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Screening of some insecticides against the cotton bollworms, *Pectinophora gossypiella* (Saund.) and *Earias insulana* (Boisd.)

Ahmed F. El-Aswad and Maher I. Aly
Pesticide Chemistry Dept., Faculty of Agriculture, Alexandria University

ABSTRACT

The experiment was conducted to evaluate the efficacy of certain EC formulations from organophosphorus and pyrethroid insecticides against the field population of cotton bollworms; *Pectinophora gossypiella* (Saund.) and *Earias insulana* (Boisd.). This experiment was done during cotton season of 2006 according to the protocol of the Egyptian Ministry of Agriculture. The results showed significant differences between the infestation numbers of all tested insecticides and untreated check. The percent infestation, varied between 2 and 33% comparable to 20 and 47% in the control. The results indicated that the tested pyrethroids were more effective in reducing cotton bollworm infestation than that of the tested organophosphorus insecticides. Moreover, the four EC formulations of chlorpyrifos (Chlorozan®, Chloroban®, Renoban® and Pyriphos Nasr®) and the three EC formulations of lambada-cyhalothrin (Agristar®, Axon® and Lamdazd®) gave different percent reduction in bollworms number. In addition, the descending order of the tested insecticides according to their efficacy is as follows: Esfenvalerate = lambada-cyhalothrin = deltamethrin = γ-cyhalothrin > chlorpyrifos > profenofos. Therefore, pyrethroid insecticides can be applied as a part of a management program to control pink bollworm, *Pectinophora gossypiella* and spiny bollworm, *Earias insulana.*

Key words: Insecticides, organophosphorus, pyrethroids, bollworms

INTRODUCTION

Cotton growing and production have been faced with several infestations; most of them, cotton bollworms which causes when neglected, an enormous damage and loss, qualitatively and quantitatively to the crop (Gadallah *et al.*, 1990, El-Feel *et al.*, 1993 and El-Aswad *et al.*, 2001). The most destructive bollworm that attack cotton in Egypt is the pink bollworm, *Pectinophora gossypiella* (Saund.) (Al-Beltagy *et al.*, 1993). The larvae spend late autumn, winter and early spring in a diapausing state inside the cotton seeds and dry bolls (Barrania, 1997). The spiny bollworm, *Earias insulana* (Boisd.), also attacks malvaceous plants, maize and bean (Shaaban and Ibrahim, 1993). In addition, the American bollworm *Heliothis armigera* (Hubn.) is a polyphagous and widely distributed pest in the world; China (Kongming, 2007), India (Gujar *et al.*, 2007) and Pakistan (Ahmad *et al.*, 2003). Moreover, it was recorded in Egypt for the first time in 1905 (El-Gayar *et al.*, 1980) it feeds on the reproductive parts of the cotton plant, i.e., the flowers, buds and bolls.

Chemical control is still considered one of the most important methods for controlling pests (Korkor *et al.*, 1995). Synthetic insecticides are often a part of management programs to control lepidopterous pests (Aydin and Gurken, 2006). The insecticide market has been dominated by the organophosphate, carbamate and pyrethroid classes of insecticides (Argentine *et al.*, 2002). There is a continuing need for new, effective and economical insecticides for crop protection (Casida and Quistad, 2005). Therefore, new compounds will be required to replace the insecticides (Argentine *et al.*, 2002). A screening program of insecticides is carried out regularly every season in research stations against the Egyptian cotton pests to select the most effective insecticides available, and to delay the development of insecticides resistance (Zeid *et al.*, 1973 and Kassem *et al.*, 1985). Accordingly comprehensive studies were carried out mainly to clarify the efficiency of certain insecticides against these pests particularly by Sherby *et al.* (1981), Watson *et al.* (1981), Kassem *et al.* (1985), Kassem and Zeid (1987), Corbitt *et al.* (1989), Moustafa *et al.* (1992), El-Feel *et al.* (1993), Korkor *et al.* (1995), Pree and Daly (1996) and Ahmad *et al.* (2003).

The present study was conducted to evaluate the efficacy of certain EC formulations from organophosphorus and pyrethroid insecticides against the field population of cotton bollworms in Egypt.

MATERIALS AND METHODS

Field experiment: The experiment was conducted according to the protocol of the Egyptian Ministry of Agriculture during 2006 cotton season in Alexandria University Experiment Station at Abees area. The cultivated cotton variety was Giza 70. All cultural methods were carried out according to good agricultural practice. An experimental area of about 2 feddans was used to study the efficiency of tested insecticides against cotton bollworms.

