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Pyrethroids and Biocides Resistance in Field Strains of the Cotton Leaf Worm, *Spodoptera littoralis* (Boisd.) During 2006-2008 Cotton Seasons

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Abstract: Four field strains of the cotton leaf worm, *Spodoptera littoralis* (Boisd.) were collected from different Egyptian Governorate during 2006-2008 cotton seasons for monitoring their resistance to four pyrethroids and six different biocides. In case of pyrethroids, resistance ratios of Karate were very high followed by Sumicidin and Sumi-alpha, while Meothrin showed lower levels of resistance when compared with the other pyrethroids tested during 2006-2008 cotton season. In case of biocides, resistance levels were insignificant during the cotton seasons 2006-2007 and 2008. This, indicate the possibility of using these materials as a replacement to conventional insecticides or in alternative with them in IPM programs.

Key words: Spodoptera littoralis (Boisd.), pesticides, resistance.

INTRODUCTION

The cotton leaf worm, *Spodoptera littoralis* (Boisd.) is one of the most injurious cotton pests in the world. It is found almost everywhere cotton and on several other crops (Matthews and Tunstall 1994). In Egypt, IPM strategy for protection of cotton plants based on rotation of insecticides with mainly upon extensive use of restriction one application per season. Biocide or IGR has used for the first spray to control of newly hatched cotton leaf worm. OP and Pyrethroid insecticides were used for the second, third and fourth sprays, respectively against cotton leaf worm and bollworm. The monitoring of resistance to chemicals is considered as pre-requisite in IPM programs (Bull and Menn, 1990). Monitoring of resistance is most useful when undertaken early in resistance episode and it can be also used to evaluate the effectiveness of alternative tactics that are employed to overcome, delay or prevent development of resistance (keiding1986). The aim of the present work is to evaluate pyrethroid and biocide resistance in cotton leaf worm, *Spodoptera littoralis* (Boisd.) in strains collected from different Governorates in Egypt during 2006-2008 cotton growing seasons.

MATERIALS AND METHODS

Four cotton field strains of the cotton leaf worm, *Spodoptera littoralis* (Boisd.) were collected from fields in several Governorates (Sharkia, Gharbia, Dakahlia and Bani-Sweif) during 2006-2007 and 2008 cotton seasons. For the detection of the median lethal concentration (LC_{50} values), six concentrations (in water) for each compound were prepared. Castor-bean leaves were dipped for 15 second in each concentration then left for one hour to dry. As for pyrethroid insecticides, newly molted 4^{th} instar larvae were fed on treated leaves in Petri dishes for 24 hr. As for biocides, newly molted 2^{nd} instar larvae of each strain were fed on treated leaves in plastic jars covered with muslin for 24 hr, and then the treated leaves were removed and provided with fresh untreated leaves in clean jars for other three days. Three replicates of ten larvae each were tested for each for each concentration. Mortality percentages were recorded after 24 hr in case of pyrethroid and 5 days in case of biocides and corrected according to natural mortality (Abbot, 1925). To estimate the LC_{50} values, the corrected mortality percentages were subjected to probit analysis according to the method of Finney, 1952. The rates of resistance of the field strains were calculated as resistance ratio (RR) compared with the susceptible strain which has been reared in under condition laboratory for more than 15 generation without exposed to any insecticides. Pyrethroid insecticides used were: lambda-cyhalothrin (Karate 2.5% EC), esfenvalerate (Sumi-alpha 5% EC), fenvalerate (Sumicidin 20% EC) and fenpropathrin (Meothrin 20% EC). Biocides used were Dipel 2X 6.4% WP (B.T. Kurstaki); Agreen 6.5% WP (B.T.), Proticto 9.4% WP (Nuclear polhydrosis virus "NPV"), Biogard 6.5% WP, Profect (5%+2%) WP (B.T. + NPV), and Spinosad 24% SC (a secondary metabolites of the soil actinomycete, Saccharopolyspora) was also tested.

RESULTS AND DISCUSSION

The resistance spectrum towards pyrethroid insecticides was investigated in different field strains (representing lower and Upper Egypt Governorates) of *S. littoralis*. Results in Table (1) show the resistance ratios of the pyrethroids tested against field strains of *S. littoralis* collected from Sharkia, Gharbia, Dakahlia and

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Bani-Sweif during 2006-2008 cotton seasons. Meothrin recorded lower levels of resistance when compared with the other pyrethroids tested. Except for Gharbia in 2006 (38.8-fold) and in 2008 (38.7-fold), the resistance ratios to Meothrin ranged from12.6 to 27.3-fold during 2006-2008 seasons.

