J. Agric. Sci. Mansoura Univ., 27(7): 4965 - 4974, 2002

RESISTANCE TO INSECTICIDES, IGR's AND INTERACTION EFFECT BETWEEN THEIR MIXTURES ON THE COTTON LEAFWORM *Spodoptera littoralis* (BOISD.)

Ghoneim Y.F.
Central Agricultural Pesticides Laboratory, Agricultural Research Centre, Dokki, Egypt.

ABSTRACT

The resistance to several insecticides and IGR's and the interaction of insecticide / IGR mixtures were evaluated in Gharbia field strain of the cotton leafworm *Spodoptera littoralis* (Biosd.) before and after insecticidal application in 2000 cotton season.

The results revealed that the field strain was very highly resistant to the pyrethroid Sumi-alpha and sumicidin, however low to moderate levels of resistance were recorded to the pyrethroid, Meothrin; organophosphates and carbamates tested were found, except lannate which had resistance ratio surpassed the critical level.

Regarding level of resistance to IGR's at 5 days after treatment, results showed that *S. littoralis* was highly susceptible to the toxic action of Cascade and Mimic. No detectable levels of resistance to Atabron, Match and Consult were observed before control season, but resistance to Atabron and Match increased to 4.3 and 5.2-fold, respectively after control season-Low level of resistance to Alsystin was detected. However, high level of resistance, but still bellow the critical limit of resistance to Phares was found.

The joint action of Dursban / IGR and curacron / IGR combinations revealed that Dursban potentiated most of IGR's in susceptible and field strains before and after control season, while Curacron potentiated Cascade, Match and Mimic in susceptible strain; Cascade and Match in field strain before control season and only Consult after control season.

INTRODUCTION

It had been demonstrated that field populations of the Egyptian cotton leafworm *Spodoptera littoralis* (Boisd.) had developed high levels of resistance to several groups of insecticides (El-Guindy *et al.*, 1975; El-Guindy *et al.*, 1978-1979; El-Guindy *et al.*, 1982; Issa *et al.*, 1984-1985 *a* and *b*; Keddis *et al.*, 1988; Ayad *et al.*, 1989 and Ghoneim *et al.*, 1994).

Recently, urea derivatives (IGR's) are used as a class of insecticides, which proved to have a new mode of action against cotton leafworm, *S. littoralis* (Abo-Elghar, 1978; Radwan, 1978; El-Guindy *et al.*, 1983; Abd El-Fattah *et al.*, 1986). However, resistance to these chemicals likely to evolve since it has been demonstrated that resistance to diflubenzuron was achieved in *S.littoralis* by laboratory selection (El-Guindy *et al.*, 1983).

Consequently, insecticides from different chemical groups with different mode of actions and also some of their combinations should be tested against *S. littoralis* to help developing a sound control program in the future.

The present work was designed to evaluate the resistance level of a field strain of cotton leafworm *S. littoralis* (Boisd.) against several conventional insecticides, IGR's and their binary mixtures.

MATERIALS AND METHODS

Samples of egg-masses of the cotton leafworm *Spodoptera littoralis* (Biosd.) were collected from Gharbia Governorate befor the beginning and after the end of control season of 2000. The newly hatched larvae were reared up until the 4*th* instar, then tested to various insecticides and IGR's alone and to their mixtures.

Dipping technique was used to test the larvicidal action of the insecticides, IGR's and their mixtures with others. Fresh castor been leaves were dipped in water solutions of these chemicals for 10 seconds then left to dry before being introduced to the 4*th* instar larvae .As for insecticides, the treated leaves and larvae were transferred to petri-dish and mortality was recorded 24 hours after treatment. As for IGR's or insecticide / IGR mixtures, the treated leaves and larvae were transferred to 1 lb glass jars covered with muslin cloth for 48 hours then larvae were transferred to new glass jars and provided daily with untreated leaves until 5 days after treatment. Mortality was recorded 3 and 5 days after treatment in case of IGR alone or 48 and 72 hours after treatment in case of insecticide / IGR mixtures. Mortality data were corrected for natural mortalities in the control using Abbott's formula(1925) and were then subjected to probit analysis by the method of Busvine (1957). The rates of resistance were expressed as resistance ratios (R.R.) at the LC_{50} levels of the field strain compared to those of the susceptible laboratory strain.

