen	300	89.42	+3.47	89.91	+0.15	88.46	+1.16	81.37	-6.43	87.29±3.99 a
(10 % EC)	150	89.70	+3.79	90.90	+1.25	93.07	+6.43	84.98	-43.68	89.60±3.42 a
Chromafenozide	400	96.73	+11.93	92.14	+2.63	87.79	+0.39	86.37	0.68	90.76±4.68 a
(5 % EC)	200	91.43	+5.79	0.01	+0.26	87.14	+0.36	86.24	0.83	88.70±2.42 a
Azadirachtin	100	92.76	+7.34	91.95	+2.42	95.53	+9.24	86.55	0.47	91.70±3.76 a
(4.5 % EC)	50	91.60	+5.99	90.66	+0.98	90.41	+3.39	86.58	-0.44	89.81±2.21 a
Ethoxazole	25	90.92	+5.22	92.11	+2.6	87.61	+0.18	86.05	-1.14	89.17±2.82 a
(10 % SC)	12.5	91.31	+5.66	90.35	+0.64	87.88	+0.49	86.55	-0.47	89.02±2.19 a
Control	-	86.42	-	89.78	-	87.45	-	86.96	-	87.65±1.48 a
L.S.D.$_{0.05}$:										4.57

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

Table (48) : Approximate digestibility (A.D.) for groups of *S. littoralis* laboratoty strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Approximate digestibility (A.D. %) for *4th* instar larvae fed for 48 h on treated leaves collected at the indicated intervals								Mean ± S.D.
		1st interval 0-1 day		*2nd* interval 7-8 day		*3rd*interval 14-15 day		*4th* interval 21-22 day		
		A.D. %	% change	A.D. %	% change	A.D. %	% change	A.D. %	% change	
Pyriproxyfen	300	80.59	-6.75	82.58	-8.02	83.88	-4.08	87.85	+1.02	83.72±3.06 c
(10 % EC)	150	83.96	-2.85	85.81	-4.42	89.29	+2.10	91.21	+4.89	87.57±3.28 bc
Chromafenozide	400	96.97	+12.12	92.99	+3.52	87.74	+0.33	87.71	+0.86	91.34±4.49 ab
(5 % EC)	200	96.49	+11.65	93.05	+3.64	93.43	+6.84	91.89	+5.67	93.71±1.96 a
Azadirachtin	100	96.49	+11.58	93.01	+3.59	93.02	+6.37	89.38	+2.78	92.97±2.90 a
(4.5 % EC)	50	94.84	+9.74	91.95	+2.42	91.09	+4.16	90.17	+3.69	92.0±2.02 ab
Ethoxazole	25	93.78	+8.52	89.88	+0.11	89.66	+2.53	88.46	+1.72	90.43±2.28 ab
(10 % SC)	12.5	98.20	+13.63	89.14	+0.71	89.21	+2.01	89.15	+2.51	91.42±4.52 ab
Control	-	86.42	-	89.78	-	87.45	-	86.96	-	87.65±1.48 bc
L.S.D.$_{0.05}$:										4.45

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

differences were noticed between them and the control. Pyriproxyfen at rate of 300 ml/200 L recorded an approximate digestibility (85.05 %) insignificantly lower than control (87.65 %).

As for late-season strain larvae (Table, 47) detailed data indicate slight increase in A.D. values ranged between +3.47 % and +11.93; +0.15 % and +2.63 %; +0.18 % and +9.24 % at 1*st* (0-1 day), 2*nd* (7-8 day) and 3*rd* (14-15 day) testing intervals, respectively, whereas remarkable decrease in A.D. % values ranged between -0.44 % and -43.68 % was recorded at the 4*th* (21-22 day) testing interval. Generally, the variations between the overall mean A.D. values during the whole experimental period were insignificant and the A.D. values ranged between 87.29 % and 91.70 %.

Data in Table (48) demonstrate the estimated A.D. % values for larvae of the laboratory strain when fed and subjected to different levels of pesticides residues on leaves collected at different testing intervals.

Data clearly show no significant difference in overall mean A.D. % between Pyriproxyfen (83.72 % and 87.57 %) and the control (87.65 %), where both recorded the least A.D. achieved. However, remarkable and significant increase in overall mean A.D. % values ranged between 93.71 % and 90.43 % was recorded for Chromafenozide (200 ml/200 L) and Ethoxazole (25 ml/200 L), respectively.

