J. Agric. Sci. Mansoura Univ., 34 (5): 5357 - 5363, 2009

EFFECT OF IMIDACLOPRID ON EARLY SEASON SAP SUCKING INSECTS IN RELATION TO ANALYSIS OF ITS RESIDUES IN COTTON PLANTS

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ABSTRACT

The experiment was carried out at Etay El-Baroud Research Station, El-Beheira Governorate during 2007 and 2008 growing seasons. The aim of this work was to evaluate the efficacy of imidacloprid insecticide as seed treatment on the early season sap sucking insects; thrips (*Thrips tabaci*), aphids (*Aphis gossypii*), jassid (*Empoasea lybica*) and whitefly (*Bemisia tabaci*) on cotton plants. Also, the investigation included the determination of imidacloprid residues in cotton plants. Results indicated that the initial efficiency against thrips was 87.16 and 86.91% and was 94.84 and 93.06 % against jassid in the two seasons, respectively. The residual efficacy was found to be 58.81 % and 57.55% as a general average after seven weeks against aphids, whereas it was 60.35 % and 59.36% against whitefly in the two seasons, respectively. Concerning the residues analysis of imidacloprid in cotton plants by HPLC, the data indicated that the residue amount was 0.0923 and 0.0123 µg/g plant after two and seven weeks of treatment, respectively.

It can be concluded that early season sucking insects can be controlled using imidacloprid as seed treatment. A reasonable efficacy and considerable residue effect (6-7 weeks after cultivation) was obtained. Imidacloprid insecticide can be applied in IPM programmes to minimize the use of insecticides to keep environment and beneficial insects.

INTRODUCTION

Chemical pesticides have played and will continue to play a major role in the rapid advancement of agricultural production. Improvement of application equipment, formulation types and techniques to permit the effective use of smaller dosages of chemicals and to reduce drift and harmful residues has become increasingly important as one means of minimizing the problems associated with the use of chemical pesticides (Emara, 1996).

The Egyptian cotton is a long-season crop attacked by many harmful insects that infest it throughout all growth stages. Of particular importance are early season sap sucking insects; thrips (*Thrips tabaci*), aphids (*Aphis gossypii*), whitefly (*Bemisia tabaci*) and jassid (*Empoasea lybica*). Special importance is given to selective insecticides, which are soft on beneficial for better integrated pest control programmes, with good environmental properties and low mammalian toxicity (Elbert *et al*., 1990).

The studies on the determination of the systemic properties of imidacloprid showed that the active ingredient can penetrate into the plant. The part of active ingredient taken up into the plant is further distributed in acropetal direction. These trials also showed the excellent root-systemic properties of the compound after application via the soil or as seed dressing (Woodford and Mann, 1992 and Nauen and Elbert, 1994). The objective of

the present investigation is to evaluate the efficiency of imidacloprid on the early season sap sucking insects; thrips, aphids, jassid and whitefly, when the insecticide was applied as seed dressing on cotton seeds. Also, the investigation included the determination of imidacloprid residues in cotton plants throughout the period of the study.

MATERIALS AND METHODS

1. Tested insecticide

The nitroguanidines, Imidacloprid (Gaucho®, 70 WS) 1-(6-chloro-3-pyridylmethyl)-N-nitroimidazolidin-2-yl-idenamine), produced by BAYER Chemical Company, Germany, was used in the present investigation.

2. Field experiment

The present investigation was carried out at Etay El-Baroud Agricultural Research Station (Experimental Farm), Beheira Governorate during 2007 and 2008 growing seasons using cotton Giza 88 variety (*Gossypium barbadense* L.). The experiment was conducted in a randomized complete block design with four replications, each plot area was 84 m^2. The rate of planting was 30 kg seeds/feddan at 7-8 seeds per hill. Then, imidacloprid (Gaucho 70 WS) was applied on the cotton seeds as a seed dressing at the rate of 7 g/kg seeds. Control treatment without imidacloprid was also included.

Two weeks after planting, a random sample of 25 seedlings for each plot was taken in the early morning for thrips, aphids, jassid and whitefly counts. After that, at regular 7 day intervals until 7 weeks, insects count was run. Reduction of pest numbers, as percentage, was calculated according to the following formula:

Reduction percentage of pest numbers (%)= $$100\left(1-\frac{\text{Pest numbers in the treatment}}{\text{Pest numbers in the control}}\right)$$

3. Determination of the imidacloprid residues in cotton plants

3.1. Extraction and cleanup

Samples of whole cotton plants were taken after two weeks of planting and at regular intervals until 7 weeks (2008 season). The analytical sample (100 g) was treated in 500 ml glass bottle with 250 ml acetonitrile and homogenized with the high-speed blender for about 3 minuters. Washing was done with 100 ml acetonitrile followed by filtration through a suction filter with fast filter paper into 1000 ml round-bottomed flask. Acetonitrile then was evaporated using the rotary evaporator at 40-50°C to dryness and the sample re-dissolved in small amount of ethyl acetate. Glass chromatographic column (30 x 1.5 cm) was packed with 1 cm^3 glass wool, 10 g of florisil (60-100 mesh 5% water deactivated) and 3 g of anhydrous sodium sulphate. The column was washed with 50 ml ethyl acetate and discarded. Imidacloprid (as active ingredient) was eluted from the column with 50 ml acetonitrile. The elute was

evaporated at 40-50°C to dryness and re-dissolved in a known volume of acetonitrile (1 ml) until analysis.

