J. Plant Prot. and Path., Mansoura Univ., Vol. 3 (4): 389 - 395, 2012

TOXICITY OF THIAMETHOXAM/CHLORANTRANILIPROLE, NOVALURON, CHLORPYRIFOS-METHYL AND METHOMYL AGAINST TWO DIFFERENT LARVAL INSTARS OF THE COTTON LEAFWORM *Spodoptera littoralis* (Boisd.) ON TOMATO PLANTS

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ABSTRACT

The toxicity of thiamethoxam/chlorantraniliprole, novaluron, chlorpyrifos-methyl and methomyl applied at recommended rates was studied against the cotton leafworm *Spodoptera littoralis* on tomato plants, during the summer seasons of 2010 and 2011 at Etay El-baroud Agricultural Research Station, El-Beheira Governorate. The % mortalities average (initial kill) caused by thiamethoxam/chlorantraniliprole, novaluron, chlorpyrifos-methyl and methomyl were 83.8, 84.8, 91.2 and 87.4%, respectively against 2nd instar of *Spodoptera* larvae, and were 82.5, 77.2, 89.9 and 87.4%, respectively against 4th instar of *Spodoptera* larvae, while %mortality average (residual toxicity) were 86.0, 70.5, 71.9 and 62.6%, respectively against 2nd instar of *Spodoptera* larvae, and were 71.7, 61.9, 67.6 and 56.9%, respectively against 4th instar of *Spodoptera* larvae. From these data it is clear that the two novel tested insecticides have a potent insecticidal activity against both 2nd and 4th instars *S. littoralis* larvae. Results revealed that tested insecticides were more effective on second instar than forth instar and showed significant differences between tested insecticides.

INTRODUCTION

Cotton leafworm *S. littoralis* is one of the most injurious insects infesting tomato plants and many of number of other host plants (Meisner *et al*., 1977). This pest is partly controlled by chemical efficient pesticides, but because of high resistance to several compounds new possible alternatives have been explored for using safer methods of control. Some of these approaches are insect growth regulators (IGRs), neonicotenoid and anthranilic diamide insecticides.

Voliam Flexi 40% WG formulation formed from (thiamethoxam20%+ chlorantraniliprole20%). Thiamethoxam is a broad spectrum neonicotenoid contact insecticide. Neonicotinoids interfere with the nicotinic acetylcholine receptor and therefore have specific activity against the insect nervous system (Maienfisch *et al*., 2001). While chlorantraniliprole, the first commercialized ryanodine receptor insecticide from anthranilic diamides, which effectively controls pest insects belonging to Lepidoptera, Coleoptera, Diptera and Hemiptera. Chlorantraniliprole causes feeding cessation, lethargy, muscle paralysis and ultimately death by activating the ryanodine receptor (Cao *et al*., 2010). Moreover, thiamethoxam and chlorantraniliprole have been shown to be effective than insecticides that have developed resistance to older classes of chemistry and have low impact on nontarget

organism including mammals, birds, fishes, microorganisms, as well as many non-target arthropods (Arthur *et al*. 2004 and Jia *et al*. 2011).

Novaluron a relatively new chitin synthesis inhibitor that inhibits the chitin formation on larvae of various insects (Lepidoptera, Coleoptera, Homoptera and Diptera). It has a potent insecticidal activity against several important foliage feeding insect pests (Cutler *et al*., 2005) and very low toxicity to mammals, birds and earthworms. By inhibiting chitin formation, novaluron selectively targets immature insect stages, causing abnormal endocuticular deposition abortive molting (Rachid *et al*. 2009).

In the present study, the efficiency of novaluron and thiamethoxam/ chlorantraniliprole formulation were investigated on tomato plants, compared with chlorpyrifos -methyl and methomyl applied at recommended rates against the cotton leafworm *S. littoralis*, during the summer seasons of 2010 and 2011 at Etay Elbaroud Agricultural Research Station, El-Beheira Governorate.