Generally, the aforementioned data (Tables 46-48) revealed that the tested compounds except Pyriproxyfen induced the 4*th* larvae to exhibit increasing A.D. Such results confirms those obtained by **Radwan *et al.* (1986)** for *S. littoralis* due to the action of diflubenzuron and triflumuron throughout th larval period from the 4*th* instar to 6*th* instar. On the other hand, our data also agree with data of **El-Dessouki and Omar (2000)** where they found that the high concentration (37.5 ppm) of the JHM Pyriproxyfen when fed as treated

leaves to the 4*th* and 6*th* larval instar of *Agrotis ipsilon* resulted in a significant reduction in AD % when compared with Control.

4.3.5- Efficiency of Conversion of Ingested-food (E.C.I.) :

The ability of insect to utilize food for growth is measured by the efficiency of conversion of ingested food (E.C.I.), together with the efficiency of conversion of digested food (E.C.D.) to body substances.

Data in Tables (49, 50 & 51) demonstrate the effect of feeding cotton leafworm 4*th* instar larvae of the three different strains for 48 h on insecticide- treated leaves, on the efficiency of conversion of ingested food (E.C.I.) to biomass. Data concerning early-season strain (Table, 49) show that all insecticides tested at the 1*st* testing interval (0-1 day) except Pyriproxyfen resulted in remarkable reduction in E.C.I. and recording reduction percentage ranged between -18.28 and -26.86. In contrast Pyriproxyfen recorded highly pronounced increase of +68.08 and +39.98 % in E.C.I. values at both rates tested.

Considering the bioresidual effect of th tested insecticides on E.C.I. values, it was obvious that the decrease in E.C.I. values decline with time elapse or/and the degradation of insecticide residues on treated leaves. For instance, it declined from -26.86 and -22.83; -22.78 and -21.07; -18.55 and -18.28 % at the 1*st* testing interval (0-1 day) to reach -9.61 and -8.29; -3.57 and -2.76; -2.08 and -2.04 % at the 4*th* testing interval (21-22 day) for Chromafenozide (400 and 200 ml/200 L), Azadirachtin (100 and 50 ml/200 L) and Ethoxazole (25 and 12.5 ml/200 L), respectively. On the other hand, the considerable percent increase in E.C.I. value recorded for Pyriproxyfen treatments at the 1*st* testing interval declined with time elapse and recorded slight percent decrease in E.C.I. values at the 4*th* testing interval.

Comparison on the basis of overall mean E.C.I. values within different testing intervals indicate that E.C.I. values in all treatments except Pyriproxyfen were slightly lower and were insignificant when

Table (49) : Efficiency of conversion of ingested food to body tissues (E.C.I.) for groups of early season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Conversion efficiency of ingested food to body tissues (E.C.I.) at the indicated tested intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		E.C.I. %	% change	E.C.I. %	% change	E.C.I. %	% change	E.C.I. %	% change	
Pyriproxyfen	300	30.79	+60.45	24.49	+9.44	24.48	+19.82	19.66	-8.75	24.85±4.56 a
(10 % EC)	150	26.50	+38.09	24.35	+18.78	19.79	-2.25	19.45	-4.89	22.57±3.42 ab
Chromafenozide	400	15.78	-17.77	16.19	-21.02	18.72	-18.49	19.12	-6.50	17.45±1.71 c
(5 % EC)	200	16.45	-14.28	17.89	-12.73	18.81	-7.93	19.41	-5.09	18.14±1.29 c
Azadirachtin	100	15.97	-16.78	17.29	-15.66	18.49	-9.49	20.43	-0.09	18.04±1.89 c
(4.5 % EC)	50	16.02	-16.52	19.19	-6.39	19.82	-3.08	20.43	-0.09	18.86±1.96 bc
Ethoxazole	25	17.01	-11.36	19.18	-6.44	19.95	-7.55	20.10	-1.71	19.06±1.24 bc
(10 % SC)	12.5	17.14	-10.68	19.57	-4.54	19.70	-3.57	20.12	-0.78	19.13±1.35 bc
Control	-	19.19	-	20.50	-	20.43	-	20.45	-	20.14±0.63 bc
L.S.D.$_{0.05}$:										3.38