The joint action of insecticide / IGR mixtures was studied by mixing concentrations equivalent to LC_{25} values at the ratio of 1: 1 (V/V). The combined action of the different mixtures was expressed at the co-toxicity factor (C.F.), estimated according to the equation given by Mansour *et al.*, (1966) as follows:

$$\text{Co-toxicity factor} = \frac{\text{observed mortality \% - expected mortality \%}}{\text{expected mortality \%}} \times 100$$

The co-toxicity factor was used to differentiate results into three categories. A positive factor of 20 or more is considered potentiation, a negative of 20 or more is considered antagonism, while intermediate values between -20 and + 20 indicate additive effect. Since insecticide / IGR mixtures were prepared by adding two equetoxic portions of concentrations each corresponding to the LC_{25} value, the expected mortality should approximate 50%.

The formulated insecticides used were chlorpyrifos (Dursban) 48% E.C., profenofos (Curacron) 72% EC, methomyl (Lannate) 90% SP, thiodicarb (Larvin) 80% DF, fenvalerate (Sumicidin) 20% EC, fenpropathrin (Meothrin) 20% EC and *Es*-fenvalerate (Sumi-alpha) 5% EC. The

formulated IGR's used were chromafenozide (Phares) 5% EC, Flufenoxuron (Cascade) 10% DC, Hexaflumuron (Consult) 10% EC, Triflumuron (Alsystan) 48% SC, Chlorfluazuron (Atabron) 5% EC, Lufenuron (Match) 5% EC, Tebufenozide (Mimic) 24% FL.

RESULTS AND DISCUSSION

Resistance ratios of insecticides tested against 4*th* instar larvae of field strain of *S.littoralis* are shown in Table (1). It is clear from the results that, significant levels of resistance, but still bellow the critical limit of resistance to the OP's Dursban (7.1 and 8.9-fold) and Curacron (8.2 and 9.6-fold) before the beginning and after the end of control season, were recorded respectively. As for carbamates, Lannate was ineffective, since high level of resistance towards this compound were detected before the beginning of control season (16.5-fold), but resistance ratio decreased to the critical level of resistance after the end of control season (10.0-fold). However, the another cabamate Larvin was effective as indicated by the low and insignificant level of resistance (3.8-fold) before the beginning of control season, while, after the end of control season, the resistance ratio increased sharply to 14-fold. Regarding pyrethroid, Meothrin was potent against field strain as indicated by the low level of resistance before the beginning of control season (4.0-fold), but resistance ratio slightly surpassed the critical level of resistance after the end of control season (12.6-fold). On the other hand, significant very high levels of resistance were observed to the pyrethroid Sumi-alpha (97.2 and 239.9-fold) and Sumicidin (53.2 and 92.8 fold) before the beginning and after the end of control season, respectively. According to resistance ratio, before the control season, the descending order was Larvin, Meothrin, Dursban, Curacron, Lannate, Sumicidin and Sumi-alpha. After control season, the descending order was Dursban, Curacron, Lannate, Meothrin, Lavern, Sumicidin and Sumi-alpha.

In general, the field strain was very highly resistant to the pyrethroids Sumi-alpha and Sumicidin, but low to moderate resistance to the pyrethroid Meothrin, OP's and carbamate insecticides. The wide scale use of different classes of insecticides to control cotton pests during cotton seasons has lead to the development of resistance in *S. littoralis* to most of the insecticides used in its control (El-Guindy *et al.*, 1978-1979; El-Guindy *et al.*, 1982; Issa *et al.*, 1984- 1985 *a* and *b*; Keddis *et al.*, 1988; Ayad *et al.*, 1989 and Ghoneim *et al.*, 1994).

