Efficiency of Certain Evaluated Igrs and Conventional Insecticides on the Incidence of Common Lepidopterous Insect- Pests of Cotton Plant

Awad,H.A., A.Z. El-Naggar, H. M. EL-Bassouiny and Haity M. Tadros.[1]

ABSTRACT

Field studies were conducted in El-Beheira Governorate during the growing cotton season of 2013 to investigate the effect of four IGRs compounds (Ageron®, Match®, Dimilin® and Topron®) against the cotton leaf worm, *Spodoptera litorallis* (Boisd); six pyrethroids; (Icton®, Lamda-Z®, Pulsar®, Buldock®, Sumi-alfa KZ® and Fenerate-S®) in addition to, Dora® as an organophorous compound against the cotton bollworms; *Pectinophora gossypiella* (Saund.) and spiny bollworm *Earias insulana* (Boisd.), besides, the side effects of these tested compounds on cotton yield was also studied.

Results indicated that Topron® gave higher reduction of the cotton leafworm infestation amounted to 85.7 % followed by Match® (83.5%), then, Ageron® (82.1%). For the cotton bollworm, the higher reduction was recorded with Sumi-alfa KZ® (83.60%) followed by Lamda-Z® (83.2%), while, Buldock® gave a more lower reduction of 80.8%. The evaluated percentages of reduction values for the other evaluated insecticides were 82.6% for Icton®, 82% for Pulsar®, 82.1% for Dora® and 81.1% for Fenerate-S®. All the tested insecticides increased the cotton yield in comparison to the untreated check.

INTRODUCTION

Cotton, *Gossypium barbadence* L. is one of the most important economical crops in Egypt and the world. Due to intensive cultivation of the crops, the list of cotton pests has become very long; implying numerous serious injurious species. Therefore, plant protection has now become a necessity for obtaining good yield. The major insect- pests of cotton plants under study are the cotton leafworm, *Spodoptera litorallis* (Boisd); the cotton bollworms; pink bollworm, *Pectinophora gossypiella* (Saund.) & spiny bollworm *Earias insulana* (Boisd.) which attack cotton in the subsequent vegetative and fruiting stages of growth. The intensive use of conventional pesticides led to several important drastic problems, i.e. environmental pollution,destruction of the natural enemies and insect resistance to different insecticides Therefore, a great need was attained to develop alternative or/and additional techniques, to allow a rational use of pesticides and provides adequate crop protection for sustainable food, feed and fiber protection. Among the most promising alternatives to the conventional insecticides, are the insect growth regulators (IGRs) that are biorotional insecticides with novel modes of action where they disrupt the development of target pest. Such compounds tend to be selective and generally less toxic to no- target organisms than the conventional insecticides (Biddinger and Hull, 1995 and Nicholas *et al*., 1999).The use of IGR´s compounds in insect control are known as insect development inhibitions, which inhibit or prevent normal metamorphosis of immature stages to the adults stage. Herein, many IGRs have shown potentiality against lepidopterous insects (Abdel-Aal, 2003 and Seth *et al*. 2004).

Therefore, the present study aimed to evaluate the efficacy of four insecticides belonged to IGRs; fulufenoxuron (Ageron®), lufenuron (Match®), difluubenzuron (Dimilin®) and chlorfluazuron (Topron®) against cotton leafworm. The synthetic pyrethroids of lambda-cyhalothrin (Icton®, Lamda-Z® and Pulsar®), beta cyfluthrin (Buldock®), ES-fenvalerate (Sumi-alfa KZ®) and ES-fenvalerate (Fenerate-S®); beside, chlorpyrifos (Dora®) as an organophorous compound were evaluated against the cotton bollworms, in addition to their effect on cotton yield.

MATERIALS AND METHODS

- Experiment

Field experiments were carried out at Abo-Homos district, El-Bheira Governorate during season of 2013. Four insect growth regulators (IGRs) were evaluated against the cotton leafworm (CLW) *Spodoptera litorallis* (Boisd.)as shown in Table (1). The experimental area was consists of five feddans for each treatment which divided into 4 replicates and involved an untreated check**.** The spraying was carried out on July, the 1st 2013**.**

The performed treatments six pyrethroids and one organophosphorous insecticides were also evaluated against the cotton bollworms (Table 1). For all tested compounds three sprays were done with two weeks interval between sprays. The application of insecticides was started on August, the 15th, 2013. In all treatments one back motor was used with 80 liter of spraying preparation / feddan, for each compound.