3.2. High Performance Liquid Chromatography (HPLC) of Imidacloprid

High performance liquid chromatograph model Beckman 406 was used to determine the residues of imidacloprid in cotton plants and the running conditions were standardized. The optimum conditions were as follows: the chromatographic column was Ultrasphere Si-column (ODS) 25 cm x 4.5 mm, the solvent system acetonitrile with flow rate of 1 ml/min, the detector involved in this study was UV 270 nm wavelength with 0.2 AUFS, the chard speed was 0.5 cm/min and the injection volume was 10 µl.

RESULTS AND DISCUSSION

1. Efficiency of imidacloprid against early season sap sucking insects

The insecticidal activity of imidacloprid applied as seed dressing against thrips (*Thrips tabaci*), aphids (*Aphis gossypii*), jassid (*Empoasea lybica*) and whitefly (*Bemisia tabaci*) was evaluated under field conditions. Table (1) showed the effect of imidacloprid in suppressing the population of thrips on cotton seedlings. The data indicated that the initial efficiency was 87.16% and 86.91% for 2007 and 2008 growing seasons, respectively. The data of the effect of imidacloprid against aphids are presented in Table (2). It may be obvious that the average reduction for 7 weeks was 58.81 % and 57.55 % for the two growing seasons, respectively. Concerning the effect of such compound on jassid, as shown in Table (3), the initial efficiency was 94.84 % and 93.06% for the two seasons, respectively. The efficacy of the insecticide against whitefly, as indicated in Table (4) revealed that the average percentage reduction for 7 weeks was 60.35 % and 59.36 % for the two seasons, respectively.

Table (1): Insecticidal efficiency of imidacloprid against thrips, *Thrips tabaci* Lind. on cotton during 2007 and 2008 growing seasons.

Weeks from sowing	2007				2008			
	Thrips counts/T		Reduc-tion (%)	General average (%)	Thrips counts/T		Reduc-tion (%)	General average (%)
	Control	Imida-cloprid			Control	Imida-cloprid		
2	**187**	**24**	**87.16**		**107**	**14**	**86.91**	
3	117	45	61.53		323	73	77.40	
4	164	53	67.68	**51.20**	392	132	66.32	**55.79**
5	99	43	56.57		342	137	59.94	
6	250	185	26.0		401	256	36.14	
7	547	502	8.23		522	480	8.06	

Several investigators studied the insecticidal activity of imidacloprid against sucking pests on vegetables and cotton plants. Eissa (1991) reported that imidacloprid, applied as seed coating, protected plants from early season pests for a period of 6-8 weeks. Emara (1996) found that Gaucho had a relatively fast initial effects against thrips and the residual efficacy lasted for

6-7 weeks. Elbert *et al*.(1991) mentioned that the residual activity of imidacloprid, applied as seed coating, lasted between7.7 and 9.3 weeks against aphids on sugar beet, depending on the dose rate. The authors added that the insecticide is extremely effective against sucking insects such as leafhopper, aphids, thrips, mealy bugs and very effective against whitefly. Moreover, the effect of the compound was better than the treatment with aldicarb granules and much better that achieved by coating seed with carbufuran. Abdel-Meguid *et al*.(1999) evaluated the effect of imidacloprid on the population density of some harmful insects, mites and beneficial insects in cotton fields. Cotton plants in untreated area included the highest level of collective infestation by sap sucking insects and mites. The low infestation in both seed and soil treatments was due to the use of imidacloprid in the two treatments.

Table (2): Insecticidal efficiency of imidacloprid against aphids, *Aphis gossypii* Glover. on cotton during 2007 and 2008 growing seasons.

Weeks from sowing	2007				2008			
	Aphid counts/T		Reduc-tion (%)	General average (%)	Aphid counts/T		Reduc-tion (%)	General average (%)
	Control	Imida-cloprid			Control	Imida-cloprid		
2	**14**	**-**	**100**		**12**	**-**	**100**	
3	165	26	84.25		134	25	81.34	
4	331	125	62.23	**58.81**	270	106	60.74	**57.55**
5	604	281	53.48		552	264	52.17	
6	962	632	34.29		963	607	36.97	
7	1175	956	18.63		1123	965	14.07	

Because imidacloprid is highly systemic, especially through root system, it is absorbed by the plant tissues and transported into the sap throughout the entire plant via vascular system, right up to the last leaf. Thus, it is disastrous for pests like aphids and other feeding on the juice of plants, while natural enemies go unharmed (Anonymous, 1992 and Mullins, 1993).

Table (3): Insecticidal efficiency of imidacloprid against jassid, *Emposca lybica* on cotton during 2007 and 2008 growing seasons.

