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efficiency of some new insecticides on cotton bollworms, *pectinophora gossypiella* (saund.) and *earias insulana* (boisd.)

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ABSTRACT

Field experiments were conducted at Sakha Agricultural Research Station Farm during 2011 and 2012 cotton growing seasons to evaluate the efficacy commercial formulation of four insecticides, i.e., pyridalyl, emamectin benzoate, methomyl and methoxyfenozide against pink bollworm, *Pectinophora gossypiella* (Saund.) and spiny bollworm, *Earias insulana* (Boisd.). Pyridalyl and emamectin benzoate were the most efficient compounds during the two seasons. The treatments could be arranged descendingly according to the average reduction of two seasons as follows: pyridalyl (52.21, 50.78 %), emamectin benzoate (46.55, 49.61%), methomyl (38.49, 37.82 %) and methoxyfenozide (34.10, 31.90 %) against pink and spiny bollworms. Also, the toxicity of these compounds was determined against 4^{th} instar larvae of spiny bollworm, *E*. *insulana* (Boisd.) using film residue assay method. The data revealed that emamectin benzoate was a superior potent compound followed by methoxyfenozide, pyridalyl and methomyl, with LC_{50} values were 1.42, 14.21, 16.99 and 99.78 ppm, respectively.
Keywords: Cotton bollworms, emamectin benzoate, methoxyfenozide, methomyl, pyridalyl.

INTRODUCTION

In Egypt, cotton is one of the most important cash crops and represents more than half the income of two million small-scale farmers (*Zidan et al*., 2012). But cotton is attacked by many insect species. Cotton bollworms are the most destructive pests infesting cotton plants, pink bollworm (PBW), *P*. *gossypiella* (Saund.) and spiny bollworm (SBW), *E*. *insulana* (Boisd.) infest many cotton producing areas of the world and cause a severe reduction in cotton yield and quality (Lohar and Nahyoon, 1995).

Emamectin benzoate is a modified isolation of the soil microorganism, *Streptomyces avermitilis*. It affects the nervous system of arthropods by increasing chloride ion flux at the neuromuscular junction, resulting in cessation of feeding and irreversible paralysis. Also, it affects on GABA and glutamate-gated chloride channel agonist (Dunbar *et al*., 1998).

Methoxyfenozide is classified as a diacylhydrazine insecticide. It acts as ecdysone agonists with enormous potential for development as insect specific control agents with little or no effect on non-target species (Dhadialla and Carlson, 1998). Also, it provides effective control of a wide range of lepidopteran insects. The chemical upon absorption into the haemolymph of the insect, binds to the ecdysone receptor which initiates the moulting process. As the normal process disrupted, the insects prevented from shedding its old cuticle. The larvae die of dehydration and starvation within 2-5 days (Kumar and Santharam, 2008).

Pyridalyl exhibit high insecticidal activity against Lepidoptera (Sakamoto and Umeda, 2003). It posses a certain type of toxicity for insect cells, it inhibited the cell growth (Satio *et al*., 2006).

The present study was conducted to evaluate the effect of the three novel insecticides (emamectin benzoate, methoxyfenozide, and pyridalyl) and the conventional one (methomyl) against pink bollworm and spiny bollworm under field and laboratory conditions.

MATERIALS AND METHODS

Insecticides used:

The insecticides used and their recommended rates of application per feddan were: Emamectin benzoate (Proclaim 5% SG, 60g/fed.), Methoxyfenozide (Runner 24% SC, 150cm^3/fed.), Methomyl (Lannate 90% SP, 300g/fed.) and Pyridalyl (Pleo 50% EC, 100cm^3/fed.).

Field experiment:

Experiments were conducted during 2011 and 2012 cotton growing seasons at Sakha Agricultural Research Station Farm. The cultivated cotton variety was Giza 86. Treatments were distributed in a randomized complete block design with four replicates for each treatment. The area of each replicate was one kirate (175m^2) and four kirate were used as untreated control. All agricultural processes were carried out as usual. Each of the tested insecticides was applied three times on the dates 10/8, 24/8 &7/9/2011and 31/7, 14/8 and 28/8/2012. The insecticides were diluted with water 200 L / fed. and sprayed using a knapsack sprayer with one nozzle (Mode Cp3).

Samples of 100 green bolls per treatment (25 bolls for each replicate) were taken at random and dissected. Percent of infestation were estimated immediately before the first spray and then every week through out the period of experiment which extended from 9/8 to 21/9 (2011) and from 30/7 to 11/9 (2012). Henderson and Tilton equation (1955) was used to calculate the reduction percentage of infestation.