MATERIALS AND METHODS

Tested compounds:

1. Voliam Flexi 40% WG (thiamethoxam20%+chlorantraniliprole20%). It was provided by Syngenta Co.
2. Roxy 10% EC (novaluron). It was provided by United Phosphorus Ltd.
3. Reldane50% EC (chlorpyrifos-methyl). It was provided by Dow Agro Sciences.
4. Ceumyl 90% SP (methomyl). It was provided by Macca for Agriculture Development.

Field strain of *Spodoptera littoralis*:

Egg-masses of *Spodoptera littoralis* were collected from cotton fields at El-Beheira Governorate and directly transferred to the laboratory. After hatching the egg-masses were reared according to Eldefrawi *et al*., (1964) and used for the experimental method.

The semi-field trial:

Tomato experimental site was divided into 20 plots, each plot 1/50 feddan (84m²). Randomized complete blocks design was used with four replicates for each treatment. Used rates of insecticides were 80gm, 200ml, 1000ml and 300gm for thiamethoxam/chlorantraniliprole, novaluron, chlorpyrifos-methyl and methomyl, respectively. Samples of treated leaves were randomly taken from each treatment and untreatment to the laboratory plot, where they were introduced to 2^{nd} and 4^{th} instars of *Spodoptera* larvae. Four replicates (each of 10 larvae were placed in clean jar) were used for each treatment. First case, samples of treated leaves were taken at 0, 6 and 9 days after spray with chlorpyrifos-methyl and methomyl, then *Spodoptera* larvae allowed to feed on treated leaves for 24 hours then mortality percentages were recorded, In the second case, treated leaves with thiamethoxam/chlorantraniliprole and novaluron were taken at 0 and 5 days after spray, then *Spodoptera* larvae allowed to feed on treated leaves for 48 hours, then mortality percentages were recorded. Survivors larvae were

transferred after 48 hours with fresh untreated leaves to clean glasses and kept at the same conditions for 3 days. Percentage mortalities were corrected and calculated according to Abbott's formula, (Abbott,1925) .The standard deviation (S. D) of four replications was calculated and subjected to analysis of variance (ANOVA)(Costat Statistical software,1990)**.**

RESULTS AND DISCUSSION

Toxicity of two seasons 2010 and 2011 of tested compounds against 2nd and 4th instars of the cotton leaf worm *S. littoralis* larvae at two seasons are summarized in Table (1) and Figs. (1&2). The exhibited data demonstrate the percent mortalities of *Spodoptera* larvae after application of different insecticides as initial kill (I.K.) and residual toxicity (R.T). Concerning the initial kill caused by thiamethoxam/chlorantraniliprole, novaluron, chlorpyrifos-methyl and methomyl were 77.5, 82.1, 92.3 and 87.2%, respectively at 2010 season against 2nd instar of *Spodoptera* larvae, and were 90.0, 87.5, 90.0 and 87.5%, respectively at 2011 season, while against the 4th instar were 70.0, 74.4, 92.3 and 89.7%, respectively at 2010 season, and were 95.0, 80.0, 87.5 and 85.0%, respectively at 2011 season.

The residual toxicity of thiamethoxam/chlorantraniliprole, novaluron, chlorpyrifos-methyl and methomyl were 97.2, 68.4, 70.0 and 63.8%, respectively against 2nd instar of *Spodoptera* larvae at 2010 season, and were 74.8, 72.5, 73.8 and 61.3%, respectively at 2011 season, while against the 4th instar were 82.0, 62.5, 66.3 and 57.5%, respectively at 2010 season, and were 61.4, 61.3, 68.8 and 56.3%, respectively at 2011 season.