Resistance ratios and LC_{50} values of insect growth regulators against 4*th* instar larvae field strain of *S. littoralis* are shown in Table (2). Summarized results showed that, according to LC_{50} values, in general, Match and Atabron were the most potent IGR's, while Alsystin was the least effective before and after control season. At 48 hours after treatment, the descending order of toxicity was Phares, Match, Consult, Atabron, Mimic, Cascade and Alsystin. At 72 hours after treatment, the descending order of toxicity was Match, Atabron, Consult, Phares, Mimic, Cascade and Alsystin. At 5 days after

treatment, the descending order of toxicity was Consult, Cascade, Match, Atabron, Phares, Mimic and Alsystin.

Regarding resistance ratios of IGR's at 5 days after treatment, results in Table (2) showed that the pest was highly susceptible to the toxic action of Cascade and Mimic before and after control season. On the other hand, no detectable levels of resistance to Atabron, Match and Consult were observed before control season, but resistance to Atabron and Match increased to 4.3 and 5.2-fold, respectively after control season. Low levels of resistance to Alsystin were detected before and after control season (3.1-and 2.7-fold, respectively). However, high level of resistance, but still bellow the critical limit of resistance to Phares was found before and after control season (6.7 and 9.0-fold, respectively).

Many investigations had focused on the activity of insect growth regulators (especially to urea derivatives) as a new class of compounds known to the chitin synthesis inhibitors in *S.littoralis* (Ammar, 1976; Radwan, 1978; Abo-Elghar *et al.*, 1978; El-Guindy *et al.*, 1983, Abdel- Fattah *et al.*, 1986). Ammar (1976) showed that successive exposure of *S. littoralis* to diflubenzuron induced cumulative positive increase in susceptibility to the compound. Similar results were also indicated by Radwan (1978) and Abo-Elghar *et al.*, (1978). On the other hand, Singab (1997) found that no change in resistance ratios to diflubenzuron was observed during the first seven generations of selection with this compound in *S. littoralis*, but a slight increase in resistance was detected with further selection and reached 13-fold at the 14*th* generation. However, El-Guindy *et al.*, (1983) demonstrated that laboratory selection by diflubenzuron had led to a marked level of resistance reached 300-fold at the 30*th* generation of selection.

The effect of interaction of several equitoxic binary Dursban / IGR and Curacron / IGR mixtures in susceptible strain and field strain before the beginning and after the end of control season, 48 and 72 hours after treatment is shown in Table (3).

As for Dursban / IGR mixtures, results showed in Table (3) indicated that in the susceptible strain, the most pronounced synergistic action was observed in mixture Dursban / Mimic followed by Dursban / Alsystin then Dursban / Atabron and Dursban / Match after 48 hours from treatment, while a lower levels of synergism were detected in the mixtures Dursban / Mimic, Dursban / Cascade and Dursban / Match after 72 hours from treatment. On the other hand, different level of additive effect were found in all other mixtures after 48 and 72 hours from treatment, except with Dursban / Phares mixture which produced antagonistic effect.

Concerned with Dursban / IGR mixtures against field strain, it is clear from the results shown in Table (3) that, before the beginning of control season, Dursban / Match and Dursban / Consult mixtures produced moderate synergism after 48 and 72 hours from treatment, respectively, but Dursban / Atabron and Dursban / Alsystin caused a slight synergism after 48 and 72 hours from treatment, while all other mixtures produced different levels of additive effect after 48 and 72 hours from treatment, except with Dursban / Cascade which produced slight antagonism after 72 hours from treatment.

Table (1) Resistance ratios of insecticides against *4th* instar larvae of field strain of *S. littoralis* (Boisd.) collected from Gharbia Governorate before and after spraying cotton season 2000.