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

Table (50) : Efficiency of conversion of ingested food to body tissues (E.C.I.) for groups of late season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Conversion efficiency of ingested food to body tissues (E.C.I.) at the indicated tested intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		E.C.I. %	% change	E.C.I. %	% change	E.C.I. %	% change	E.C.I. %	% change	
Pyriproxyfen (10 % EC)	300	17.02	-11.31	18.87	-7.95	19.67	-3.72	22.89	+11.93	19.61±2.45 a
	150	17.01	-11.36	18.77	-8.44	19.17	-6.17	24.93	+21.91	19.97±3.44 a
Chromafenozide (5 % EC)	400	18.31	-4.59	19.96	-2.63	20.14	-1.42	25.91	+26.69	21.08±3.32 a
	200	18.13	-5.52	19.96	-2.63	20.01	-2.06	25.99	+27.91	21.02±3.42 a
Azadirachtin (4.5 % EC)	100	17.99	-6.25	18.43	-10.09	19.86	-2.74	25.43	+24.35	20.43±3.49 a
	50	17.17	-10.53	19.41	-5.32	19.51	-4.50	24.93	+21.91	20.25±3.30 a
Ethoxazole (10 % SC)	25	16.88	-12.04	17.41	-15.07	18.08	-11.50	25.72	+25.77	19.52±4.16 a
	12.5	15.97	-16.78	16.46	-19.76	20.01	-2.06	26.31	+28.66	19.68±4.77 a
Control	-	19.19	-	20.50	-	20.43	-	20.45	-	20.14±0.63 a
L.S.D.$_{0.05}$:										4.92

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

Table (51) : Efficiency of conversion of ingested food to body tissues (E.C.I.) for groups of *S. littoralis* laboratory strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Conversion efficiency of ingested food to body tissues (E.C.I.) at the indicated tested intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		E.C.I. %	% change	E.C.I. %	% change	E.C.I. %	% change	E.C.I. %	% change	
Pyriproxyfen	300	31.66	+64.98	26.26	+28.09	24.17	+18.31	20.23	-1.08	25.58±4.25 a
(10 % EC)	150	27.56	+43.62	25.47	+24.24	26.07	-1.76	19.39	-5.18	24.62±3.60 a
Chromafenozide	400	12.64	-34.13	13.84	-34.49	14.65	-28.29	17.79	-13.01	14.73±2.20 d
(5 % EC)	200	13.48	-29.78	16.40	-20.0	17.86	-12.57	19.47	-4.79	16.80±2.45 bcd
Azadirachtin	100	14.18	-26.11	14.99	-26.88	15.09	-26.14	15.95	-22.01	15.05±0.72 cd
(4.5 % EC)	50	15.98	-16.73	16.83	-17.90	17.57	-13.99	19.60	-4.16	17.49±1.55 bcd
Ethoxazole	25	16.09	-16.15	19.13	-6.68	19.21	-5.97	19.38	-5.23	18.45±1.76 bcd
(10 % SC)	12.5	16.99	-5.73	19.47	-5.02	19.61	-4.01	19.63	-4.01	18.92±1.29 bc
Control	-	19.19	-	20.50	-	20.43	-	20.45	-	20.14±0.63 b
L.S.D.$_{0.05}$:										3.57

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

compared with control. However, Pyriproxyfen treatments only exhibited significantly higher E.C.I. values when compared with all other treatments including control.

Regarding the response of late-season strain larvae, data in Table (50) indicate no significant variations between different treatment and control based on overall mean E.C.I. values. However, detailed data at different testing intervals elucidate that the level of insecticides residues on leaves at the 4*th* testing interval (21-22 day) was low and not effective enough to affect the E.C.I. values specially against the tolerant larvae of the late-season strain. Furthermore, the level of residues at such testing interval (21-22 day) exhibited stimulatory effect and increase the E.C.I. values by percentages reached its maximum (+25.77 % and +28.66 %) for Ethoxazole at rate of 25 and 12.5 ml/200 L, while the minimum E.C.I. values of +11.93 and +21.91 % were recorded for Pyriproxyfen at rate of 300 and 150 ml/200 L, respectively.

As for the response of the laboratory strain larvae (Table, 51) it behaved almostly similar as those of the early season strain, where Pyriproxyfen at both rates recorded significantly the highest overall mean E.C.I. values (25.58 and 24.62 %), while Chromafenozide at 400 ml/200 L recorded significantly the least overall mean E.C.I. values (14.73 %).

4.3.6- Efficiency of Conversion of Digested-food (E.C.D.) :

The second indicator of food utilization is the efficiency of conversion of digested food (E.C.D.) which is sometimes called "Net Growth Efficiency" (or "Metabolic Efficiency"). It estimates the percentage of assimilated food to biomass **(Slansky and Scriber, 1985)**.