[1]Plant Protection Res., Institute Agric. Res. Centre., Alex., Egypt
Email:alyelnaggar31@gmail.com, alyelnaggar@ymail.com
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Table 1. The tested pesticides and their application rates which used in this study

Pesticides	Group	Rate of application / feddan
Fulufenoxuron10% DC (Ageron®)	IGRs	200 cm^3
Lufenuron 5 % EC (Match®)	IGRs	100 cm^3
Diflubenzuron 48% SC (Dimilin®)	IGRs	125 cm^3
Chlorfluazuron 5 % EC (Topron®)	IGRs	400 cm^3
Lambda-Cyhalothrin 2.5 % EC (Icton®)	Pyrethroids	750 cm^3
Lambda-Cyhalothrin 5 % EC (Lamda-Z®)	Pyrethroids	375 cm^3
Lambda-Cyhalothrin 5 % EC (Pulsar®)	Pyrethroids	375 cm^3
Beta Cyfluthrin 12.5 % SC (Buldock®)	Pyrethroids	150 cm^3
ES-Fenvalerate 5 % EC (Sumi-alfa KZ®)	Pyrethroids	400 cm^3
Esfenvalerate 5 % EC (Fenerate-S®)	Pyrethroids	600 cm^3
Chlorpyrifos 48 % EC (Dora®)	O.P.	1Litre

-Sampling technique:

-The cotton leafworm (CLW) *Spodoptera litorallis* (Boisd.)

Randomly; 100 cotton plants were chosen from each replicate (400 plants per each treatment) to count the CLW larvae in the early morning before and after treatment. Examination was performed after three days with non-conventional compounds (IGR's) in order to calculate the initial reduction effect (I.R.E.) The examination was furtherly after 7and10 days to calculate the latent reduction effect (L.R.E.). The rate of infestation reduction was calculated for comparison, according to Henderson and Tilton (1955).

- The cotton bollworms:

Weekly samples of 100 green bolls were collected from each replicate (400 bolls per each treatment) just before spraying and after 7 and 14 days of each spray; they were externally and internally examined. The numbers of inspected larvae in green bolls were calculated. The percentage of reduction was calculated according to the equation of Henderson and Tilton (1955).

- Determination of cotton yield

In each treatment ripened open bolls from twenty five cotton plants were collected to estimate the cotton yield / plant, from which, the total yield / feddan was relatively calculated.

RESULTS AND DISCUSSION

-Effect of IGRs compounds on cotton leafworm

The results in Table (2) show, the insignificant difference in detected efficiency between treatments after 3 days of application where the mean numbers of counted larvae amounted to 254.75, 195, 209.25 and 163.75 larvae /100 plants for Ageron®, Match®, Dimilin® and Topron®, respectively but still less than untreated check (1168 larvae /100 plants). The maximum efficient toxic effect was recorded at the 7th day post application for Topron® (114.75 larvae /100 plants), followed by Match® and Dimilin® (142.75 &147.25 larvae /100 plants, in respect). The same trend of toxic activity was detected at the 10th days from spraying (Table, 2). The overall mean of the larval account was significantly differed between treatments, indicating that the lowest mean number of the inspected larvae was determined for Topron® (122.08 larvae /100 plants), versus, the highest recorded mean numbers (195.25 /100 plants) for Ageron® treatment; in comparison to the untreated check (998.75 larvae /100 plants).

This results were ascertained by the included results in Table,3. Herein, the higher value of Initial reduction effect was recorded after application with Topron® (83.4%), followed by Match® treatment (81.1%), while, Ageron® gave the least effect (79.8%). Also, the latent reduction effect values were 86.9%, 84.2%, 84.7% and 83.2% with Topron®, Dimilin®, Match® and Ageron® treatments, respectively. In general, it could be confirmed that the treatment of Topron® gave the highest overall mean of reduction (85.7%), while the treatment of Ageron® gave the least reduction 82.1% (Table, 3).