Insecticide	Susceptible strain		Before the beginning of control season			After the end of control season		
	Slope ± SE	LC_{50} (5 % fiducial limit) in ppm	Slope ± SE	LC_{50} (5 % fiducial limit) in ppm	RR	Slope ± SE	LC_{50} (5 % fiducial limit) in ppm	RR
Dursban	4.8 ± 0.83	20.1 (16.9 - 23.7)	3.27 ± 0.65	142.7 (112.0 - 176.6)	7.1	2.33 ± 0.41	178.9 (137.3 - 235.2)	8.9
Curacron	2.11 ± 0.43	40.8 (28.9 - 57.1)	2.96 ± 0.49	336.5 (261.6 - 415.7)	8.2	2.11 ± 0.40	390.0 (295.7 - 530.9)	9.6
lannate	4.42 ± 0.80	45.0 (38.4 - 54.4)	2.27 ± 0.59	742.3 (500.4 - 990.3)	16.5	1.90 ± 0.30	456.5 (342.2 - 609.9)	10.1
Larvin	4.60 ± 0.81	50.1 (42.5 - 60.2)	1.89 ± 0.39	188.5 (124.6 - 253.9)	3.8	2.30 ± 0.41	703.4 (544.7 - 943.3)	14.0
Sumicidin	2.10 ± 0.40	19.7 (14.9 - 27.9)	1.44 ± 0.37	1048.6 (606.6 -1535.4)	53.2	2.65 ± 0.44	1827.9 (1455.8 - 2367.1)	92.8
Meothrin	1.90 ± 0.40	50.4 (33.3 - 67.8)	0.92 ± 0.35	203.2 (49.7 - 377.7)	4.0	3.00 ± 0.63	637.3 (503.5 - 812.6)	12.6
Sumi-alpha	4.33 ± 0.80	3.2 (2.7 - 3.9)	2.54 ± 0.61	310.9 (216.9 - 401.7)	97.2	2.50 ± 0.34	767.7 (610.5 - 963.4)	239.9

Table (2) Resistance ratio of insect growth regulators, Dursban and Curacron against 4th instar larvae of field strain of *S. littoralis* (Boisd.) collected from Gharbia Governorate before the beginning and after the end of control season 2000.