Data of E.C.D. shown in Table (52) indicate that at the 1*st* testing interval the initial effect of the tested compounds on early-season strain larvae was manifested by reduction percentages ranged between

Table (52) : Efficiency of conversion of digested food to body tissues (E.C.D.) for groups of early season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Conversion efficiency of ingested food to body tissues (E.C.I.) at the indicated tested intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		E.C.D. %	% change	E.C.D. %	% change	E.C.D. %	% change	E.C.D. %	% change	
Pyriproxyfen	300	37.33	+68.08	29.02	+27.06	27.97	+21.65	21.06	-10.46	28.84±6.67 a
(10 % EC)	150	31.09	+39.98	28.17	+23.34	21.99	-4.43	21.41	-8.97	25.66±4.74 ab
Chromafenozide	400	16.24	-26.86	17.67	-22.64	20.69	-10.08	21.26	-9.61	18.69±2.40 c
(5 % EC)	200	17.14	-22.83	19.27	-15.63	20.86	-9.34	21.57	-8.29	19.71±1.9 6c
Azadirachtin	100	17.15	-22.78	19.12	-16.28	20.70	-10.04	22.68	-3.57	19.91±2.35 c
(4.5 % EC)	50	17.53	-21.07	21.21	-7.13	22.42	-2.56	22.87	-2.76	21.01±2.43 bc
Ethoxazole	25	18.09	-18.55	21.21	-7.53	22.04	-4.22	23.03	-2.08	21.09±2.14 bc
(10 % SC)	12.5	18.15	-18.28	21.37	-6.44	22.42	-2.56	23.04	-2.04	21.24±2.18 bc
Control	-	22.21	-	22.84	-	23.01	-	23.52	-	22.89±0.54 bc
L.S.D.$_{0.05}$:										4.78

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

-18.28 % and -26.86 % for all tested pesticides except for Pyriproxyfen where a remarkable increase in E.C.D. relative to control reached +68.08 % and +39.98 % was recorded at both tested rates of 300 and 150 ml/200 L, respectively. However, such increase in E.C.D. value continued within the 2*nd* and 3*rd* testing intervals but was of gradually lower magnitude and then switch at the 4*th* testing interval to record low reduction percentage in E.C.D. of -10.46 and -8.97 % for both rates of Pyriproxyfen.

As for the late-season strain larvae (Table, 53), the E.C.D. was moderately affected for all insecticidal treatments and within most testing intervals recording percent reduction ranged between -10.72 % and -21.25 %; -2.93 % and -17.43 %; -0.3 % and -33.89 % for the 1*st* (0-1 day), the 2*nd* (7-8 day) and the 3*rd* (14-15 day) testing interval, respectively; while an increase percent ranged between +20.11 % and +29.21 % was recorded within the 4*th* testing interval (21-22 day).

Comparison based on overall mean E.C.D. revealed insignificant slight variations between E.C.D. values of different treatments including the control.

The response of the laboratory-strain larvae in relation to the obtained E.C.D. value was recorded in Table (54). The larvae performed similarly as the early-season strain larvae where reduction in E.C.D. values ranged between -41.29 % and -22.11 % for Chromafenozide, Azadirachtin and Ethoxazole versus an increase in E.C.D. value reached +76.86 % and +47.55 % for Pyriproxyfen at the 1*st* (0-1 day) testing interval.

Following the residual effect of pesticides residues after feeding the larvae on treated leaves collected at different time intervals after spray, it was obvious that the percent increase in E.C.D. values of Pyriproxyfen treatments was declined gradually with time elapse and switch to negligible decrease at the 4*th* (21-22 day) testing interval. Likewise, the highly decrease percent in E.C.D. value recorded at the

Table (53) : Efficiency of conversion of digested food to body tissues (E.C.D.) for groups of late season *S. littoralis* field strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Conversion efficiency of ingested food to body tissues (E.C.I.) at the indicated tested intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		E.C.D. %	% change	E.C.D. %	% change	E.C.D. %	% change	E.C.D. %	% change	
Pyriproxyfen	300	19.03	-14.32	20.99	-8.09	22.23	-33.89	28.25	+20.11	22.62±3.79 a
(10 % EC)	150	18.97	-14.59	20.65	-9.59	20.59	-10.52	29.34	+24.75	22.39±3.98 a
Chromafenozide	400	18.93	-14.77	21.65	-5.21	22.94	-0.30	29.99	+27.51	21.63±1.90 a
(5 % EC)	200	19.83	-10.72	22.17	-2.93	22.95	-0.26	30.14	+28.15	23.77±4.45 a
Azadirachtin	100	19.39	-12.69	20.04	-12.26	20.79	-9.65	29.38	+24.92	22.4±4.69 a
(4.5 % EC)	50	18.75	-15.58	21.41	-6.26	21.58	-6.21	28.79	+22.41	22.63±4.31 a
Ethoxazole	25	18.57	-16.43	18.91	-17.21	20.64	-10.29	29.89	+27.08	22.00±5.34 a
(10 % SC)	12.5	17.49	-21.25	18.86	-17.43	22.77	-10.43	30.39	+29.21	22.38±5.79 a
Control	-	22.21	-	22.84	-	23.01	-	23.52	-	22.98±0.54 a
L.S.D.$_{0.05}$:										6.19

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

Table (54) : Efficiency of conversion of digested food to body tissues (E.C.D.) for groups of *S. littoralis* laboratory strain larvae fed for 48 h on treated leaves, collected at indicated day posttreatment, followed by 5 days feeding on untreated leaves.