Weeks from sowing	2007				2008			
	Jassid counts/T		Reduc-tion (%)	General average (%)	Jassid counts/T		Reduc-tion (%)	General average (%)
	Control	Imida-cloprid			Control	Imida-cloprid		
2	**252**	**13**	**94.84**		**173**	**12**	**93.06**	
3	167	34	79.64		232	30	87.07	
4	260	131	49.62	**49.87**	259	100	61.38	**55.29**
5	290	163	43.79		311	152	51.13	
6	436	345	20.37		446	321	28.03	
7	582	521	10.48		578	514	11.07	

Table (4): Insecticidal efficiency of imidacloprid against whitefly, *Bemisia tabaci* Gennadius on cotton during 2007 and 2008 growing seasons.

Weeks from sowing	2007				2008			
	Whitefly counts /T		Reduc-tion (%)	General average (%)	Whitefly counts /T		Reduc-tion (%)	General average (%)
	Control	Imida-cloprid			Control	Imida-cloprid		
2	**-**	**-**	**-**		**8**	**-**	**100**	
3	4	-	100		19	3	84.21	
4	15	4	73.33		35	12	65.71	
5	24	10	58.33	**60.35**	84	45	46.43	**59.36**
6	43	23	46.51		146	96	34.24	
7	89	68	23.59		219	163	25.57	

2. Residues of imidacloprid in cotton plants

Fortified samples showed that percentage recovery was 83.1%. Levels of imidacloprid residues, calculated as µg/g plant, are shown in Table (5). The data indicate that the residue amounts of imidacloprid were 0.0923, 0.0785, 0.0521, 0.0340 , 0.0142 and 0.0123 µg/g plant after 2, 3, 4, 5, 6 and 7 weeks, respectively. These results are in agreement with those obtained by Nauen *et al*.(1999) and Shaheen (2001), who reported that imidacloprid can be detected after 40 days of treatment on potato plants. Troltzch *et al*.(1994) mentioned that imidacloprid can be detected until 81 days after seed treatment and cultivation of cotton.

Table (5): Residue amounts of imidacloprid in cotton plants with pre-treated cotton seeds.

Rate per fed. (g/30 kg seeds)	Residue amounts (µg/g plant) in cotton detected after cultivation weeks					
	2	3	4	5	6	7
210	0.0923	0.0785	0.0521	0.0340	0.0142	0.0123

In conclusion, early season sucking insects on cotton plants can be controlled using imidacloprid as seed treatment. A reasonable efficacy and considerable residual effect (6-7 weeks after cultivation) was obtained. Imidacloprid insecticide can be applied in IPM programmes to minimize the use of insecticides to keep safe the environment and beneficial insects.

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تأثير الإميداكلوبراید ضد حشرات بداية الموسم الثاقبة الماصة وإرتباط ذلك بتحليل متبقياته فى نباتات القطن

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أجريت هذه الدراسة بمحطة البحوث الزراعية بإيتاى البارود، محافظة البحيرة موسمى ٢٠٠٧، ٢٠٠٨ لدراسة كفاءة مبيد الإميداكلوبراید المستخدم كمعاملة بذور ضد حشرات التربس والجاسيد والمن والذبابة البيضاء على نباتات القطن فى بداية الموسم.

أوضحت النتائج المتحصل عليها أن الإبادة الفورية بعد أسبوعين من الزراعة كانت ٨٧,١٦٪ و ٨٦,٩١٪ ضد حشرة التربس خلال الموسمين على التوالى، بينما كانت ٩٤,٨٤٪ و ٩٣,٠٦٪ ضد حشرة الجاسيد خلال الموسمين على التوالى. بالنسبة للتأثير الإبادى المتبقى، إستمر لمدة ٦-٧ أسابيع وكان متوسط خفض الإصابة لحشرة المن ٥٨,٨١٪ و ٥٧,٥٥٪ خلال الأسابيع السبعة للموسمين على التوالى، بينما كانت النسبة ٦٠,٣٥٪ و ٥٩,٣٩٪ لحشرة الذبابة البيضاء خلال الموسمين على التوالى. وقد أظهرت نتائج تحليل متبقيات مبيد الإميداكلوبراید فى نباتات القطن بإستخدام جهاز الكروماتوجرافى السائل عالى الكفاءة (HPLC) أن كمية المتبقى بعد أسبوعين كانت ٠,٠٩٢٣ ميكروجرام/جرام نبات، بينما كانت كمية المتبقى ٠,٠١٢٣ ميكروجرام/جرام نبات بعد سبعة أسابيع من الزراعة.

يتضح من هذه الدراسة أن إستخدام مبيد الإميداكلوبراید كمعاملة بذرة يعطى كفاءة جيدة ضد الحشرات الثاقبة الماصة فى بداية الموسم على نباتات القطن وكذلك سمية متبقية لمدة مناسبة. ويمكن إستخدام هذا المبيد فى برامج المكافحة المتكاملة للقطن وذلك لتقليل إستخدام المبيدات للمحافظة على سلامة البيئة وكذلك الحشرات النافعة.