Insecticide	Time after treatment	Susceptible strain		Field strain					
				Before the beginning of control season			After the end of control season		
		Slope ± SE	LC_{50} (5 % fiducial limit) in ppm	Slope ± SE	LC_{50} (5 % fiducial limit) in ppm	R.R.	Slope ± SE	LC_{50} (5 % fiducial limit) in ppm	R.R.
Phares	48 h	0.63 ± 0.37	27.3	1.42 ± 0.26	18.1 (12.2 - 33.3)	0.7	1.34 ± 0.31	9.9 (6.1 - 19.2)	0.4
	3 days	1.10 ± 0.37	2.9 (1.2 - 6.9)	1.49 ± 0.25	11.4 (8.0 - 17.6)	3.9	2.00 ± 0.37	4.6 (3.2 - 6.6)	1.6
	5 days	1.01 ± 0.25	0.3 (0.1 - 0.5)	0.88 ± 0.15	2.0 (1.1 - 3.2)	6.7	0.70 ± 0.30	2.7 (0.9 - 73.1)	9.0
Cascade	48 h	0.80 ± 0.23	20.1 (8.5 - 118.3)	0.88 ± 0.29	251.5 (80.8 - 2825)	12.5	0.71 ± 0.20	49.3 (19.7 - 525.3)	2.5
	3 days	1.19 ± 0.25	6.9 (3.6 -13.3)	1.02 ± 0.24	49.3 (28.1 - 158.6)	7.1	0.52 ± 0.20	30.9 (10.6 - 1102.1)	4.4
	5 days	1.40 ± 0.27	1.4 (0.8 - 2.4)	0.66 ± 0.14	0.7 (0.3 - 1.3)	0.5	0.30 ± 0.12	0.90 (0.004 - 9.0)	0.6
Consult	48 h	0.52 ± 0.22	24.1 (6.8 - 2124)	0.76 ± 0.25	143.3 (51.6 - 7742)	5.9	0.80 ± 0.30	32.9 (14.9 - 415.9)	1.4
	3 days	0.54 ± 0.16	7.2 (2.4 - 44.4)	0.81 ± 0.41	9.1 (5.4 - 16.8)	1.3	1.37 ± 0.63	11.6	1.6
	5 days	1.05 ± 0.25	0.2 (0.06 - 0.3)	1.04 ± 0.24	0.3 (0.1 - 0.5)	1.5	0.50 ± 0.13	0.17 (0.02 - 0.5)	1.0
Alsystin	48 h	1.09 ± 0.25	18.2 (8.3 - 35.4)	0.45 ± 0.28	3422	188	0.63 ± 0.30	220 (80 - 27390)	12.1
	3 days	1.03 ± 0.18	9.6 (4.7 - 18.3)	0.72 ± 0.24	579 (214 - 31395)	60	0.55 ± 0.30	64.4 (1.2- 58931)	6.7
	5 days	0.80 ± 0.23	0.9 (0.2 - 2.1)	0.42 ± 0.09	2.8 (0.5 - 7.2)	3.1	0.61 ± 0.14	2.4 (0.4 - 6.0)	2.7
Atabron	48 h	0.56 ± 0.35	16.0	0.45 ± 0.15	250 (52.3 - 19049)	15.6	0.95 ± 0.30	30.6 (15.7 - 140.9)	1.9
	3 days	0.56 ± 0.16	3.5 (1.2 - 18.7)	0.77 ± 0.14	9.9 (5.7 -19.3)	2.8	0.94 ± 0.20	4.4 (2.2 - 8.1)	1.3
	5 days	1.04 ± 0.25	0.3 (0.1 - 0.6)	1.15 ± 0.25	0.3 (0.1 - 0.4)	1.0	0.98 ± 0.20	1.3 (0.7 - 2.4)	4.3
Match	48 h	0.81 ± 0.36	14.9 (5.8 - 69.7)	1.02 ± 0.53	39.9	2.7	0.70 ± 0.14	8.4 (3.9 - 23.9)	0.6
	3 days	1.05 ± 0.25	6.0 (3.1 - 15.8)	0.91 ± 0.15	5.6 (3.3 - 9.0)	0.9	0.90 ± 0.14	2.5 (1.3 - 4.7)	0.4
	5 days	0.69 ± 0.17	0.25 (0.08 - 0.6)	1.68 ± 0.28	0.3 (0.2 - 0.5)	1.2	0.83 ± 0.20	1.3 (0.6 - 2.6)	5.2
Mimic	48 h	0.78 ± 0.24	66.9 (26.1 - 917)	0.93 ± 0.25	210 (99 - 1546)	3.1	0.63 ± 0.48	39.1 (15.3 - 3438)	0.6
	3 days	0.79 ± 0.23	37.1 (15.7 - 228)	1.13 ± 0.23	39.5 (25.4 - 66.5)	1.1	0.59 ± 0.19	23.7 (7.0 - 1318)	0.6
	5 days	0.77 ± 0.22	3.3 (0.9 - 10.1)	0.98 ± 0.16	1.0 (0.5 - 1.6)	0.3	0.95 ± 0.15	4.1 (2.2 - 7.1)	1.2
Dursban	48 h	5.40 ± 1.10	16.7 (13.8 - 20.2)	1.48 ± 0.27	117.6 (83.9 - 178.2)	7.0	3.02 ± 0.40	136.3 (108.5 - 170.4)	8.2
	3 days	5.84 ± 1.20	14.5 (12.0 - 17.5)	1.62 ± 0.27	102.9 (75.1 - 146.5)	7.1	2.83 ± 0.41	124.6 (98.2 - 159.5)	8.6
Curacron	48 h	2.80 ± 0.35	32.4 (25.5 - 40.5)	1.45 ± 0.28	319.4 (225.6 - 519.9)	9.9	1.24 ± 0.40	340.7 (186.0 - 507.3)	10.5
	3 days	2.71 ± 0.36	29.5 (23.4 - 37.3)	1.81 ± 0.66	300.3 (203.9 - 417.4)	10.1	2.10 ± 0.44	311.3 (211.4 - 410.6)	10.5

Table (3): The effect of interaction of several equitoxic binary insecticide mixtures on *4th* instar larvae in susceptible and field strains of *S. littoralis* (Boisd.).

