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RESISTANCE LEVELS OF SOME DIFFERENT FIELD STRAINS OF THE COTTON LEAFWORM, *Spodoptera littoralis* (BOISD.) AGAINST CERTAIN CONVENTIONAL INSECTICIDES AND IGR'S

Abdel-Hay, N. S.; M. Singab; Y.F. Ghoneim and Mona.K. El-Hadek
Central Agricultural Pesticide Laboratory, Agricultural Research Center, Dokki, Egypt

ABSTRACT

Four field strains of the cotton leafworm, *Spodoptera littoralis* (Boisd.) were collected from different Egyptian Governorates (Fayoum, Menofia, Sharkia and Dakahlia) in 2012 cotton season for monitoring their resistance to four conventional insecticides namely Dursban, Telton, Lannate and Sumi-alpha and three insect growth regulators (IGRs), namely Consult, Cascade and Tobron. In case of conventional insecticides, the results indicated that in all field strains, resistance ratios of Sumi-alpha were very high followed by Dursban and Lannate while Telton showed lower levels of resistance when compared with the other tested compounds where resistance ratios ranged between 40-55-fold, 25-38-fold, 16-38-fold and 12-18-fold, respectively. In case of IGR_S, resistance ratios of Cascade were high where resistance ratios ranged between11-22-fold, while Tobron and Consult showed lower levels of resistance where resistance ratios ranged between 2-4-fold, and 4-6-fold, respectively. These results indicate the possibility of using these materials as a replacement to conventional insecticides or as alternatives in IPM programs.
Keywords: *Spodoptera littoralis* (Boisd.), insecticides, IGR_S resistance

INTRODUCTION

The Egyptian cotton leafworm, *Spodoptera littoralis* (Boisd.) is considered as the most serious and destructive pest of Egyptian cotton. Larvae attack to other crops such as vegetables, ornamentals and orchard trees (Bayoumi *et al*., 1998). As a result of intensive use of broad-spectrum chemical insecticides, cotton leafworm populations have developed high levels of resistance to conventional insecticides organophosphates, pyrethroids and carbamates (Ishaaya *et al*., 1995). In Egypt, *S. littoralis* developed resistance to several insecticides belonging to organophosphates, carbamates and pyrethroids El-Guindy *et al*., 2002 a and b, Ghoneim 2002 and 2012, Abdel-Sattar *et al.,* 2012, Issa *et al*., 1984 and Abo-El Ghar *et al.,* 1986.

Urea derivatives (IGRs) are used as a class of insecticides that proved to have a new mode of action against cotton leafworm, *S. littoralis*. The cotton leafworm is reported to has developed resistance against these compounds but resistance levels was still very low (Ghoneim 2012). Therefore, highly selective insecticides should be used for pest control. Moreover, much safer insecticides are needed to be developed in order to decrease the burden on the environment by using less chemicals in compared to conventional insecticides.

The frequent use of chemical insecticides created serious of problems such as, the environmental pollution, the development of resistance and the hazard to both natural enemies and the beneficial insects. In order to reduce these hazards, insect control should be accomplished with fewer applications at far lower doses. This aim might be realized, for example by mixing acute toxicants with other chemicals such as insect growth regulators (El-Guindy *et al.,* 1983).

Present study aimed to evaluate insecticide resistance level in cotton leaf worm, *Spodoptera littoralis* (Boisd.) in field strains collected from different Governorates in Egypt during 2012 cotton growing seasons.

MATERIALS AND METHODS

1- Maintenance of the strains :

The field strains of the cotton leafworm, *Spodoptera littoralis* (Boisd.) were obtained from Fayoum, Menufia, Sharkia and Dakahlia Governorates in 2012 cotton growing season. These strains were kept under normal laboratory conditions at 25º ± 2ºC and 65º ± 5º relative humidity. The egg-masses were kept separately until eggs hatched and then provided with castor-oil leaves.

2- Insecticides used

A) Conventional insecticides:

1- Organophosphates: Chlorpyrifos (Dursban,48% EC), profenofos (Telton72% EC)

2- Carbamates: methomyl (Lannete, 90% SP).

3-Pyrethroids: es-fenvalerate (Sumi-alpha 5% EC).

b) Insect Growth Regulators (IGRs):

I- Hexaflumuron (Consult 10% EC).

2- Flufenoxuron (Cascade 10% DC).

3- Chlorfluazuron (Tobron 5% EC).