Laboratory tests:

The residual film method was used to determine the LC_{50} values of different insecticides. A series of concentrations (in acetone) for each insecticide was prepared on the active ingredient (a.i) based on ppm by diluting the commercial formulation, one milliliter of acetone solution of the toxicant under test was uniformity distributed on the surface of a Petri-dish (9 cm diameter). After complete dryness, five full-grown larvae (4th instar larvae) of spiny bollworm were confined and left to dose themselves by crowling on the deposited film. The Petri-dish was covered and the mortality was counted and recorded after 24 hrs of exposure. Three replicates (each of 5 larvae) were used for each concentration. Mortality percentages were corrected according to Abbott's formula (1925) and the LC_{50} values were calculated (Finney, 1971).

Statistical analysis:

Statistical analysis of data was carried out according to Duncan multiple range test (Duncan, 1955) using Costate version 4.20 Cohort software. Mortality percentages were corrected according to Abbott's formula (1925) and the LC_{50} values were calculated (Finney, 1971) using « Ldp Line » software [http:// embark.tripod.com/ldpline.htm].

RESULTS AND DISCUSSION

The obtained results in Tables (1) showed the toxic effect of the tested insecticides against pink bollworm in 2011 and 2012 cotton seasons, when they were applied once, twice and triple. Based on the mean of reduction percentage in infestation, in two seasons, pyridalyl and emamectin benzoate were the most effective compounds as they caused (52.94, 51.48 %) and (43.74, 49.37 %) reduction respectively, followed by methomyl causing (38.25, 38.74 %) reduction. While the tested insecticide methoxyfenozide was the least effective recording (33.23, 34.96 %).

Results in Table (2) showed the toxic effect of the same tested insecticides against spiny bollworm in 2011 and 2012 cotton seasons during three sprays. The obtained results showed that, mean of reduction percentage in infestation of spiny bollworm in 2011 season were 47.93, 47.93, 33.47 and 31.30% for pyridalyl, emamectin benzoate, methomyl and methoxyfenozide, respectively. In 2012, the percentage of reduction in spiny bollworm larval population was higher than in 2011 season and could be arranged descendingly as follows: pyridalyl (53.64%), emamectin benzoate (51.29%), methomyl (42.18%) and methoxyfenozide (32.51%).

Results in Table (3) show the susceptibility of the full-grown larvae of spiny bollworm to the four tested insecticides during 2012 cotton season. The obtained results indicated that the emamectin benzoate was a superior potent compound followed by methoxyfenozide and pyridalyl, while methomyl was the least toxic one. The LC_{50} values of emamectin benzoate, methoxyfenozide, pyridaly and methomyl were 1.42, 14.21, 16.99 and 99.78 ppm after 24 hrs of exposure, respectively.

According to the toxicity index at LC_{50} level, emamectin benzoate was the most effective one (100.0 %), however methoxyfenozide and pyridalyl were 9.99-8.35 % as toxic as emamectin benzoate, the rest toxicant was methomyl 1.42 % as toxic as emamectin benzoate.

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These results agree with Nair *et al*., (2008), who reported that pyridalyl provided excellent control of the two bollworm species of cotton. Mohamed (2008) found that the new chemical insecticide Pyridalyl proved of highest efficacy for bollworms control. Also, Amer *et al*., (2012) mentioned that emamectin benzoate and pyridalyl exhibited various efficacy effect against the newly hatched larvae of *P. gossypiella* especially 3-day after treatment, where the susceptibility of the pest to the tested compounds was the highest compared with the other recorded investigated time. The tested compound, pyridalyl is more effective than emamectin benzoate against the newly hatched larvae, the LC_{50s} were 12.51 and 3.222 ppm for emamectin benzoate and pyridalyl at 3-day after treatment, followed by 2-day (LC_{50} 18.59 and 8.542 ppm), 1-day (LC_{50}: 194.4 and 48.6 ppm) then one hour age (LC_{50} : 2115.6 and 656.9 ppm) after treatment for emamectin benzoate and pyridalyl, respectively. Gupta *et al*., (2005) and Sontakke *et al*., (2007) reported that emamectin benzoate was the most potent treatment in reducing pink bollworm, *P. gossypiella* and spotted bollworm, *Earias sp*. and causing significantly higher yields. Also, Shekeban *et al*., (2010) reported that emamectin benzoate was the most toxic insecticide between the tested insecticides. Also, Massoud *et al*., (2011) found that emamectin benzoate was a superior potent compound by LC_{50} 0.001 ppm followed by spinosad with LC_{50} of 0.0065 ppm.

It be concluded that the two compounds pyridalyl as a cell toxic compound and emamectin benzoate as a nervous system blockers play an important role to be a valuable addition in an integrated pest management programmes followed by methomyl and methoxyfenozide against cotton bollworms, *P. gossypiella* and *E. insulana*.

Table (3): Toxicity of tested insecticides against full-grown larvae of spiny bollworm, E. insulana.