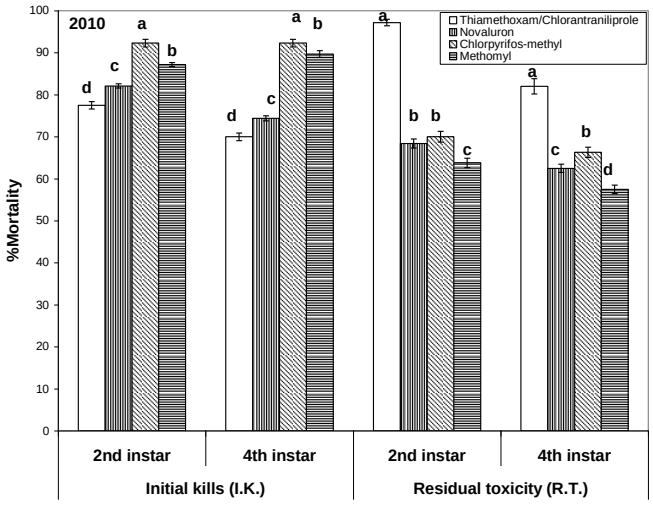

Fig. (1): Effect of thiamethoxam/chlorantraniliprole, novaluron, chlorpyrifos-methyl and methomyl against 2nd and 4th instars of *Spodoptera* larvae exposed to treated tomato leaves at 2010 season. Symbols and bars represents means ± standard deviation of four replications.

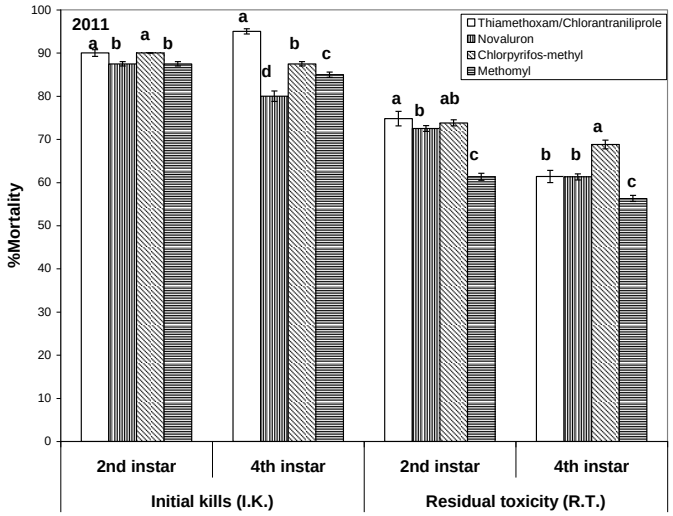

Fig. (2): Effect of thiamethoxam/chlorantraniliprole, novaluron, chlorpyrifos-methyl and methomyl against 2nd and 4th instars of *Spodoptera* larvae exposed to treated tomato leaves at 2011season. Symbols and bars represents means ± standard deviation of four replications.

Concerning of %mortality average (I.K) of the two seasons of thiamethoxam/chlorantraniliprole, novaluron, chlorpyrifos-methyl and methomyl were 83.8, 84.8, 91.2 and 87.4%, respectively against 2nd instar of *Spodoptera* larvae, and were 82.5, 77.2, 89.9 and 87.4%, respectively against 4th instar of *Spodoptera* larvae, while %mortality average (R.T.) were 86.0, 70.5, 71.9 and 62.6%, respectively against 2nd instar of *Spodoptera* larvae, and were 71.7, 61.9, 67.6 and 56.9%, respectively against 4th instar of *Spodoptera* larvae. From these data it is clear that all tested insecticides have a potent insecticidal activity against 2nd and 4th instars *S. littoralis* larvae (El-Seady *et al*. 1998; El-Maghraby *et al*. 1999; Arthur *et al*. 2004; Cutler *et al*., 2005 and Rachid *et al*. 2009). Results revealed that tested insecticides were more effective on second instar than forth instar and showed significant differences between tested insecticides. These results were agreement with those obtained from Cutler *et al*., (2005) and Jia *et al*. (2011) they found that thiamethoxam/ chlorantraniliprole and novaluron have a potent insecticidal activity against several important foliage feeding insect pests, and very low toxicity to nontarget organism including mammals, birds, fishes, microorganisms and earthworms, as well as many non-target arthropods. Because of haven't been found to exhibit cross resistance with other commercial insecticides and low ecotoxicology (Wang *et al*. 2010; Sial *et al*., 2010), thiamethoxam/chlorantraniliprole and novaluron are excellent alternatives to broad-spectrum insecticides in Integrated Pest Management (IPM) programs where commercial standards are no longer effective because

of resistance (Ishaaya *et al*. 1996 & 2003; Lahm *et al*. 2007 and Lai *et al*., 2011).

