BIOLOGICAL ACTIVITY OF SOME NONCONVENTIONAL INSECTICIDES AGAINST COTTON LEAFWORM, *SPODOPTERA LITTORALIS*

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Abstract

Under laboratory conditions the initial, latent effect and biometric effects of two IGR's pyriproxyfen (Admiral) and diafenthiuron (Polo) and melbimectin (biocide) were studied on the 6th instar larvae of the cotton leafworm, *Spodoptera littoralis* (Boisd.) of pyriproxyfen was the most effective, it caused 101.56% increase in duration of the 6th instra larval, followed by diafenthiuron at the recommended rate gave 73.77% increase, in contrast melbimectin was ineffective when all the three chemicals tested at the recommended rate of each. Pyriproxyfen was the most potent compound in increasing the weight of treated larvae (46.15% increase), while diafenthiuron and melbimectin reduced the larval weight (33.33 and 20.51% decrease, respectively). Melbimectin was highly effective against larval stage, where mortality percentages ranged from 30.3 to 54.5 after 48 hrs of treatment. While, it was ineffective during pupal stage, recording from 0.0 to 5.0% mortality. On the other hand, pyriproxyfen and diafenthiuron exhibited poor effect against larval stage, while they were potent during pupal stage. The highest reduction pupation percentages were (38, 52 and 56% pupation), for melbimectin, diafenthiuron and pyriproxyfen, respectively. However, pyriproxyfen was superior to melbimectin and diafenthiuron in forming abnormal pupae. In this respect, pyriproxyfen at the rates 75 and 37.5 ppm exhibited the highest percent pupal malformation (75.00% and 76.32%, respectively). Melbimectin at the rate of 75 ppm and diafenthiuron at the rate of 1500 ppm gave 57.89 and 50.00% pupal malformation, respectively. Pyriproxyfen reduce moths emergence (23.68-50.00%), while diafenthiuron (50.00-89.19%) and melbimectin recorded 42.11-93.33% with different concentrations.

INTRODUCTION

The cotton leafworm, *Spodoptera littoralis* (Boisd.) is considered a serious polyphagous noctuid pest on several agricultural important crops, including cotton, in Egypt. Depending mainly on chemical control methods by extensive use of various insecticides had led to resistance to most groups of conventional insecticides. During the last 3 decades extensive investigation efforts is being made for development of unconventional effective control materials with new modes of action, against this pest. One of such new groups is the insect growth regulators (IGR's) that interfere with moulting process (Mulder and Gijswijt, 1973, Mituis, 1985).

However, more selective, insect growth inhibitors (IGI's) and regulators (IGR's) have become increasingly available in the last decade. Therefore, the present study was aiming to evaluate the biological activity, either initial or residual effects and biometrics effects of two IGR's including the thiourea derivative diafenthiuron, and the juvenoids compound pyriproxyfen, in addition to a biocide product, melbimectin against the 6th instar larvae of the cotton leafworm, *S. littoralis* (Boisd.).

MATERIALS AND METHODS

a. Source of insects:

Laboratory strain of *S. littoralis* was reared under the laboratory conditions of Sakha Agricultural Research Station for over 20 generations according to the method of El-Defrawi *et al.* (1964).

b. Pesticides:

1. Insect growth regulators (IGR's):

a. Pyriproxyfen (Admiral 10% EC):

4-phenoxyphenyl (RS)-2-(2-pyridyloxy) propyl ether at rate of 75, 37.5, 18.8 and 9.4 ppm.

b. Diafenthiuron (Polo 50% SC):

1-teret butyl-3(2,6-di-isopropyl-4-phenoxyphenyl) thiourea, at rate of 1500, 750, 375 and 187.5 ppm.

2. Biocide:

a. Melbimectin (CM006 1% EC):

Natural product (metabolite) produced through fermentation of soil microorganism, *Streptomyces hygroscopicus* at rates of 75, 37.5, 18.8 and 9.4 ppm.