Table 1: Resistance ratios to four pyrethroid insecticides in the cotton leaf worm, *Spodoptera littoralis* (Boisd.) collected from four Governorates during 2006- 2007-2008 cotton growing seasons.

Insecticide	Season	S. strain LC_{50} ppm	Sharkia		Gharbia		Dakahlia		Bani-Sweif	
			LC_{50} ppm	RR	LC_{50} ppm	RR	LC_{50} ppm	RR	LC_{50} ppm	RR
Lambda- cyhalothrin (Karate 2.5% EC)	2006	32.90	422.84	12.9	702.35	21.3	797.04	24.2	965.46	29.3
	2007		460.36	14.0	789.69	24.0	1082.62	32.9	827.78	25.2
	2008		426.34	13.0	2814.9	85.6	4492.54	136.5	2516.70	76.5
esfenvalerate (Sumi-alpha 5% EC)	2006	15.15	430.91	28.4	597.22	39.4	690.80	45.6	444.25	29.3
	2007		667.50	44.1	626.09	41.3	1356.88	89.7	849.80	56.1
	2008		1251.1	82.6	867.00	27.0	1700.63	112.3	1172.28	77.4
fenvalerate (Sumicidin 20% EC)	2006	14.49	759.07	52.4	2190.6	151.1	2105.33	145.3	332.88	23.0
	2007		507.15	35.7	700.25	48.3	1037.66	71.6	531.07	36.6
	2008		801.35	55.3	2366.4	163.3	1369.08	94.5	585.80	40.4
fenpropathrin (Meothrin 20% EC)	2006	23.80	299.95	12.6	922.46	38.8	523.38	22.0	326.88	13.7
	2007		360.09	15.1	458.19	19.3	615.26	25.8	416.68	17.5
	2008		398.15	16.7	921.26	38.7	650.00	27.3	335.12	14.1

RR (Resistance ratio) = LC_{50} of the field strain / LC_{50} of the susceptible strain

On the other hand, very high levels of resistance were observed to Karate during 2006-2008, but the resistance ratios were higher in season 2008 than that in season 2006 and 2007, where the resistance ratios ranged between 12.9-29.3-fold, 14.0-33.0 -fold and 13.0-136.5-fold during 2006,2007and 2008 cotton seasons, respectively. The same trend to Karate was also observed for Sumicidin and Sumi-alpha, where the resistance ratios fluctuated between23.0-163.3-fold for Sumicidin and 28.4-112.3-fold for Sumi-alpha during 2006-2008 cotton seasons. Summarized results showed in Table (1), the pyrethroid karate recorded very high levels of resistance followed by Sumicidin then Sumi-alpha, while Meothrin recorded lower levels of resistance when compared with the other pyrethroids tested These results could be discussed in the light of findings obtained from other studies on resistance monitoring to pyrethroid insecticides in *S .littoralis*. El-Guindy *et al.,* (2002) studied the history of resistance to pyrethroids in field strains of *S. littoralis* over period of twenty years (1979-1999).They found that the rate of increase in resistance before spraying had nearly increased every five years to 1,2,3,4 and 6tims for fenpropathrin, fenvalerate, es-fenvalerate and deltamethrin, respectively. However, it is interesting to note that the net rate of increase in resistance usually rise up sharply in one or two seasons and was associated with decline sharply in resistance in the other seasons within every five seasons. On the other hand, Rashwan *et al*., (1992), Ishaaya and Klein (1990) indicated that the fluctuation in tolerance levels could be attributed to the type of pesticides used in each locality as well as the sequence of pesticides used for control of the cotton pest complex. Data on susceptibility for biocides in field strains of *S. Littoralis* collected from Sharkia, Gharbia, Dakahlia and Bani-Sweif governorates during 2007 and 2008 cotton seasons are presented in Table(2).

Table 2: Monitoring of resistance to some Biopesticides after 5 days from treatment in the cotton leaf worm, *Spodoptera littoralis* (Boisd.) collected from four Governorates during 2006-2007 and 2008 cotton growing seasons.