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سمية ثيامثوكسام/كلورانترانيليبرول، نوفاليورون، كلوربيريفوس ميثيل و ميثوميل ضد دودة ورق القطن على نباتات الطماطم

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أجرى هذا البحث بمزرعة محطة البحوث الزراعية بايتاى البارود خلال موسمى 2010،2011 لدراسة السمية لثيامثوكسام/كلورانترانيليبرول، نوفاليورون بالمقارنة مع كلوربيريفوس ميثيل و ميثوميل بالتركيزات الموصى بها ضد دودة ورق القطن على نباتات الطماطم معمليا و حقليا . وضحت الدراسة أن متوسطات النسبة المئوية للسمية الفورية لثيامثوكسام/كلورانترانيليبرول، نوفاليورون، كلوربيريفوس ميثيل و ميثوميل هى 83.8، 84.8، 91.2 و 87.4% على التوالى ضد يرقات العمر الثانى لدودة ورق القطن، بينما كانت 82.5، 77.2، 89.9 و 87.4% على التوالى ضد يرقات العمر الرابع لدودة ورق القطن، و كانت متوسطات النسبة المئوية للاثر التبقى لهذه المركبات ضد يرقات العمر الثانى لدودة ورق القطن هى 86.0, 70.5، 71.9 و 62.6% على التوالى بينما كانت 71.7، 61.9، 67.6 و 56.9% على التوالى ضد يرقات العمر الرابع لدودة ورق القطن. أظهرت النتائج أن كل هذه المركبات شديدة التاثير ضد يرقات دودة ورق القطن وأن العمر اليرقى الثانى أكثر حساسية من يرقات العمر الرابع و أن هناك فروق معنوية فى السمية

قام بتحكيم البحث

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Table (1): % Mortalities of *Spodoptera* larvae after application of different insecticides during 2010 and 2011tomato summer season.

Toxicity	Treatment	Rate / feddan	% Mortalities of *Spodoptera* larvae					
			2010		2011		Mean	
			2nd instar	4th instar	2nd instar	4th instar	2nd instar $LSD_{0.05}$=5.6	4th instar $LSD_{0.05}$=7.2
I.K.	thiamethoxam/chlorantraniliprole	80g	77.5±0.9	70.0±0.9	90.0±0.8	95.0±0.6	83.8 b	82.5 b
	Novaluron	200ml	82.1±0.5	74.4±0.6	87.5±0.5	80.0±1.2	84.8 b	77.2 b
	chlorpyrifos-methyl	1000ml	92.3±0.9	92.3±0.9	90.0±0.0	87.5±0.5	91.2 a	89.9 a
	Methomyl	300g	87.2±0.5	89.7±0.8	87.5±0.5	85.0±0.6	87.4 ab	87.4 a
R.T.	thiamethoxam/chlorantraniliprole	80g	97.2±0.8	82.0±1.8	74.8±1.7	61.4±1.4	86.0 ab	71.7 c
	Novaluron	200ml	68.4±1.1	62.5±1.0	72.5±0.7	61.3±0.7	70.5 c	61.9 d
	chlorpyrifos-methyl	1000ml	70.0±1.3	66.3±1.2	73.8±0.7	68.8±1.0	71.9 c	67.6 c
	Methomyl	300g	63.8±1.1	57.5±1.0	61.3±0.8	56.3±0.7	62.6 d	56.9 d

Means within the same column followed by the same letters are not significantly different according to the $LSD_{0.05}$.
I. K= Initial kill
R.T=Residualtoxicity

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