C. Testing procedure:

To study the initial and latent effect activity of pyriproxyfen, diafenthiuron and melbimectin against *S. littoralis,* recommended, ½, ¼ and ⅛ recommended rates of each compound were prepared using tap water in dilutions. Castor bean leaves were dipped in each prepared solution for ten seconds, and then left under laboratory conditions till complete dryness. Ten replicates for each concentration were prepared where five 6th instar larvae were confined in a (1 lb) plastic jar as a replicate. The larvae were fed on fresh treated leaves for 24 hrs and then replaced by untreated ones till pupation. Survival larvae of each replicate were weighted daily. Ten replicates were used as control where larvae were fed on untreated leaves. The plastic jars were replaced with clean ones daily till pupation and pupae were transferred and kept in cages for adult emergence. Dead larvae were recorded daily and mortality percentages were corrected according to Abbott's formula (1925). Also, percent

mortality during pupal stage, percent pupation, pupal malformation percentages and percent of moths emergence were estimated using formula suggested by Toppozada *et al.* (1966).

RESULTS AND DISCUSSION

1. Mortality during larval and pupal stages:

Data in Table (1) indicated that although the biocide melbimectin was the highly effective tested compound against larval stage and gave appreciable mortality ranged from 30.3 to 54.5 after 48 hrs of treatment, nevertheless it was completely non-effective during pupal stage, exhibiting mortality ranging between 0.0-5.0. On contrary, pyriproxyfen and diafenthiuron exhibited poor effect against larval stage (percent mortality ranged from 0.0 to 12.12) for both compounds, while potent effect appeared during pupal stage mainly at the recommended rates of each, reaching 40.43 and 33.33% mortality, respectively.

These results are in agreement with that of Korkor *et al.* (1961), they reported that 5 days post-treatment of the 4th instar larvae of cotton leafworm IGR (methoprene) caused less mortality (32.7%), than IDI's which caused 100% mortality during the same period.

2. Effect on percent pupation and pupal malformation:

Results in Table (2) showed that the most effective treatment in reducing pupation percentages was melbimectin (38% pupation), followd by diafenthiuron (52% pupation) and pyriproxyfen (56% pupation), respectively at the recommended rate of each, compared with normal percent pupation of 96% in control.

Regarding the effect on pupal malformation, pyriproxyfen showed the highest effect in forming abnormal pupae resulted from treated the 6th instar larvae of *S. littoralis*. However, pyriproxyfen at the rates of 75 and 37.5 ppm exhibited the highest percent pupal malformation (75.00% and 76.32%, respectively) without significant differences in between. melbimectin at the rate of 75 ppm and diafenthiuron at the rate of 1500 ppm were as effective equal pyriproxyfen at the lowest rate, 9.4 ppm, pupal malformation were 57.89, 50.00 & 50.00%, respectively.

However, diafenthiuron and melbimectin at their other three decreasing tested rates resulted (low pupal malformation%, it ranged between (6.67-16.23) and (from 23.08 to 10.81), respectively compared with 10.42%) pupal malformation in untreated check (control). Shaaban and Mourad (1994) stated that treatment of cotton leafworm larvae at different instars with flufenoxuron obviously reduced normal pupation and inhibited adult emergence.

3. Effect on normal moths emergence:

Data in Table (2) showed that the treatments under test could be arranged descendingly according to their efficiency in reducing normal moths emergence as follows, pyriproxyfen (25.0-50.0%), diafenthiuron (50.00-76.92%) and melbimectin (42.11-93.33%), compared with 89.58% in control. These findings were similar to the results of Abd El-Naby *et al.* (1988), they reported that triflumuron and chlorfluazuron (IGR's) caused reduction in pupation and emergence of adult moths. These results agree with the finding Moawad *et al.* (1996) who reported that treating egg masses of *S. littoralis* by dipping technique resulted 77.6°/°non emerged moth.

4. Effect on larval longevity:

Data in Table (3) showed that pyriproxyfen at the field recommended rate (75 ppm) was the most effective in this respect, where it caused 101.56% increase in duration of the 6th instra larvae compared with untreated (check) (mean longevity of larvae was (7.76±3.56) pyriproxyfen versus (3.85±0.24) days for untreated (check). Diafenthiuron at the recommended rate (1500 ppm) was as effective as pyriproxyfen at 37.5 ppm (73.77% increase in larval period).

