

EFFECT OF CERTAIN BIO AND CHEMICAL INSECTICIDE ON COTTON LEAFWORM, *SPODOPTERA LITTORALIS* (BOISD.) AND SOME ASSOCIATED PREDATORS UNDER FIELD CONDITION

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Abstract

Present work was carried out at Zagazig district, Sharkia Governorate during 2008 and 2009 seasons to evaluate the effect of some bioinsecticides, Jojoba oil, Dimilin and Dursban on *Spodoptera littoralis* and some accompanied Predators under field condition. The results indicated that the initial effect of the tested compounds, (expressed as the rate of reduction in the percent infestation) recorded (18.7, 23.61, 23.6, and 17.9% in the first season. (2008), (16.88, 19.53, 19.9 and 17% in the second one (2009) for Biorinza, Biovar, Protecto and Jojoba oil, respectively. It is obvious that Biovar was the most potent compound in both seasons. Also, results indicate that the initial effect of tested IGR (Dimilin) induced reduction in the rate of *S. littoralis* infestation, as it recorded (77.295%) reduction, in 2008 season, 71.8% during 2009. Dursban recorded 95% in 2008 season: 94.09% during 2009. bioinsecticides and Jojoba oil recorded on predators (13.7, 14.97, 12.43 and 19% in the first season 2008, 10.41, 13.19, 9.74 and 15.85 % in the second one 2009 for Biorinza, Biovar, Protecto and Jojoba oil, respectively. Dimilin recorded after five days 18.61% in the first season 2008, 16.70 % during 2009. The initial effect of Dursban on predators reduction was 89.42% in first season, 83.26% second season. Dursban was the highest effective compound against predators. The higher toxicity of Dursban could be attributed to its toxic effect against nearly all the developmental stages of predators.

INTRODUCTION

Cotton is the most important natural textile fiber in the world and considered one of the major sources of the national income in Egypt due to its excellent and incomparable technological characters. However, cotton plants are attacking by several insect pests during its all growing stages that affect severely and negatively its productivity. It is well known that the cotton leaf worm, *Spodoptera littoralis* (Boisd.) is one of the most destructive and dangerous pests for cotton plants and other field crops and vegetables. Although insecticides are still one of the most powerful weapons in our never ending battle against insect pests, it is becoming increasingly important to develop and use other control agents that are effective but

do not pose hazard for man and/or environment. Owing to the endless and various problems that have been arisen by using insecticides (the development of pest resistance, rapid resurgence of target species and outbreaks of secondary pests), the need to develop novel alternatives or functional combination of pest control techniques is emphatically a product of this decade. This destructive polyphagous pest causing substantial loss of different plants of cotton plantations could result in yield reduction up to 50% (Russell *et. al.*, 1993). The wide and misuse of insecticidal or pesticidal chemical compounds resulted in great damage caused to beneficial insects and beekeeping all over the world. (Toscano *et. al.*, 1974). Attention was therefore paid to control insects using different non-chemical methods (e.g. IGR compounds, bioinsecticides, plant extracts and mechanical control) which are considered nowadays a main components of IPM programs in order to minimize the usage of conventional insecticides, hence to reduce the environmental pollution and the hazard to both man and domestic animals.

The present investigation aimed to clarify the effective reduction percentages of the IGR (Dimilin), bioinsecticides (Biovar, Bioranza and Protecto), plant extract (Jojoba oil) and Dursban on *Spodoptera littoralis* (Boisd.) and predators in cotton fields.

MATERIALS AND METHODS

Tested compounds

1. Plant extracts

Jojoba oil: (plant oil formulated as E.C) produced by Egyptian Natural oil Co. used at the rate of 500ml/feddan.

2. Insect growth regulator

Dimilin[®]: (diflubenzuron).

A commercial water dispersible powder containing 25% diflubenzuron, 1-(4-chlorophenyl)-3-(2.6-diflubenzoyl) urea was available for testing. The suspension at the rate of. 0.5kg formulation/feddan.

3. Bioinsecticides

Protecto[®]: *Bacillus thuringiensis* var. *Kurstaki* 32.000 IU/mg). The recommended rate is 300gm / 100L water.

Biovar[®]: an Entomomopathogenic fungi 32000 viable spore/mg) containing the fungus *Beauveria bassiana* applied at rate of 200g/100 L water.

Biorinza®: ***Metarhizium anisopliae*** sore Biorinza 10% W.P (32 x 10⁶ spores/ml)
Rate 200 g / 100 L water.