Plots of 1/100 feddan (42 m^2) each arranged in randomized design. Four replicates were sprayed three times (every two weeks) using a knapsack sprayer at the rate of 400 liter per feddan. For each treatment, samples of 25 green bolls were collected at random from both diagonals of each replicate (100 green bolls/treatment) before spraying time and weekly after pesticide application. Percentage of infestation by pink bollworm, *Pectinophora gossypiella* and spiny bollworm, *Earias insulana* was determined in the laboratory by dissection of bolls and checking the bolls externally and internally. The percent reduction of bollworms infestation was calculated according to the following equation as reported by Henderson and Tilton (1955).

$$\%\text{ Reduction of infestation} = \left[1 - \left(\frac{a}{b} x \frac{c}{d}\right)\right] x\ 100$$

Where: a = No. of infestation in control before spray, b = No. of infestation in control after spray, c = No. of infestation in treatment after spray, d = No. of infestation in treatment before spray. In addition, the boll protection was calculated according to El-Feel *et al.* (1993) who used the following equation to calculate the initial kill. Moreover, the treatments were compared with each other using one way ANOVA with LSD test (Costat Statistical Software, 1990).

$$\%\text{Boll protection} = \frac{\text{No.of infestation in control - No.of infestation in treatment}}{\text{No.of infestation in control}} x100$$

Insecticides tested: The commercial insecticides were obtained from local companies. The insecticides used and their rates were as follows:

- Chlorpyrifos;O,O-diethyl-O-(3,5,6-trichloro-2-pyridyl) phosphoro-thioate. Chlorozan (KZ Co.), Chloroban (E.G.D.), Renoban (CAM Co.) and Pyrifos-Nasr (El-Nasr Co. for intermediate chemicals), 48% EC, at the rate of 1 L/Fed.

- Profenofos; O-(4-bromo-2-chlorophenyl)-O-ethyl S-propyl phosphoro-thioate. Akaron (CAM Co.), 72% EC, at the rate of 750 ml/Fed.

- Deltamethrin; (S)-α-cyano-m-phenoxybenzyl (1R, 3R)-3(2,2-dibromo-vinyl)-2,2 dimethylcyclopropane-carboxylate. Dimethrin (Agrochem) 2.5%

EC, at the rate of 750 ml/Fed., Kothrin-Nasr (El-Nasr Co. for intermediate chemicals), 5% EC, at the rate of 750 ml/Fed.

- Lambada-cyhalothrin;(S)-α-cyano-3-phenoxybenzyl (Z)-(1R, 3R)-3-(2-chloro-3.3.3- trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate and (R)-α-cyano-3-phenoxybenzyl (Z)-(1S, 3S)-3-(2-chloro-3.3.3 tri-fluoro-prop-1-enyl)-2,2-dimethylcyclopropanecarboxylate. Agristar (EGYCHEM), Axon (CAM Co.), Lamdazd (KZ Co.), 5% EC, at the rate of 375 ml/Fed.

- γ-cyhalothrin; (S)-α-cyano-3-phenoxybenzyl (Z)-(1R, 3R)-3-(2-chloro-3.3.3- trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate. Vantex (Agreen serv and Dow Agrisynthesis), 6% CS, at the rate of 100 ml/Fed.

- Esfenvalerate; (S)-cyano(3-phenoxyphenyl)methyl-(S)-4 chloro-alpha-(1-methylethyl) benzene acetate. Fenerat-S (Agrochem), 5% EC, at the rate of 600 ml/Fed.

RESULTS AND DISCUSSION

The average percent infestation in all experimental field plots was monitored till that reached 7% at zero time of insecticides application. The percent infestations in the bolls were evaluated every week for six weeks after spraying. Data in Table (1) show that the final percent infestation in the control treatment reached 47% after six weeks. The percent infestation varied between 2 and 15% and varied between 3 and 33% on the base of 20 and 47% in the untreated check after the second spray (4th week) and third spray (6th week), respectively. The statistical analysis indicated that no significant differences were obtained among the commercial EC formulations of chlorpyrifos and that of deltamethrin and lambada-cyhalothrin throughout the experimental time. Contrary, the significant differences were detected between all tested insecticides and untreated check at 4th, 5th and 6th week. The lowest number of infestation was observed and it was obtained by tested pyrethroids particularly Lamdazd and Fenerat-S after second and third sprays. On the other hand, the highest percentages of boll protection were 73.3% obtained by Dimethrin and Fenerat-S at 2nd week, 90.0 and 93.6% due to Lamdazd application at 4th and 6th week, respectively. While, the lowest percentages (the ranged 0-30%) were obtained at 2nd, 4th and 6th week by Chloroban (Fig. 1). Almost all applied insecticides could be categorized into four groups according to the boll protection percentage after 2nd and 3rd sprays. The 1st group has a high effect, gave protection percentage more than 87%. The 2nd group has a considerable effect, caused protection percentage that ranged between 70-81%. The 3rd group has a moderate effect, being 50-61% percent of boll protection. Consequently, the 4th group has a low effect, produced protection percentages less than 31%. Insecticide that had a high effect (1st group) was Lamdazd. The insecticides that had a considerable effect (2nd group) included Dimethrin, Kothrin Nasr, Agristar and Fenerate-S. The 3rd group included Pyrifos Nasr and Akaron. The 4th group included Chloroban only.