Insecticide / IGR mixture	Time after treatment	Co-toxicity factor (C.F.)		
		Susceptible strain	Field strain	
			B *	A * *
Dursban + Phares	48 h	- 29	- 4	+ 25
	72 h	- 59	- 8	+ 24
Dursban + Cascade	48 h	+ 10	+ 5	+ 17
	72 h	+ 23	- 28	0
Dursban + Consulte	48 h	- 10	- 13	+ 92
	72 h	- 19	+ 44	+ 88
Dursban + Alsystin	48 h	+ 66	+ 23	+ 62
	72 h	- 17	+ 30	+ 60
Dursban + Atabron	48 h	+ 44	+ 27	+ 76
	72 h	+ 7	+ 22	+ 38
Dursban + Match	48 h	+ 38	+ 66	+ 12
	72 h	+ 22	0	+ 14
Dursban + Mimic	48 h	+ 88	+ 17	+ 28
	72 h	+ 37	- 4	+ 22
Curacron + Phares	48 h	+ 4	- 7	- 5
	72 h	- 23	+ 4	- 34
Curacron + Cascade	48 h	0	+ 70	- 17
	72 h	+ 30	+ 12	- 28
Curacron + Consulte	48 h	- 22	+ 2	+ 80
	72 h	0	- 40	+ 58
Curacron + Alsystin	48 h	- 31	- 32	+ 9
	72 h	- 31	+ 16	+ 4
Curacron + Atabron	48 h	0	- 22	- 19
	72 h	- 18	- 24	- 16
Curacron + Match	48 h	+ 83	+ 46	- 45
	72 h	+ 27	- 20	- 52
Curacron + Mimic	48 h	+ 8	- 20	- 25
	72 h	+ 25	0	- 25

B * = Before the beginning of control season .
A * * = After the end of control season.

In the case of after the end of control season, except with Dursban / Cascade mixture which produced additive effect, all other mixtures produced different levels of synergistic effect after 48 and 72 hours from treatment.

As for Curacron / IGR mixtures, results showed in Table (3) indicated that in the susceptible strain, Curacron / Match produced a high and slight synergism after 48 and 72 hours from treatment, respectively but Curacron / Cascade and Curacron / Mimic caused slight synergism only 72 hours after treatment, while all other mixtures caused different levels of additive or antagonistic effect.

Regarding Curacron / IGR mixtures against field strain, results in Table (3) showed that these mixtures, in general, produced different levels of additive or antagonistic effect, except with Curacron / Cascade and Curacron / Match mixtures after 48 hours from treatment in the case of before the beginning of control season and Curacron / Consult mixture after 48 and 72 hours in the case of after the end of control season which produced synergistic effects.

In general, Dursban potentiated IGR's in susceptible and field strains before and after control season, while Curacron potentiated Cascade, Match and Mimic in susceptible strain, Cascade and Match in field strain before control season and only Consult after control season.

Maher Ali *et al.*, (1972) indicated that the joint action of different insecticide mixtures against 4*th* instar larvae of *S.littoralis* was different in the resistant strain to Methyl parathion from that in the susceptible strain. The authors stated that this might be due to differences in enzyme systems between both strains.

A survey of resistance to urea derivatives and their mixtures with insecticides was carried out on field strains of *S. littoralis* during the cotton season 1983, 1984 and 1985 (Keddis *et al.*, 1986).They found that resistance to urea derivatives either alone or in combination with insecticides is likely occur. This was clearly indicated in the detectable and significant levels of resistance observed to these chemicals during the three years of investigation Eldoksch *et al.*, (1990) studied IGR (urea derivatives) / insecticide mixtures against *S.littoralis*. They found that the mixture of Curacron / CME (teflubenzuron) gave the highly toxic effect on *S.littoralis* larvae followed by methafin / CME, Curacron / IKI, Larvin / CME, then Cyanox / Dimilin mixture, while the mixture Sevin / CME was the least toxic.

REFERENCES

Abdel-Fattah, M.S.; M.N. Shaaban; A.E. Omar and E.A. Gomaa (1986): Effect of diflubenzuron and triflumuron on trehalase, invertase and amylase enzymes activity in susceptible and profenofos-resistant strains of *Spodoptera littoralis* (Boisd.). Bull. ent. Soc. Egypt, Econ. Ser., 15: 209-219.