Basic product: Insect Pathogen Unite Plant Protection Research Institute, Agricultural Research Center Dokki, Giza ,Egypt.

4. Organophosphorous

Dursban ®

(Chlorpyrifos) 48% E.C. O, O-diethyl O-(3,5,6-trichloro-2-pyridinyl) phosphorothioate. Used the rate of 1 L/feddan. Dow Agro science.

1. Field experiments

Field experiments were carried out on cotton, ***Gossypium barbadense* L.** (variety Giza 86) cultivated in Zagazig district, Sharkia Governorate during the two successive seasons of 2008 and 2009. The tested insecticides were applied at the recommended field rate, using a Solo motor sprayer, 20liter in capacity used with 200 liter volume of insecticidal solution per feddan, while control was sprayed with water only. Spray treatments were applied at 23/05/2008,19/05/2009 to study the effect of bio and chemical insecticides (Protecto, Biovar, Biorinza, Jojoba oil, Dimilin and Dursban) on the ***Spodoptera littoralis*** insect pest and some related predators insects, namely *Chrysoperla carnea*, *Coccinella* sp. ,*Paederus alfiriai* and Spiders. The initial effect of Insect growth regulator (Dimilin) against ***Spodoptera littoralis*** was measured 5 days after spraying Badr, *et. al.*, (2000) and Khedr (2002). The efficiency of plant extract jojoba oil and Bioinsecticides against ***Spodoptera littoralis*** were measured 3 days after spraying (Badr *et. al.*, (2000) and Khedr (2002) the efficiency of Dursban against ***S. littoralis*** was measured one day after spraying. (The percentage of reduction in the population density of insect was calculated according to (Henderson and Tilton 1955). equation.

An area of 2 feddan divided into 8 plots. Post treatment count were recorded 3,5,7 and 9 days for both plant extracts and Bioinsecticides (Badr *et. al.*, 2000 and Khedr, 2002) and 5,10 and 15 days for IGR (Khedr, 2002). The initial effect was calculated at day 3 and 5 for Bioinsecticides, jojoba oil and IGR, respectively. The general mean was calculated as the mean reduction percentages observed at days (1, 3, 5, 7 and 9 post treatment for Dursban), (3, 5, 7 and 9, 10 and 15 post treatment for Bioinsecticides, jojoba oil and IGR), respectively.

The changes in the population density of predators were studied depending on the weekly counts in cotton fields treated with the previous mentioned bio and

insecticides. The weekly samples were taken randomly before and after treatments by sweep net throughout the period of inspection. The collected insects transferred to plastic bags and transported to laboratory where they were thoroughly inspected. Predator adults were separated, identified and counted.

RESULTS AND DISCUSSIONS

1. Initial and residual activity of bioinsecticides and Jojoba oil against *S. littoralis* infesting cotton fields

a. Initial effect [After three days]

The results presented in Table (1) indicate that the initial effect of the tested compounds, expressed as the rate of reduction in the percent infestation recorded (18.7, 23.61, 23.6, and 17.9% in the first season. 2008, (16.88, 19.53, 19.9 and 17% in the second one 2009 for Biorinza, Biovar, Protecto and Jojoba oil, respectively. It is obvious that Biovar was the most potent compound in both seasons, meanwhile Jojoba was the least effective one.

b. Residual Effect

After five days

Percent of reduction in the rate of *S. littoralis* infestation after five days of spray recorded (35.53, 36.85, 34.78 and 35%) in 2008 season, (31.006, 33.88, 28.97 and 29.22%) in 2009 season for Biorinza, Biovar, Protecto and Jojoba oil respectively, Table (1).

After seven days

Percent of reduction in the rate of *S. littoralis* infested cotton fields after seven days of spray recorded (36.39, 38.55, 39.92 and 40.96% in first season 2008, 34.145, 40.05, 37.21 and 36.6% in second season for Biorinza, Biovar, Protecto and Jojoba oil.

After nine days

It is obvious that from the results obtained and presented in Table (1) that the reduction percentages of *S. littoralis* infestation due to treatment of the tested compounds, Biorinza, Biovar, Protecto and Jojoba oil recorded (37.09, 49.9, 48.41 and 47.21% in 2008 season, 39.03, 51.16, 42.42 and 44.5 in 2009 season, respectively.

Table1

The general mean rate of reduction in the cotton leaf worm as resulted to Biorinza, Biovar, Protecto and Jojoba oil applied recorded (32.00, 37.23, 36.7, and 35.32 in the first season, 30.3, 36.2, 32.2 and 31.83 in the second season for Biorinza, Biovar, Protecto and Jojoba oil, respectively (Table 1).