Table (1): Number of infestations (per 100 bolls) before and after spraying with insecticides

Insecticides		Rate /Fed.	Zero time	Time after treatment (Week)					
Common name	Trade name			1	2	3	4	5	6
Chlorpyrifos	Chlorozan	1 L	6	10^{b}	16^{a}	16^{abc}	15^{b}	9^{cdef}	13^{cde}
	Chloroban	1 L	7	9^{b}	16^{a}	19^{ab}	14^{b}	16^{bc}	33^{b}
	Renoban	1 L	12	15^{ab}	21^{a}	15^{bc}	11^{bc}	8^{def}	20^{cd}
	Pyriphos Nasr	1 L	9	16^{ab}	16^{a}	7^{de}	9^{bcd}	3^{f}	21^{c}
Profenofos	Akaron	750ml	10	18^{a}	14^{a}	10^{cd}	8^{cde}	13^{bcd}	18^{cd}
Deltamethrin	Dimethrin	750ml	8	15^{ab}	4^{c}	6^{de}	5^{cde}	8^{def}	11^{cde}
	Kothrin Nasr	750ml	6	10^{b}	6^{bc}	9^{cde}	6^{cde}	10^{cdef}	9^{de}
Lambada-cyhalothrin	Agristar	375ml	5	9^{b}	5^{bc}	8^{cde}	6^{cde}	10^{cdef}	13^{cde}
	Axon	375ml	5	9^{b}	5^{bc}	5^{de}	7^{cde}	11^{bcde}	12^{cde}
	Lamdazd	375ml	5	8^{b}	5^{bc}	5^{de}	2^{e}	4^{ef}	3^{e}
Gamma-cyhalothrin	Vantex	100ml	11	8^{b}	13^{ab}	16^{abc}	1^{5b}	17^{b}	11^{cde}
Esfenvalerate	Fenerat-S	600ml	5	8^{b}	4^{c}	1^{e}	4^{de}	5^{ef}	9^{de}
Control			4	8^{b}	15^{a}	23^{a}	20^{a}	34^{a}	47^{a}
$LSD_{0.05}$				4.87	5.79	5.41	3.88	4.82	7.14

Values within the same column having the different letters are significantly different according to Student- Newman -Keuls test at P = 0.05 level.

Table (2) showed the percent reduction in infested bolls calculated every week after treatments until six weeks. In general, all the tested insecticides resulted in an appreciable reduction in bollworm infestation as compared with control. Infestation reduction percentages increased with the time of experiment in all treatments. The percent reduction for the tested insecticides was ranged from 8.0 to 62.3%, 27.9 to 86.5 and 50.6 to 95.4%

at 1st, 2nd and 3rd week, respectively. The percent reduction within the last three weeks indicated that the insecticide, Lamdazd showed superior reduction in bollworms infestation more than 90% followed by Dimethrin (88% reduction). On the other hand, Chloroban was the least effective tested insecticide in this respect.

Fig. (1): Boll protection (%) by tested insecticides

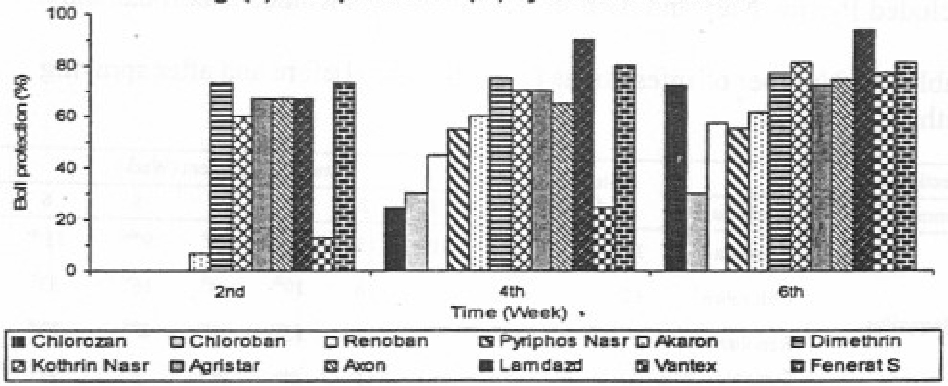

Table (2): Percent reduction in cotton bollworms infestation following the application of tested insecticides