Table 1. Initial and accumulative activity of biocide and two IGR's against the 6th instar larvae and pupale stage of *S. littoralis* under laboratory conditions.

Tested compounds	Ppm	% Corrected larval mortality post-treatment at		%Pupal mortality
		24 hrs	48 hrs	
Pyriproxyfen (Admiral 10% EC)	75	0.0^{a}	1.01^{ab}	40.73^{g}
	37.5	0.0^{ab}	5.05^{b}	15.56^{ed}
	18.8	0.0^{a}	3.03^{ab}	13.33^{ed}
	9.4		0.0^{a}	18.38^{de}
Diafenthiuron (Polo 50% SC)	1500	4.0^{ab}	12.12^{e}	33.33^{f}
	750	0.0^{a}	0.0^{a}	21.28^{e}
	375	0.0^{a}	2.0^{ab}	4.26^{ab}
	187.5	6.0^{b}	9.09^{e}	9.30^{be}
Melbimectin (CM006 1% EC)	75	54.0^{e}	54.5^{f}	5.00^{a}
	37.5	28.0^{e}	30.3^{d}	3.13^{a}
	18.8	32.0^{ed}	36.4^{e}	0.00^{a}
	9.4	36.0^{d}	37.4^{e}	0.00^{a}
Control (untreated)	water	-	2	2.04^{a}

In the same column, means followed by a common letter are not significantly different at the 5% level by Duncan (1955).

Table 2. Biometric effects of biocide and two IGR's during pupal stage of 50 treated the 6th instar larvae of *S. littoralis*.

Tested compounds	ppm	No. alive larvae	% pupation	No. of normal pupae	No. of abnormal pupae	%pupal malformation	%normal moths emergence
Pyriproxyfen (Admiral 10% EC)	75	49	56^{e}	7	21	75.00^{a}	25.00^{e}
	37.5	48	76^{bcd}	9	29	76.32^{a}	23.68^{e}
	18.8	49	78^{bc}	13	26	66.67^{b}	33.33^{de}
	9.4	50	80^{b}	20	20	50.00^{d}	50.00^{e}
Diafenthiuron (Polo 50% SC)	1500	44	52^{ef}	13	13	50.00^{d}	50.00^{e}
	750	50	74^{bed}	33	4	10.81^{fg}	89.19^{ab}
	375	49	90^{ab}	34	11	24.44^{e}	75.56^{b}
	187.5	46	78^{bc}	30	9	23.08^{c}	76.92^{ab}
Melbimectin (CM006 1% EC)	75	23	38^{f}	8	11	57.89^{e}	42.11^{ed}
	37.5	35	62de	26	5	16.23^{f}	83.77^{ab}
	18.8	32	60de	27	3	10.00^{fg}	90.00^{ab}
	9.4	32	60de	28	2	6.67^{g}	93.33^{a}
Control	Water	-	96^{ab}	43	5	10.42^{fg}	89.58^{ab}

In the same column, means followed by a common letter are not significantly different at the 5% level by Duncan (1955).

Table 3. Effect of biocide and two IGR's on longevity and weight of treated the 6th larval instar of *S. littoralis*.

Tested compounds	Ppm	Larval duration (days) Mean±SE	%Change in larval longevity than control	Larval weight (grams) Mean±SE	%Change in larval weight than control
Pyriproxyfen (Admiral 10% EC)	75	7.76±0.356	101.56	0.57±0.017	46.15
	37.5	6.74±0.290	75.06	0.50±0.011	28.21
	18.8	5.82±0.661	51.17	0.46±0.013	17.85
	9.4	5.85±0.205	51.85	0.43±0.025	10.26
Diafenthiuron (Polo 50% SC)	1500	6.69±1.189	73.77	0.26±0.013	-33.33
	750	4.73±0.154	22.86	0.41±0.013	5.13
	375	5.80±0.200	50.65	0.36±0.013	-7.69
	187.5	5.83±0.258	51.43	0.33±0.008	-15.38
Melbimectin (CM006 1% EC)	75	3.85±0.518*	0.00	0.31±0.021*	-20.51
	37.5	4.84±0.232	25.71	0.42±0.019	7.69
	18.8	3.65±0.442	-5.18	0.43±0.017	10.26
	9.4	3.69±0.638	-4.16	0.43±0.022	10.26
Control (untreated)	Water	3.85±0.241	-	0.39±0.020	-

On contrary, melbimectin at the recommended rate (75 ppm) as expected do not exhibited any influence on the longevity of the treated 6th instra larvae, while the rates 18.8 and 9.4 ppm resulted in reduction of the larval longevity in comparison to untreated larvae.