Insecticides	LC_{50} (ppm)	95% FL[a] of LC_{50}		Slope ± SE	Ti[b]
		Lower	Upper		
Emamectin benzoate	1.42	0.788	2.66	1.645 ± 0.413	100.0
Methoxyfenozide	14.21	6.31	29.70	1.316 ± 0.385	9.99
Methomyl	99.78	49.70	185.16	1.534 ± 0.404	1.42
Pyridalyl	16.99	8.46	30.66	1.583 ± 0.411	8.35

FL[a]: Fiducial limit. (Ti[b]): Toxicity index = LC_{50} of the most effective compound/LC_{50} of the other tested compound × 100

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كفاءة بعض المبيدات الحشرية الجديدة علي ديدان اللوز القرنفلية والشوكية

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أجريت التجارب الحقلية بمحطة البحوث الزراعية بسخا أثناء موسمي قطن ٢٠١١، ٢٠١٢ لتقييم فعالية أربعة مركبات هي البيريداليل، الإيمامكتين بنزوات، الميثوميل، الميثوكسيفينوزايد ضد يرقات دودة اللوز القرنفلية والشوكية.

أظهرت النتائج المتحصل عليها أن مركبي البيريداليل، الإيمامكتين بنزوات هما الأكثر كفاءة أثناء الموسمين. و كان متوسط نسبة الخفض في التعداد في المعاملات أثناء الموسمين لدودة اللوز القرنفلية هو ٥٢.٢١ % للبيريداليل، ٤٦.٥٥ % للإيمامكتين بنزوات، ٣٨.٤٩ % للميثوميل، ٣٤.١٠ % للميثوكسيفينوزايد ولدودة اللوز الشوكية ٥٠.٧٨ % للبيريداليل، ٤٩.٦١ % للايمامكتين بنزوات، ٣٧.٨٢ % للميثوميل، ٣١.٩٠ % للميثوكسيفينوزايد. كما تم دراسة سمية هذه المركبات معملياً علي العمر اليرقي الرابع لدودة اللوز الشوكية باستخدام طريقة متبقي المبيد. وتشير النتائج إلي أن الإيمامكتين بنزوات هو الأكثر قوة فعالية يليه الميثوكسيفينوزايد ثم البيريداليل ثم الميثوميل. حيث التركيز النصفي لموت الأفراد هو ١.٤٢، ١٤.٢١، ١٦.٩٩، ٩٩.٧٨ جزء في المليون للإيمامكتين بنزوات، الميثوكسيفينوزايد، البيريداليل، الميثوميل علي التوالي.

قام بتحكيم البحث

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Table (1): Reduction % of pink bollworm (*P. gossypiella*) larval population after treated with recommended rate of various insecticides during 2011 and 2012 cotton seasons.

Treatments	% Reduction during 2011						Mean	% Reduction during 2012						Mean	Average reduction of two seasons
	1st Spray		2nd Spray		3rd Spray			1st Spray		2nd Spray		3rd Spray			
	1 W	2 W	1 W	2 W	1 W	2 W		1 W	2 W	1 W	2 W	1 W	2 W		
Emamectin benzoate	35.24	26.56	58.18	39.22	65.27	38.00	43.74 ab	54.76	45.00	55.37	50.77	56.04	34.33	49.37 a	46.55 a
Methoxyfenozide	32.33	26.56	41.78	32.33	48.62	17.76	33.23 b	35.24	35.24	35.24	26.56	46.78	30.72	34.96 b	34.10 b
Methomyl	35.24	26.56	41.78	32.33	57.29	36.33	38.25 b	35.24	30.00	48.22	35.24	52.24	31.50	38.74 b	38.49 b
Pyridalyl	61.89	58.89	58.18	53.31	57.29	28.11	52.94 a	54.76	45.00	54.76	50.77	56.04	47.58	51.48 a	52.21 a

Means followed by the same letter (s) are not significantly different at the 5% level by Duncan (1955).

Table (2): Reduction % of spiny bollworm (*E. insulana*) larval population after treated with recommended rate of various insecticides during 2011 and 2012 cotton seasons.

Treatments	% Reduction during 2011						Mean	% Reduction during 2012						Mean	Average reduction of two seasons
	1st Spray		2nd Spray		3rd Spray			1st Spray		2nd Spray		3rd Spray			
	1 W	2 W	1 W	2 W	1 W	2 W		1 W	2 W	1 W	2 W	1 W	2 W		
Emamectin benzoate	54.76	40.92	53.73	40.22	50.77	47.18	47.93 a	66.27	58.89	52.53	41.78	49.08	39.23	51.29 a	49.61 a
Methoxyfenozide	35.24	22.22	46.89	28.11	39.23	16.11	31.30 b	31.50	18.44	45.34	34.45	40.16	25.18	32.51 c	31.90 b
Methomyl	45.00	22.22	53.73	20.70	43.11	16.11	33.47 b	52.89	39.23	52.53	41.78	36.69	30.00	42.18 b	37.82 b
Pyridalyl	54.76	40.92	53.73	40.22	50.77	47.18	47.93 a	62.10	50.77	70.54	48.22	55.49	34.76	53.64 a	50.78 a

Means followed by the same letter (s) are not significantly different at the 5% level by Duncan (1955).