Insecticides		Rate /Fed.	First spray		Second		Third	
			Time (weeks)					
Common name	Trade name		1	2	3	4	5	6
Chlorpyrifos	Chlorozan	1 L	16.7	27.9	53.2	51.3	81.8	81.1
	Chloroban	1 L	29.5	34.5	50.6	57.6	71.5	57.3
	Renoban	1 L	39.2	52.0	78.7	82.3	92.2	85.8
	Pyriphos Nasr	1 L	11.1	52.0	87.1	79.3	96.6	80.1
Profenofos	Akaron	750 ml	8.0	61.1	81.8	84.0	84.7	84.3
Deltamethrin	Dimethrin	750 ml	8.8	86.5	87.7	87.5	88.2	88.2
	Kothrin Nasr	750 ml	13.3	71.2	73.7	80.0	80.4	86.8
Lambada-cyhalothrin	Agristar	375 ml	12.3	73.0	73.5	77.4	77.8	78.6
	Axon	375 ml	14.0	71.4	81.4	72.0	74.1	78.5
	Lamdazd	375 ml	20.0	71.4	81.4	90.4	90.6	95.6
Gamma-cyhalothrin	Vantex	100 ml	62.3	66.1	73.5	72.5	80.8	91.5
Esfenvalerate	Fenerat-S	600 ml	20.0	78.4	95.4	84.0	87.5	84.6

Table (3) summarized reduction percentages in infested bolls by pink and spiny bollworms, calculated on the basis of the mean of every spray and the general average during the whole period of investigation. Vantex and

Fenerate-S proved to be the most effective compounds for the 1st and 2nd spray, respectively. While, Chlorozan was the least effective one.

Table (3): Means of the reduction percentage of cotton bollworm infestation (± SE) for three sprays

Insecticides		Rate /Fed.	% Reduction			
Common name	Trade name		First spray	Second spray	Third spray	General average
Chlorpyrifos	Chlorozan	1 L	22.3 ± 16.0	52.3 ± 14.7	81.5 ± 4.2	52.0 ± 10.5
	Chloroban	1 L	32.0 ± 14.3	54.1 ± 9.8	64.4 ± 7.3	50.2 ± 10.1
	Renoban	1 L	45.6 ± 12.9	80.5 ± 2.5	89.0 ± 1.7	71.7 ± 5.1
	Pyriphos Nasr	1 L	31.6 ± 5.2	83.2 ± 3.9	88.4 ± 1.2	67.7 ± 3.1
Profenofos	Akaron	750 ml	34.6 ± 41.5	82.9 ± 5.7	84.5 ± 7.8	67.3 ± 18.3
Deltamethrin	Dimethrin	750 ml	47.7 ± 13.5	87.6 ± 4.5	88.2 ± 4.2	74.5 ± 7.3
	Kothrin Nasr	750 ml	42.3 ± 19.0	76.9 ± 9.4	83.6 ± 5.1	67.6 ± 11.0
Lambada-cyhalothrin	Agristar	375 ml	42.7 ± 3.0	75.5 ± 4.3	78.2 ± 5.5	65.5 ± 4.2
	Axon	375 ml	42.7 ± 13.3	76.7 ± 3.3	76.3 ± 2.6	65.2 ± 5.3
	Lamdazd	375 ml	45.7 ± 9.2	85.9 ± 4.4	93.1 ± 2.9	74.9 ± 3.4
Gamma-cyhalothrin	Vantex	100 ml	64.2 ± 9.6	73.0 ± 6.2	86.2 ± 3.1	74.5 ± 6.2
Esfenvalerate	Fenerat-S	600 ml	49.2 ± 9.2	89.7 ± 2.9	86.1 ± 1.8	75.0 ± 4.0