According to the general mean of reduction, Biovar proved to be the most potent compound reduced number of larvae in both seasons, 37.23 and 36.30, respectively while the reverse is true in case of Jojoba which recorded the least effective percentages of reduction (32.00 and 30.30, respectively). Salem *et. al.*, (2003) tried to explain the reason of efficiency of Jojoba showed that Jojoba oil is a proven as wetting agent and damaged the cuticle of *Bemisia tabaci*, *Empoasca discipiens* resulting in desiccation then death in *Bemisia tabaci*.

Bleicher *et. al.*, (1990) found that selective insecticides (Dimilin at 13-15g, trichlorofen at 138-178g, endosulfan at 394g and *B. thuringiensis* at 14-21g/ha) were as effective as non-selective (parathion- methyl at 187g/ha and showed a better residual effect than the standard insecticide, these results in are agreement with Salama and Salem (1999) who found that the mortality of *S. littoralis* larvae resulted Bt Diplex was varied between 36.9- 67.2% in Soya been field.

While Purwar and Yadav (2003) found that the anetomopatogenic fungi *Beauveria bassiana*) was more effective than the botanical insecticide, neem seed, kernel extract in suppressing the populating of *S. litura*. Farag (2008) found that Biovar induced the highest percentage mortality, followed by Biorinza, Delfin then Neem-Azal- T/S product.

2. Initial and residual activity of the tested Dimilin against *S. littoralis* infesting cotton fields

a. Initial effect (After five days)

The results obtained in Table (2) indicate that the initial effect of IGR (Dimilin) induced significant reduction in the rate of *S. littoralis* infestation, as it recorded (77.295%) reduction, in its population during 2008 season, 71.8% during 2009.

b. Residual effect

After ten days

Percent of reduction in the rate of *S. littoralis* infestation after ten days of spray recorded 83.8% in season 2008, 73.9% in 2009 season for Dimilin.

After fifteen days

Percent of reduction in the rate of *S. littoralis* infestation after fifteen days of spray recorded 86.735 in 2008 season, 82.16 % in 2009 season for Dimilin.

The general mean reduction percentage in the rate of *S. littoralis* infestation as a result of IG R Dimilin application recorded 82.6% in 2008 season and 76.0.

Table 2. The mean numbers of cotton leaf worm larval before and after treatments with Dimilin in cotton fields during 2008 and 2009 season at Zagazig district, Sharkia Governorate.

Season	treatment	Recommended field rate	Mean of larvae before spray	No of larvae /plant and % reduction						General mean of Residual effect	
				Initial effect after		Residual effect after					
				5 days		10 days		15 days			
				No.	%Red.	No.	%Red.	No.	%Red.	No.	%Red.
2008	Dimilin	500gm/ fed.	17.81	6.21	77.29	4.33	83.80	1.86	86.74	4.13	82.60
	Control	-	17.21	26.43	-	25.87	-	13.55	-	-	-
	Mean C ^o	-	-	26 ^o	-	28 ^o	-	28 ^o	-	-	-
	RH%	-	-	48%	-	42%	-	48%	-	-	-
2009	Dimilin	500gm/ fed.	14.93	5.92	71.80	5.44	73.90	1.95	82.160	4.43	76.00
	Control	-	15.61	21.95	-	21.80	-	11.48	-	-	-
	Mean C ^o	-	-	25.8	-	28.7	-	33	-	-	-
	RH%	-	-	62%	-	55%	-	53%	-	-	-

It is obvious that Dimilin induced highly reduction in the rate of cotton leaf worm infestation in cotton field up to 15 days after spray. It is obvious that the residual effect of Dimilin as an insect growth regulator is stronger than its initial effect after 5 days. the same conclusion obtained by Bleicher *et. al.*, (1990) recorded that residual effects of Dimilin is higher than its initial effect.