These results agreed fully with that of Moawad *et al.* (1996) found that life time of treated larvae on cotton leafworm was longer than control when pyriproxyfen and KZ-oil were used against eggs of *S. littoralis.* Also, Zidan *et al.* (1996) stated that pyriproxyfen (Admiral) prolonged larval duration, adult longevity and decreased pupal weight of *S. littoralis.*

5. Effect on larval weight:

Results in Table (3) indicated that pyriproxyfen was the only potent compound in increasing the weight of treated the 6th instar larvae of *S. littoralis,* exhibiting 46.15% increase in comparison to control larvae, while the rest three tested rates showed increase in larval weight percentages ranged from 10.26 to 28.21. On the other hand, diafenthiuron and melbimectin revealed decrease in larval weight than control particularly, at the recommended rate of each recording 33.33 and 20.51%, respectively.

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دراسة تأثير بيربروكسيفين، ديافنثيرون مقارنة بالمركب الطبيعي ميلبيتلتين علي السلالة المعملية لدودة ورق القطن

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أجريت الدراسات المعملية لدراسة التأثير الأولي والتأثير المتبقي وكذلك بعض التأثيرات الحيوية لأثنين من مانعات الإنسلاخ (بيربروكسيفين، ديافنثيرون) وكذلك المركب الحيوي الطبيعي ميلبيتلتين علي العمر اليرقي السادس لدودة ورق القطن.

أثبتت النتائج أن التركيز الموصي به لمركب بيربروكسيفين كان الأكثر تأثيراً علي العمر اليرقي السادس حيث سبب زيادة في فترة العمر اليرقي بنسبة ١٠١,٥٦% حيث وصلت نسبة الحياة الي ٧,٧٦ يوم بينما مركب ديافنثيرون بالتركيز الموصي به سبب ٧٣,٧٧% نسبة زيادة في حين كان التركيز الحقلي لمركب ميلبيتلتين غير مؤثر علي طول العمر اليرقي. كذلك أدي مركب بيربروكسيفين زيادة في وزن اليرقات المعاملة بالتركيز الموصي به حقلياً بنسبة ٤٦,١٥% بينما سجلا المركبين ديافنثيرون وميلبيتلتين قلة في الوزن بنسبة ٣٣,٣٣، ٢٠,٥١% علي الترتيب. كما سجل مركب ميلبيتلتين أعلي نسبة موت لليرقات المعاملة تراوحت بين ٣٠,٣ الي ٥٤,٥% بعد ٤٨ ساعة لمختلف التركيزات كما أثر علي العذاري الناتجة بينما كان تأثير بيربروكسيفين وديافنثيرون قليل علي اليرقات وكذلك علي العذاري الناتجة. هذا وقد ووصلت نسبة التعذير الي ٣٨، ٥٢، ٥٦% لمركبات ميلبيتلتين ، ديافنثيرون ، وبيربروكسيفين علي الترتيب. كما سجل مركب بيربروكسيفين أعلي نسبة عذاري غير طبيعية مقارنة بالمركبين الآخرين. كما أدي الي تشوه في العذاري بلغ ٧٥، ٧٦,٣٢% عند استخدام التركيزين ٠,٧٥٠، ٠,٣٧٥ مل/لتر ماء. بينما سجل مركب ميلبيتلتين ٥٧,٨٩% عند استخدامه بالتركيز الموصي به (٧,٥ مل/ لتر ماء). أخيرا سجل بيربروكسيفين نسبة خفض في معدلات خروج الفراشات تراوحت من ٢٣,٦٨ الي ٥٠% بينما في حالة مركب ديافنثيرون أعطي نسبة بين ٥٠-٨٩,١٩% وأخيرا سجل مركب ميلبيتلتين نسبة خروج فراشات بين ٤٢,١١ الي ٩٣,٣٣%.