As regards the percent reduction in boll infestation for the 3rd spray, the highest percent reduction was recorded by Lamdazd, whereas the lowest level was recorded by Chloroban. Using statistical analysis, the applied insecticides could be categorized into four groups as follows: 1st group which included the insecticides that gave 75.0 to 74.5% reduction namely; deltamethrin (Dimethrin), lambada-cyhalothrin (Lamdazd), γ-cyhalothrin (Vantex) and esfenvalerate (Fenerate-S), 2nd group which included chlorpyrifos (Renoban), accounted 71.7% reduction, 3rd group which included chlorpyrifos (Pyrephos Nasr), deltamethrin (Kothrin Nasr), profenofos (Akaron) and lambada-cyhalothrin (Agristar and Axon), caused reduction percentages ranged from 65.2 to 67.7%, 4th group which included chlorpyrifos (Chloroban and Chlorozan) which caused 50.2 and 52.0% infestation reduction. The results also clearly indicate that the tested pyrethroids were more effective in reducing cotton bollworms infestation than that of the tested organophosphorus compounds. The superior activity of the synthetic pyrethroids against cotton bollworms was also recorded by Watson *et al.* (1981), Ghattas (1985) and Korkor *et al.* (1993 and 1995). Renoban caused percent reduction in bollworms infestation more than that other tested commercial products of chlorpyrifos. Clearly, both products of chlorpyrifos; Chlorozan and Chloroban were the least effective compounds. These results agree with the finding of Kassem *et al.* (1985) who found that chlorpyrifos (Dursban) was the least effective compound. In contrast, El-Aswad *et al.* (2001) and El-Aswad (2003) found that chlorpyrifos (Chlorozan) was the high effective compound against cotton leafworm. Concerning the tested commercial products of deltamethrin, Dimethrin was more effective compared to Kothrin Nasr. Both commercial products of lambada-cyhalothrin; Agristar and Axon gave the same effect in reducing the infestation of bollworms which was lower than that of Lamdazd. The data also indicated that the four products of chlorpyrifos (Chlorozan, Chloroban, Renoban and Pyriphos Nasr) and the three products of lambada-cyhalothrin (Agristar, Axon and Lamdazd) caused different percent reduction in bollworms number. These results are in agreement with those of Korkor *et al.* (1995) who found that the three commercial products of cypermethrin caused different reduction percentages of bollworms.

In conclusion, the descending order of the tested insecticides according to their efficacy was follows: Esfenvalerate = lambada-cyhalothrin = deltamethrin = γ-cyhalothrin > chlorpyrifos > profenofos. Therefore, pyrethroid insecticides can be applied as a part of a management program to control pink bollworm, *Pectinophora gossypiella* and spiny bollworm, *Earias insulana*. However, there is a continuing need for new, effective and economical insecticides for cotton protection. The best strategy would be to use all the effective compounds in rotation along with other integrated pest management tactics.

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تقييم كفاءة بعض المبيدات الحشرية على ديدان اللوز القرنفلية والشوكية فى القطن

أحمد فرحات الأسود – ماهر ابراهيم على
قسم كيمياء المبيدات – كلية الزراعة – جامعة الإسكندرية

تم تقييم أثنى عشر مركبا منهم خمسة مركبات فسفورية وهم عبارة عن أربعة منتجات تجارية لمركب الكلوربيرفوس وتجهيزة واحدة لمركب البروفينفوس وكذلك سبعة مركبات بيروثرويدية عبارة عن ثلاثة منتجات تجارية لمركب لامبادا – سيهالوثرين واثنين لمركب دلتامثرين وتجهيزة واحدة لكل من جاما سيهالوثرين واس فينفاليرات. وصممت التجارب طبقا لبروتوكول وزارة الزراعة المصرية الخاص بتقييم المركبات ضد ديدان اللوز (دودة اللوز القرنفلية والشوكية) فى القطن. ولقد أوضحت النتائج وجود فروق معنوية بين كل المعاملات والكنترول. وكانت نسبة الإصابة بصورة عامة بين ٢ - ٣٣% فى المعاملات وما يقابلها فى الكنترول في حدود ٢٠ - ٤٧% . ولوحظ أن مركبات البيروثريدات كانت أعلى كفاءة من حيث خفض الإصابة بديدان اللوز عن المركبات الفسفورية. ويمكن ترتيب المركبات المختبرة تنازليا طبقا لخفض نسبة الإصابة كالتالي: اس فينفاليرات = لامبادا سيهالوثرين = دلتامثرين = جاما سيهالوثرين > كلوربيرفوس > بروفينفوس. وعموما بناء على هذه النتائج يجب الاهتمام بتطبيق المركبات البيروثرويدية ضمن برامج المكافحة المتكاملة ضد ديدان اللوز في محصول القطن.