Insecticides	Rate/ feddan (ml.)	Conversion efficiency of ingested food to body tissues (E.C.I.) at the indicated tested intervals								Mean ± S.D.
		1*st* interval 0-1 day		2*nd* interval 7-8 day		3*rd*interval 14-15 day		4*th* interval 21-22 day		
		E.C.D. %	% change	E.C.D. %	% change	E.C.D. %	% change	E.C.D. %	% change	
Pyriproxyfen	300	31.28	+76.86	36.68	+60.59	28.82	+25.25	23.12	-1.70	31.97±7.39 a
(10 % EC)	150	32.77	+47.55	31.14	+36.34	22.48	-2.30	21.26	-9.61	26.91±5.88 ab
Chromafenozide	400	13.04	-41.29	14.89	-34.81	16.69	-27.47	20.24	-13.73	16.23±3.09 d
(5 % EC)	200	13.97	-37.10	17.63	-22.81	19.12	-16.91	22.28	-5.27	18.25±3.45 cd
Azadirachtin	100	14.70	-33.81	16.12	-29.42	16.22	-29.51	17.84	-24.15	16.22±1.28 d
(4.5 % EC)	50	16.85	-24.13	16.24	-28.89	17.07	-25.82	21.74	-7.57	17.97±2.53 cd
Ethoxazole	25	17.16	-22.74	21.28	-6.83	21.42	-6.19	21.91	-6.85	20.44±2.20 cd
(10 % SC)	12.5	17.30	-22.11	21.81	-4.51	21.98	-4.48	22.03	-6.34	20.78±2.32 cd
Control	-	22.21	-	22.84	-	23.01	-	23.52	-	16.22±0.54 d
L.S.D.$_{0.05}$:										5.50

Mean followed by the same letter are not significantly different (P = 0.05) according to Duncan's (1955) multiple range test.

1*st* (initial) time interval for the other three insecticides gradually decline with time elapse to reach the least percent decrease in *E.C.D.* values at the 4*th* testing interval.

Comparison based on overall mean E.C.D. values elucidate significantly the superiority of Pyriproxyfen both treatment and recording the highest E.C.D. values. Other treatments including the control came significantly next without any significant variations between each other.

The ability of insects to utilize food for growth is measured by the efficiency of conversion of ingested food (E.C.I.), together with efficiency of conversion of digested food (E.C.D.) to body substances. In the present study these two criteria (E.C.I. and E.C.D.) were decreased with most of pesticides tested (Chromafenozide, Azadirachtin and Ethoxazole). Similarly, previous studies indicate that different IGRs reduced E.C.I. and E.C.D. of various insect species such as diflubenzuron and triflumuron against *S. littoralis* **(Radwan *et al.*, 1986)**, fenarimol against *S. littoralis* **(Farag, 1991)** and fenoxycarb against *S. gregaria* **(Ismail, 1995)**.

El-Shazly (1993) indicated that the E.C.I. will vary with the digestibility of food (A.D.) and the proportional amount of digestible portion of the food which is converted to body substance and metabolized for energy to maintain life. Furthermore, **Waldbauer (1968)** cited that the (E.C.I.) would raise and fall with the (A.D.). This statement extends to the results obtained in this study. Though the reduced (E.C.I.) and (E.C.D.) obtained may result from diversion of energy from production of biomass to overcoming the effect of treatment.

Several studies indicates that some IGRs action on E.C.I. and E.C.D. depended on the dose level, in addition to the nature of the chemical and insect species. In this respect, **Abo-Elghar (1993)** found

that abamectin at 10 and 25 ppm caused a significant decrease in E.C.I. and E.C.D., whereas all concentrations tested of the JHM fenoxycarb and buprofezin caused increase in the E.C.I. and E.C.D. over control. Furthermore, **Abo-Elghar (1994)** found that several herbicides such as fluazifop, bentazone, ametryne, flamprop and ioxynil reduced the E.C.I. and E.C.D. below those of untreated control in *S. littoralis*.