3 - **Median lethal concentrations of the tested compounds**:

The toxicity lines (median lethal concentrations, LC_{50} values) of the examined compounds were determined as follows: a series of several concentrations was prepared by diluting the formulated compound with tap water. Castor bean leaves were dipped for 10 seconds in each concentration, then left to dry at room temperature. Treated leaves were transferred to plastic jars covered with muslin. Ten 4^{th} instar larvae starved (two hrs before treatment) were placed in each plastic jar. All treatments were replicated three times. Larvae were left to feed on the treated castor bean leaves for 24 hrs in case of conventional insecticides, and 48 hrs in case of IGRs. Mortality percentage was recorded after 24 hrs in case of conventional insecticides, while it was recorded after 72 hrs in case of IGRs. The average percent mortality was corrected using Abbott's formula (Abbott, 1925) if necessary and statistically analyzed according to (Finny, 1952). The rates of resistance of the field strains were collected as resistance ratio (RR) compared with the susceptible starin, Resistance Ratio (RR) = LC_{50} for field strain / LC_{50} for susceptible strain

RESULTS AND DISCUSSION

The resistance spectrum towards organophosphorus, carbamate and pyrethroid insecticides was investigated in different field strains of *S. Littoralis* collected from Fayoum, Dakahlia, Menofia and Sharkia in 2012 cotton season. The resistance ratios of the conventional insecticides tested against field strains is presented in Table (1). The results show that almost field strains showed high levels of resistance to the four insecticides tested in 2012. Telton (profenofos) recorded lower levels of resistance when compared with the other compounds. The resistance ratios to Telton were 11.52, 14.70, 14.72 and 18.38-fold for Menofia, Sharkia, Dakahlia and Fayoum strains, respectively. On the other hand, very high levels of resistance were observed to Sumi-alpha (es-fenvalerate) where the resistance ratios were 39.91, 45.98, 54.14 and 54.79-fold for Dakahlia, Menufia, Sharkia and Fayoum strains, respectively. Similar trend was also observed for Lannate and Dursban, where the resistance ratios ranged between (15.52 -37.60)-fold for Lannate (methomyl) and (16-38.29)-fold for Dursban (chlorpyrifos). From these results, Sumi-alpha recorded very high levels of resistance followed by Dursban then Lannate, while Telton recorded lower levels of resistance.

These results agree with those obtained by El-Guindy *et al*., (2002 b) who studied the history of resistance to pyrethroids in field strains of *S. littoralis* over period of twenty years (1979-1999).They found that the increasing rate of resistance after spraying had nearly increased every five years to 1,2,3,4 and 6-fold for fenpropathrin, fenvalerate, es-fenvalerate and deltamethrin, respectively. However, it is interesting to note that the net rate of increase in resistance usually rose up sharply in one or two seasons and was associated with decline sharply in resistance in the other seasons within every five seasons.

Table (1): Resistance ratio of the cotton leafworm, *S. littoralis* collected from four Governorates in 2012 cotton growing season to four conventional insecticides.

Conventional Insecticides	Susceptible Strain	Fayoum		Dakahlia		Menofia		Sharkia	
	LC_{50} (ppm)	LC_{50} (ppm)	RR*	LC_{50} (ppm)	RR*	LC_{50} (ppm)	RR*	LC_{50} (ppm)	RR*
Chlorpyrifos (Dursban 48 % EC)	7.62	291.10	38.29	304.12	16.00	245.24	32.18	188.22	24.70
Profenofos (Telton 72% EC)	36.23	666.10	18.38	533.47	14.72	417.11	11.52	532.71	14.70
Methomyl (Lannate 90% SP)	11.71	440.25	37.60	181.69	15.52	182.22	15.56	181.70	15.52
Es- fenvalerate (Sumi-alpha5% EC)	5.22	286.10	54.79	83.55	39.91	240.00	45.98	282.57	54.14

RR* = Resistance Ratio = LC_{50} for field strain / LC_{50} for susceptible strain

These results were also compatible with those obtained by El-Dahan *et al*., (1985), who indicated that the resistance of the cotton leafworm, *S.littoralis* (Boisd.) to pyrethroids did not exceed 10-fold in 1980. However, the resistance ranged between 25.5 to 66.7-fold in 1990 (El-Barmawy *et al*., 1991). Rashwan *et al*., (1992), Ishaaya and Klein, (1990) indicated that the fluctuation in resistance levels could be attributed to the type of insecticides used in each locality as well as the sequence of insecticides used for control of the cotton pest complex. On the other hand, Ghoneim, *et al.,* (2012) found that 4th instar larvae of field strain showed very high levels of resistance to the pyrethroids es-fenvalerate (168.1- fold), fenpropathrin (78.1-fold) and fenvalerate (26.7-fold) and the OP profenofos (25.8-fold), while the carbamates thiodicarb, methomyl and the OP chlorpyrifos showed slightly high levels of resistance (18.5, 9.6 and 14.8- fold, respectively). These results were compatible with those obtained by Abdel-Sattar, *et al*., (2012) who found that very high levels of resistance were observed to Karate (pyrethroids) 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-folds, 14.0-33.0 -folds and 13.0-136.5-folds during 2006, 2007and 2008 cotton seasons, respectively.