Biopesticides	Season	S. strain LC_{50} ppm	Bani-Sweif		Dakahlia		Gharbia		Sharkia	
			LC_{50} ppm	RR	LC_{50} ppm	RR	LC_{50} ppm	RR	LC_{50} ppm	RR
Diple2X 24% WP	206	18.516	-	-	-	-	-	-	--	-
	2007		10.375	0.56	9.093	0.49	10.269	0.55	5.276	0.28
	2008		19.150	1.03	12.028	0.65	30.301	1.64	15.514	0.84
Agreen 6.5% WP	2006	22.371	10.228	0.46	28.116	1.256	2.667	0.119	83.577	3.735
	2007		13.533	0.604	42.932	1.919	9.867	0.441	1.915	0.085
	2008		26.854	1.200	33.465	1.495	35.453	1.584	47.580	2.126
Protecto 9.4% WP	2006	471.012	4.622	0.001	40.495	0.086	5.336	0.011	48.474	0.103
	2007		18.078	0.038	40.850	0.089	23.845	0.051	41.845	0.089
	2008		39.262	0.084	52.732	0.112	77.845	0.165	20.534	0.043
Biogard 6.5% WP	2006	377.680	3.117	0.008	21.146	0.056	3.519	0.009	265.44	0.703
	2007		12.330	0.033	8.732	0.023	7.114	0.018	46.115	0.122
	2008		38.656	0.102	29.575	0.078	30.146	0.079	45.049	0.119
Profect 6.4%WP	2006	587.101	2.962	0.005	14.662	0.025	1.612	0.003	8.119	0.014
	2007		13.594	0.022	55.238	0.094	11.298	0.019	47.718	0.081
	2008		55.433	0.094	31.309	0.053	61.463	0.105	37.874	0.065
Spinosad 24%SC	2006	0.484	0.093	0.192	0.214	0.442	0.038	0.078	0.778	1.607
	2007		0.134	0.277	0.112	0.231	0.047	0.097	0.638	1.318
	2008		0.127	0.262	0.220	0.455	0.627	1.295	0.371	0.766

The results showed that all field strains were very highly susceptible to Protecto, Biogard and Profect during 2006, 2007 and 2008 cotton seasons, where RR values ranged between 0.001-0.703-fold. On the other hand, all field strains were more susceptible to Dipel 2X in 2007, but this susceptibility declined slightly in 2008, where RR values ranged between 0.28-0.56-fold in 2007 and they became 0.65-1.64-fold in 2008. The

same trend was also observed for Agreen. But the lowest and highest RR values were 0.09-and 2.13-fold. As for Spinosad, RR values fluctuated among field strains and through cotton seasons. Sharkia and Gharbia were still more susceptible to Spinosad where the highest RR value was 0.45-fold during 2006, 2007 and 2008 cotton seasons. Dakahlia exhibited a slight decline in its susceptibility to Spinosad, where RR value were 0.08,1.0 and 1.29-fold during 2006,2007 and2008, respectively, but Bani-Sweif showed a slight increase in susceptibility, where RR value were 1.61,1.32 and 0.77-fold during 2006,2007 and 2008 cotton seasons, respectively.

The results of the present investigation clearly reveal that the biocides were effective against all field strains of the cotton leaf worm; a fact indicating the possibility of using such biocides as replacement to conventional insecticides or in alternation with in IPM programs. Many scientists found clear levels of resistance to B.T. formulates in field strains of pests (Tabashink, 1994, Judy *et al*., 1996, Carlos and Shelton. 1997 and Patricia *et al*., 1990).

In conclusion, the field strains of *S. littoralis* possess high resistance to pyrethroid insecticides when compared with the susceptible strain. However, Biopesticides were more effective on these strains than the susceptible strain. These results indicate that the main factors responsible for resistance to pyrethroids were different than to these Biopesticides. This is due to the Biopesticides sites of action is so different from that of pyrethroid insecticides. In theory, one advantage offered by biocides is that they act at new site, thus no cross-resistance between these biocides and insecticides would be expected. Thus, from these results, we may conclude that with novel mode of action are assuming major importance as components of cotton leaf worm control programs. On the basis of present information's, high success has been achieved with biocides on field strains of cotton leaf worm and cotton bollworm (Matter and Keddis, 1988; Moulton *et al.*, 1999; Betz *et al.*, 2000; Arora, 2003; Fly, 2003; Temerak, 2003 and EL-Zemaity *et al.*, 2007). On the other hand, high resistance has been archived with pyrethroids (Allam, 2000; El-Guindy *et al.*, 2002; Ghoneim, 2002; and El-Zemaity *et al*., 2007).

REFERENCES

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

Allam, A.M., 2000. Synthetic pyrethroids, IGR and JHM as control agents for *Spodoptera littoralis* (Boisd.) in relation to some enzyme activity. J. Agric. Sci. Mansoura Univ., 25(2): 1035-1042.