Ammar, I.M.A. (1976): Toxicological and histopathological studies on the Egyptian cotton leafworm *Spodoptera littoralis* (Boisd.) with especial reference to antimoulting insecticides .M. Sc. Thesis, Fac. Agric. Shebin El-kom, Menufia Univ. Egypt.

Abbott, W.S. (1925). A method for computing the effectiveness of an insecticide. J. Econ. Entomol., 18: 265-267.

Abo-Elghar, M.R.; H.S.A. Radwan and Z.A. El-Bermawy (1978). Status of tolerance and change in cotton leafworm susceptibility subsequent to laboratory selection with granular insecticides and insect growth regulators. 4th conf. Pest control, NRC, Cairo: 445-449.

Ayad, F.A.; M.E. Keddis; W.M. El-Deeb; Y.F. Ghoneim and M.A. El-Guindy (1989). Monitoring of resistance to insecticides in field strains of the cotton leafworm *Spodoptera littoralis* (Boisd.) during 1987 and 1988 cotton growing seasons. Proc. Int 1*st* Conf. Econ. Ent., 11: 469-476.

Busvine, J.R. (1957). A critical review of the technique for testing insecticides. Commonwealth Inst. Entomol., London., 214 pp.

Eldoksch, H.A.; F.M. Elsheikh; S.A. Abo-seda and M.S. Abdel-Fattah (1990): Ovicidal, larvicidal and residual toxicity of certain insecticides and IGR-insecticide mixtures against *Spodoptera littoralis* (Boisd.). J. Agric. Sci. Mansoura Univ., 15 (9): 1500-1507.

El-Guindy, M.A.; G.N. El-Sayed and S.M.Madi (1975). Distribution of insecticide resistant strains of the cotton leafworm *Spodoptera littoralis* (Boisd.) in two Governorates of Egypt. Bull. ent. Soc. Egypt, Econ. Ser., 9: 191-195.

El-Guindy, M.A.; S.M. Madi; G.N. El-Sayed; A.M.I. Farrag; S.M.A. Dogheim; M.E. Keddis and Y.H. Issa (1978-1979). Further studies on resistance spectrum and sub-grouping of certain insecticides in field populations of the Egyptian cotton leafworm *Spodoptera littoralis* (Boisd.) during the 1980 cotton season. Bull. ent. Soc. Egypt, Econ. Ser., 11: 243-258.

El-Guindy, M.A.; S.M. Madi; M.E. Keddis; H.I. Yehia and M.M. Abdel-Sattar (1982): Development of resistance to pyrethroids in field population of the Egyptian cotton leafworm *Spodoptera littoralis* (Boisd.). Int. Pest cont., 24: 6-10.

El-Guindy, M.A.; A. El-Refai and M.M. Abdel-Sattar (1983). The pattern of cross-resistance to insecticides and juvenile hormone analogues in a diflubenzuron-resistant strain of the cotton leafworm *Spodoptera littoralis* (Boisd.) .Pestic. Sci., 14(3): 235-245.

Ghoneim, Y.F.; A.M. Allam; M.E. Keddis; M.F. Rofael; F.A. Ayad and M.A. El-Guindy (1994): Comparative toxicity of certain insecticides to field strains of the cotton leafworm *Spodoptera littoralis* (Boisd.) and the role of esterases in insecticides resistance. Egypt. J. Appl. Sci., 9 (6): 64-80.

Issa, Y.H.; M.E. Keddis; F.A. Ayad; M.M. Abdel-Sattar and M.A. El-Guindy (1984 - 1985) *a*: Survey of resistance to organophsphorus insecticides in field strains of the cotton leafworm *Spodoptera littoralis* (Boisd.) during 1980-1984 cotton growing seasons. Bull. ent. Soc. Egypt, Econ. Ser., 14: 399-404.

Issa, Y.H.; M.E. Keddis; M.M. Abdel-Sattar; F.A. Ayad and M.A. El-Guindy (1984-1985) *b*: Survey of resistance to pyrethroids in field strains of the cotton leafworm *Spodoptera littoralis* (Boisd.) during 1980-1984 cotton growing seasons. Bull. ent. Soc. Egypt, Econ. Ser., 14: 405-411.