3. Initial and residual activity of Dursban 48% against *S. littoralis* infesting cotton

a. Initial effect (After one day)

The results obtained in Table (3) show the initial effect of Dursban on rate of infestation with *S. littoralis*. A significant reduction in the rate of *S. littoralis* infestation, was recorded as a result of treatment with it (95% in 2008 season: and 94.09% during 2009).

b. Residual effect

After three days percent of reduction in the rate of *S. littoralis* infestation after three days of spray recorded 97% in 2008 season and 95.81% in 2009 season for Dursban and after five days percent reduction in the rate of *S. littoralis* infestation recorded 93% in 2008 season and 92% in 2009 season. After seven days from application with Dursban, Percent reduction in the rate of *S. littoralis* infestation recorded 89% in 2008 season and 87.92% in 2009 season. After nine days percent of reduction in the rate of cotton leaf worm infestation recorded 83% in 2008 season and 82.9% in 2009 season. The general mean of residual effect of reduction was 91.4% in 2008 season and 90.56% in 2009 season.

Initial effect after 1 day for Dursban recorded 95% in 2008 season and 94.09 in 2009 season while residual effect after nine days recorded 83% in season 2008, 82.9 in 2009 season.. It is obvious that initial effect (1 day) of Dursban against cotton leaf worm is higher than its effect after nine days from treatment .

Shivankor *et. al.*, (2008) found that chlorpyrifos 20 Ec a to 1% recorded mortality percentage 94.1% in *Spodoptera littoralis* larvae in field.

Table 3. The mean numbers of cotton leaf worm larval before and after treatments with Dursban in cotton fields during 2008 and 2009 season at Zagazig district, Sharkia Governorate.

Season	Treatment	Recommended field/rate	Mean. No. of larvae before spray.	No. of larval instars / plant and reduction percentage										General mean of Residual effect	
				Initial effect after		Residual effect after									
				1day		3 days		5days		7 days		9 days			
				No.	% Red.	No.	% Red.	No.	% Red.	No.	% Red.	No.	% Red.	No.	% Red.
2008	Dursban	IL/fed.	17.54	0.85	95%	0.68	97	1.88	93	2.92	89	4.52	83	2.17	91.4
	Control	-	17.21	18.32	-	22.43	-	26.43	-	26.60	-	26.09	-	-	-
	Mean ± C	-	-	25	-	24	-	26	-	27	-	28	-	-	-
	R.H.%	-	-	53%	-	56%	-	48%	-	40%	-	54%	-	-	-
2009	Dursban	IL/fed.	15.47	1.17	94.09	0.76	95.81	1.74	92	2.68	87.92	3.79	82.99	2.02	90.56
	Control	-	15.61	20.00	-	18.32	-	21.95	-	22.39	-	22.49	-	-	-
	Mean ± C	-	-	27.80	-	29.90	-	25.80	-	28	-	30.50	-	-	-
	R.H.%	-	-	57%	-	68%	-	62%	-	57%	-	58%	-	-	-

4.1. Initial and residual activity of the tested compounds against predators associated with *S. littoralis* infesting cotton

4. 1.1. Bioinsecticides and Jojoba oil

a. Initial effect (After three days)

The results presented in Table (4) indicate that the initial effect of the tested compounds, expressed as the rate of reduction in the percent of infestation recorded (13.7, 14.97, 12.43 and 19% in the first season 2008 and 10.41, 13.19, 9.74 and 15.85 in the second one 2009 for Biorinza, Biovar, Protecto and Jojoba oil, respectively.

b. Residual effect

After five days

Percent of reduction in the rate of predators after five days of spray were 18.2, 21.12, 19.85 and 25.65% in 2008 season and 15.19, 17.5, 18.55 and 23.32 in 2009 season for Biorinza, Biovar, Protecto and Jojoba oil, respectively.

After seven days

Percent of reduction in the population of predators after seven days of spray recorded 24.27, 24.8, 25.71 and 28.33 in the first season, 20.7, 20.64, 22.4 and 24.61 in the second season, for the Biorinza, Biovar, Protecto and Jojoba oil, respectively (Table-4).

After nine days

Reduction percentage in the population of predators after nine days of spray recorded 28.38, 28.98, 28.85 and 30.95% in the first season, 24.39, 28.24, 26.7 and 27.44% in the second season for Biorinza, Biovar, Protecto and Jojoba oil, respectively.

The general mean of the tested compound recorded 21.14, 22.5, 21.7 and 26.00% in the first season, 17.7, 20, 19.35 and 22.8% in the second one for Biorinza, Biovar, and Protecto and Jojoba oil, respectively.

Biorinza was the least effective compound induced the least reduction in predator population recorded 21.14 and 17.7% in both seasons, respectively.