Araro, P.K., 2003. Baseline susceptibility and quantification of resistance in *Plutella xylostella* (L.) to spinosad. Resist. Pest. Mang. News letter, 12(2): 27-30.

Betz, F.S., B.G. Hammond and R.L. Fuchs, 2000. Safety and advantages of *Bacillus thuringiensis* produced plants to control insect pests. Regul. Toxicol. Pharmacol. 2000 Oct; 32(2): 156-173.

Bull, D.L. and J.J. Menn, 1990. Strategies for managing resistance to insecticides in *Heliothes* pests of cotton. In: Managing resistance to agrochemicals. Green, M. B. *et al*., Eds., American Chemical Society. Washington, 118-133.

Carlos, J.P. and A.M. Shelton, 1997. Resistance of *Plutella xylostella* (Lepidoptera: Pluellidae) to *Bacillus thuringiensis*. J. Econ. Entomol., 90(1): 87-93.

El-Guindy, M.A., Y.F. Ghoneim, M. Singab and M.M. Abdel-Star, 2002. History of resistance to pyrethroids in field strains of *Spodoptera littoralis* (Boisd.) over a period of twenty years (1979-1999). Annals of Agric. Sc. Moshtohor, 40(1): 615-628.

El-Zemaity, M.S., A.M Allam and K.S. Ahmed, 2007. Impact of dipel-2x and spinosad in relaxation resistance of pink bollworm, *pectinophora gossypiella* (saund.) to different groups of conventional insecticides. Research Bulletin, Ain Shams Univ. In press.

Finny, M.D.J., 1952. Probit Analysis 3rd .Cambridge Univ. Press, London, pp: 333.

Fly, S.M.P., 2003. Efficacy of Spionosad against cherry fruit flies in Washington State Zbornik. Zrece, Solvenye,-6- marec, 211-218.

Ghoneim, Y.F., 2002. Resistance to insecticides and IGRs and interaction effect between their mixtures on the cotton leaf worm, *Spodoptera littoralis* (Boisd.). J.Agric. Sci. Monsoura Univ., 27(7): 4965-4970.

Ishaaya, I. and R. Klien, 1990. Response of susceptible laboratory and resistant field strains of *Spodoptera littoralis* (Lepidoptera: Noctiude) to Teflubenzuron. J.Econ. Entomol., 83: 59-62.

Judy, M.C., J. Chaufaux, C. Buisson, N. Gilois, V. Sanghis and D. Lereclus, 1996. *Spodoptera littoralis* (Lepidoptera: Noctiude) resistance to crylc and cross to other *Bacillus thuringiensis* crystal toxins. J. Econ. Entomol., 89(4): 791-797.

Kiding, J., 1986. Prediction or resistance risk assessment In: Pesticide resistance (Strategies and tactics for management).Glass: E. H. *et.al*. National Academy press. Washington D.C.

Matter, M.M. and M.E. Keddis, 1988. Effect of Bacillus thuringiensis on field strains of the cotton leaf worm, *Spodoptera littoralis* (Boisd.). Agricultural research review, 66(1): 1-7.

Matthews, G.A. and Tunstall, 1994. Insect pests of cotton. Commonwealth Insecticide of Entomology. Chapter, 24: 463-479.

Moulton, J.K., D.A. Pepper, J.J. Dennely, P. Dugger and D. Richter, 1999. Studies of resistance of beet army worm, *Spodoptera exigua* to spinosad in field populations from the Southern USA and Southern Asia. Proceeding Belwid cott. Conferences, Orlando, Florida, USA, 3-7 January, 2: 884.

Patricia, C.B., W.D. Hutchison and D.A. Androw, 1999. Long term selection for resistance to *Bacillus thuringiensis* Crylc and toxin in a Mimesota population of European corn borer (Lepidoptera: Crambidae). J. Econ. Entomol., 5: 1021-1030.

Rashwan, M.H., Z.A. El-Bermawy, A.A. El-Sheikh and H.S.A. Radwan, 1992. The onest of organophosphate and carbamate resistance among Lower Egypt population of the cotton leaf worm, *Spodoptera littoralis* (Boisd.). Bull. Ent. Soc. Egypt, Econ. Ser., 19: 211-220.

Tabashnik, B.E., 1994. Evaluation of resistance to resistance to *Bacillus thuringiensis*. Annu. Rev. Entomol., 39: 47-79.

Temerak, S.A., 2003. Negative cross-resistance to Spionosad as interesting observation in the field population of cotton leaf worm larvae, *Spodoptera littoralis* in Egypt. Resist. Pest. Manag. Coll. of Agric. Assiut Univ. Assiut, Egypt.