Data in Table (2) show the resistance for IGRs in field strains of *S. littoralis* collected from Fayoum, Dakahlia, Menufia and Sharkia Governorates in 2012 cotton growing season. Results showed that high levels of resistance were observed to Cascade in all tested field strains, where the resistance ratios were 11.10, 16.40, 22.98 and 28.20-fold for Menufia, Sharkia, Fayoum and Dakahlia strains, respectively, whereas Tobron recorded low levels of resistance where resistance ratios were 2.11, 2.75, 3.95 and 6.70-fold for Sharkia, Menufia Fayoum and Dakahlia strains, respectively. As for Consult, it recorded moderate levels of resistance, where the resistance ratios ranged between 3.35 and 6-folds.Ghoneim (2002) showed that field strain of cotton leafworm showed high susceptibility to the toxic action of Cascade and no detectable levels of resistance to both Atabron and Consult were observed before control season of 2000, while resistance to Atabron increased to 4.3-fold after control season. Anwar and Abdel-Mageed (2005) showed that resistance ratio for the 2nd instar larvae of cotton leafworm *S. littoralis* (Boisd.) were 162850, 17680, 2145 217.60, 20.40 and 2.81-fold to Flufenoxuron, Lufenuron, Chlorfluazuron, Hexaflumuron, Diflubenzuron and Tebufenozide, respectively, but for the 4th instar larvae, resistance ratio reached to 886371, 8198.8, 533.95,18.131,17.51 and 5.39-fold to Flufenoxuron, Lufenuron, Chlorfluazuron, Hexaflumuron, Diflubenzuron and Tebufenozide respectively.

High levels of resistance to pyrethroids, OPs and carbamates had already been observed in cotton leafworm by El-Guindy *et al*., 2002a and 2002b. Low resistance to IGRs in field strains of cotton leafworm was also found by Ghoneim (2002).

Table (2): Resistance ratio to IGRs in the cotton leafworm, *S. littoralis* collected from four Governorates during 2012 cotton growing season

Insect growth regulators (IGRs)	Susceptible Strain	Fayoum		Dakahlia		Menufia		Sharkia	
	LC_{50} (ppm)	LC_{50} (ppm)	RR*	LC_{50} (ppm)	RR*	LC_{50} (ppm)	RR*	LC_{50} (ppm)	RR*
Chlorfluazuron (Tobron 5% EC)	2.72	8.96	3.95	15.20	6.70	5.83	2.75	7.92	2.11
Hexaflumuron (Consult 10% EC)	2.99	13.44	4.49	17.95	6.00	10.03	3.35	6.30	3.49
Flufenoxuron (Cascade 10% DC)	2.50	54.45	22.98	70.94	28.20	27.75	11.10	41.03	16.40

RR* = Resistance Ratio = LC_{50} for field strain / LC_{50} for susceptible strain

The results of the present investigation clearly revealed that both the IGRs Tobron and Consult were effective against all field strains of the cotton leafworm. These data suggest potential use of Tobron and Consult alternatives in the IPM programs. These data agree with Abdel-Mageed *et al.*, (2005) who reported that, based on resistance ratio, the fold of resistance varied considerably according to the chemical structure of studied insecticides and instar of larvae. Data revealed that, small differences in the LC_{50} values were observed between the laboratory and field strains as demonstrated by resistance ratio 0f 0.892, 0.939 and 1.757-fold for profenfos, fenpropathrin and chloropyrifos, respectively, relating to 2^{nd} instar larvae.

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مستويات المقاومة لبعض السلالات الحقلية المختلفة لدودة ورق القطن ضد بعض المبيدات الحشرية ومنظمات النمو الحشرية

نبيل صابر عبد الحي ، محمد سنجاب ، يحيى فتحى السيد غنيم ، منى قطب الحادق
المعمل المر كزى للمبيدات- مركز البحوث الزراعية - الدقى- مصر

لقد تم إحضار أربعة سلالات حلقية من حشرة دودة ورق القطن من محافظات الفيوم - المنوفية - الشرقية والدقهلية فى موسم 2012 وذلك لتقصى مستويات المقاومة لأربعة مبيدات تقليدية دورسبان- تليتون-لانيت- سومى ألفا تتبع ثلاثة مجاميع للمبيدات هى المبيدات الفوسفورية - الكرباماتية والبيرثرويد على التوالي، بالإضافة إلى ثلاثة مركبات تتبع منظمات النمو الحشرية وهى كونصلت - كاسكيد- توبرون. وأوضحت النتائج وجود مستويات مقاومة عالية لمركب سومى ألفا يتبعه دورسبان واللانيت بينما أظهر مركب تليتون مستويات مقاومة منخفضة بالمقارنة بالمركبات الأخرى المختبرة. وفى حالة منظمات النمو الحشرية فإن مستويات المقاومة لمركب كاسكيد كانت مرتفعة، بينما أظهر مركب كونصلت ومركب توبرون معدلات مقاومة منخفضة بمقارنته بالمركبات الأخرى المختبرة. هذه النتائج تشير إلى إمكانية استخدام هذه المواد كبدائل للمبيدات الحشرية التقليدية أو بالتبادل معها في برامج المكافحة المتكاملة للآفات.

قام بتحكيم البحث

أ.د / سلوى السعيد نجم	**كلية الزراعة – جامعة المنصورة**
أ.د /هالة محمد حسين ابو يوسف	**مركزالبحوث الزراعية**