The reverse is true in case of the other three compounds, especially Jojoba oil which proved to be the most toxic compound among this category as it recorded 26.0 and 22.8% reduction of predators in both seasons, respectively. The higher toxicity of Jojoba oil could be attributed to its toxic effect against nearly all the developmental stages of predators. Qiao *et. al.*, (2009) *Bacillus thuringiensis* had no significant effects on life span of *Chouioia cunea* adults. Andréev and Atanasova (2005) stated that Azadirachtin showed a low level of toxicity to coccineloide adults.

Roy *et. al.*, (2008) stated that fungal pathogens (*Beauveria bassiana*, *Metarhizium anisopliae*) are all too often forgotten natural enemies and future research should address the profound absence of knowledge in this field.

Table 4.

4.1.2. Initial and residual activity of growth regulator (Dimilin) against predators associated *S. littoralis* infesting cotton fields

a. Initial effect (After five days)

The results obtained in Table (5) indicate that the initial effect of the tested IGR, (Dimilin) on predators of *S. littoralis* recorded 18.61% in the first season, 16.70% in second season.

b. Residual effect

After ten days

Percent of reduction in the rate of predators of *S. littoralis* after ten days of spray recorded 32.870% in 2008 season and 28.730% in 2009 season for Dimilin.

After fifteen days

Percent of reduction in the rate of predators of *S. littoralis* after fifteen days from spray recorded (41.12%) in 2008 season, (38.70%) in 2009 season for Dimilin. The general mean reduction in the rate of predators of *S. littoralis* as a result of IGR application recorded (30.870%) in first season and 28.043% in second for Dimilin.

Table 5. The mean numbers of predators before and after treatments with Dimilin in cotton fields during 2008 and 2009 seasons at Zagazig districts Sharkia Governorate.

Season	Treatment	Recommended rat/fed	No. of predators before spray					No of predators/100 plant and % reduction						Mean of general effect	
								Initial effect after		Residual effect after					
			5 days		10 days		15 days								
			A	B	C	D	T	No.	%Red.	No.	%Red.	No.	%Red.		
2008	Dimilin	500 gm/fed.	43	18	23	51	135	130	18.61	131	32.87	133	41.12	131.30	30.87
	Control	-	83	61	17	41	202	239	-	292	-	338	-	-	-
	Mean °C	-						26	-	28	-	28	-	-	-
	R.H.%	-						48%	-	42%	-	48%	-	-	-
2009	Dimilin	500 gm/fed.	53	36	21	59	169	164	16.70	167	28.73	166	38.70	165.67	28.04
	Control	-	59	41	31	45	176	205	-	244	-	282	-	-	-
	Mean °C	-						25.8	-	28.7	-	33	-	-	-
	R.H.%	-						62%	-	55%	-	53%	-	-	-

A=, *Coccinella* sp. ,

B= *Chrysoperla carnea*

C= *Paederus alfiriai*

D= Spiders

T= Total number of predators

Andreev and Atanasova (2005) found that toxicity of insecticide to predatory ladybirds under laboratory toxic to eggs, reducing highly production by *coccinell asptempunctata*, although this insecticide was less toxic than other insecticides. Azadirachtin showed a low level of toxicity to coccinell adults.

Kuldeep *et. al.*, (2005) found that Impact of sect growth regulators on predators had very low effect on parasitism 200,300,400 g/ha) except for diflubenzuron at 600 gm/ha. Qiao *et. al.*, (2009): found that Dimilin, *Bacillus thuringiensis* had no significant effects on life – span of *Chouioia cunea* adults.

4.1.3. Initial and residual activity of the tested organophosphoras (O.P)

Dursban 48% against some common predators of *S. littoralis* infesting cotton fields

a. Initial effect (After 1 day)

The result presented in (Table 6) indicated that the initial effect of the tested compound, expressed as the rate of reduction in the percent infestation recorded (89.42% in the first season 2008 and 83.26 in the second one 2009).

b. Residual effect

After three days

Percent of reduction in the rate of some common predators after three days of spraying Dursban were recorded 82.22% in 2008 season, 78.4% in 2009 season (Table 6) while after five days percent of reduction in were recorded 76.70% in 2008 season, 76.46% in 2009 season. After seven days the percent of reduction gave 68.9% and 59.5%, respectively (Table 6) and After nine days percent reduction in predators were recorded 56.7% in The general mean of Dursban reduction percentage (74.8%) in first season, 69.12% second season for Dursban.

Dursban was the highest effective compound induced the highest reduction 48% - 89.42%) between 9th – 1 day of spray on cotton the tow season of study. The reverse is true in case of the Dursban. It could be concluded that Dursban proved to be. The most compound tested against natural enemies infesting in cotton fields.

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