Keddis, M.E.; F.A. Ayad; M.S. Abdel-Fattah and M.A. El-Guindy (1986). Studies of resistance to urea derivatives and their mixtures with insecticides in field strains of the cotton leafworm *Spodoptera littoralis* (Boisd.) during the cotton seasons 1983, 1984 and 1985. Bull. ent. Soc. Egypt, Econ. Ser., 15: 229-234.

Keddis, M.E.; M.E. Omar and M.A. El-Guindy (1988). Monitoring of resistance to insecticides in field strains of the cotton leafworm *Spodoptera littoralis* (Boisd.) during 1986 cotton Season Agric. Res. Rev., 66: 25-31.

Maher Ali, A.; M.D. Abdallah; M.N. Zaazou and M.R. Rizkallah (1972). Interaction of chemical insecticides in susceptible and resistant strains of *Spodoptera littoralis* (Boisd.). Bull. ent. Soc. Egypt, Econ. Ser., VI: 175-180.

Mansour, N.A.; M.E. El-Defrawi; A. Toppozada and M.Zeid (1966). Toxicological studies on the Egyptian cotton leafworm *Prodenia littura*.VI. Potentiation and antagonism of organophosphorus and carbamate insecticides. J. Econ. Ent., 59: 307-311.

Radwan, H.S.A. (1978): Selection with chitin biosynthesis inhibtor (Dimilin) for resistance and cross-resistance in the cotton leafworm *Spodoptera littoralis* (Boisd.) Int. Pest cont., 21: 23-29.

Singab, M. (1997): Biochemical detection of resistance in the cotton leafworm *Spodoptera littoralis* (Boisd.) Ph. D. Thesis, Fac. Agric. Al-Azhar Univ.wEgypt.

مقاومة المبيدات ومنظمات النموالحشريه وتأثيرمخاليطها على دودة ورق القطن

يحيى فتحى السيد غنيم

المعمل المركزى للمبيدات - مركز البحوث الزراعيه - الدقى

تم دراسة مقاومة العديد من المبيدات الحشريه ومنظمات النمو الحشريه وتأثير مخاليطها على السلاله الحقليه لدودة ورق القطن التى جمعت من محافظة الغربيه قبل وبعد موسم رش القطن لعام ٢٠٠٠ .

بالنسبه للمبيدات الحشريه فقد اوضحت النتائج ان مركبى البيرثرويدزالسومى الفا والسومسيدين اظهرا مستويات عاليه من المقاومه بينما اظهرت باقى مركبات البيرثرويدز ومركبات الفوسفور العضويه والكاربامات مستويات مقاومه صغيره او متوسطه فيما عدا المركب الكارباماتى ميثومايل الذى اظهر مستوى مقاومه تعدى الحد الحرج للمقاومه .

بالنسبه لمنظمات النمو الحشريه فلقد لوحظ ان الافه قد اظهرت حساسيه عاليه لمركبى الكاسكيد والماميك . اما مركبات الاتابرون ، الماتش ، الكونصلت فلم تستطيع الافه ان تكتسب مقاومه ضدهم قبل بداية موسم الرش ، الا انه بعد نهاية موسم الرش فقد اظهر الاتابرون والماتش مستويات مقاومه متوسطه . من جهة اخرى فقد اظهرمركب السيستين مستوى منخفض من المقاومه بينما اظهر مركب فارس مستويات مقاومه عاليه الا ان هذه المستويات كانت اقل من الحد الحرج للمقاومه .

أما بالنسبه لتأثير خلط مركبى الدورسبان أو الكيراكرون مع منظمات النمو الحشريه فقد اوضحت النتائج ان مركب الدورسبان اظهر تنشيط لمعظم منظمات النمو الحشريه على السلاله الحساسه والسلاله الحقليه ، بينما مركب الكيراكرون اظهر تنشيط لمركبات الكاسكيد ، الماتش ، الماميك على السلاله الحساسه ، الكاسكيد ، الماتش والكونصلت على السلاله الحقليه .