The above cited results are in agreement with findings of Clarke and Jewess (1990) who showed that the enhanced toxicity of Flufenoxuron to *S. littoralis* compared with Diflubenzuron can probably be attributed to its slow metabolism and reduced excretion. Rao and Subbaratnam (2000) proved that Flufenoxuron was relatively more toxic than either Diflubenzuron or Lufenuron on the third instars larvae of *S. exigua*. YuXian *et al*. (2003)

Table 3. The calculated percentage of reduction of cotton Leafworm after application of IGRs

Inspection dates	Replicates	The percentage Reduction %			
		Treatments			
		Ageron®	**Match®**	**Dimilin®**	**Tobron®**
3 Days	1	82.5	83.5	80.9	84.1
	2	79.8	81.3	80.2	84.9
	3	78.7	80.7	79.8	83.5
	4	78.1	78.9	78.2	80.9
M. Reduction%		79.8	81.1	79.8	83.4
I.R.E*		79.8	81.1	79.8	83.4
7 Days	1	84.8	85.8	84.1	86.6
	2	84.4	84.9	83.4	87.8
	3	80.6	82.4	83.5	86.3
	4	84.3	84.1	84.8	86.6
M. Reduction%		83.6	84.3	84.0	86.8
10 Days	1	83.6	84.7	84.5	86.1
	2	84.9	85.7	84.1	87.9
	3	80.5	83.4	84.09	87.2
	4	82.4	86.3	84.8	86.9
M. Reduction%		82.9	85.1	84.3	87.03
L.R.E**		83.2	84.7	84.2	86.9
Overall Mean of Reduction		82.1	83.5	82.7	85.7

*I.R.E= Initial Reduction % Effect ** L.R.E =Latent Reduction % Effect

mentioned that the deduced inhibition values for carboxylesterase activity after feeding the second-instar larvae of *S. exigua* on treated leaves with Chlorfluazuron (50 mg/litre) was 60.56%. EL-Naggar *et. al*. (2012) found that the general mean of larval reduction was 87.5 % for Cabris®, while it was 85.3 % for Cascade®. Also, Ghoneim *et. al.* (2012) reported that the IGRs (lufenuron, Flufenoxuro, Tobufenozite, Hexaflumuron, Triflumuron and Chlorfluazuron) exhibited low levels of resistance on both the stages of eggs and larvae, andthey had higher toxic action on larvae than that on eggs.

-Efficacy of the evaluated insecticide on the cotton bollworm

The implied results in (Table,4) elucidate that after the first spray, Lamda-Z® gave the least mean number of infested bolls (1.1 /100bolls), while, for the other treatments ranged from 1.2 for Icton® to 2.1 /100 bolls for Sumi-alfa KZ® compared to the untreated check (10.9 /100 bolls). However, after the second and third sprays, there were no significant differences between the tested compounds where they gave means values of infested bolls ranged between 1.2 and 1.6 /100 bolls after the second spray and from 1.5 to 2.6 /100 bolls after the third spray in comparison with the untreated check (12.6 and 16 infested bolls /100 bolls, respectively). The calculated overall means of infested bolls /100 bolls amounted to 1.29, 1.58, 1.66, 1.70, 1.75, 1.79 and 2.0 for Lamda-Z®, Dora®, Sumi-alfa KZ®, Icton®, Pulsar®, Fenerate-S® and Buldock®, respectively (Table,4).

Moreover, the exhibited data in Table, 5, show that the performed treatments of Icton®, Lamda-Z®, Dora®, Buldock® and Fenerate-S® gave high reduction of infested bolls after the first spray comprised 89, 86.1, 86.4, 84.2 and86 %, but thes values consequently, more or less decreased after the 2nd spray up to 76.6, 80.3, 77.5, 76.6 and 78.4 %, respectively; and after the 3rd spray up to 82.3, 83.2, 82.5, 81.5 and 81.1%, in respect. Moreover, the treatment of Sumi-alfa KZ® gave the more lower of 80.8% reduction after the first spray, then increased to 87.5% after the second one, but decreased again 82.4% after the third spray. In general, the overall means reduction values were higher for the treatments of Sumi-alfa KZ® and Lamda-Z® (83.60 and 83.2), while they were 82.6, 82.1, 82, 81.1 and 80.8 for Icton®, Dora®, Pulsar®, Fenerate-S® and Buldock®, respectively.

The above mentioned results are in agreement with the concluded results by Mahar *et al.* (2004), who reported that, Fenpropathrin, Chlorpyrifos and Endosulfan insecticides were effective against the pink bollworm.

Sandeep *et al.* (2006) who stated that the lowest averages of infestation rates at the 14th day after spraying were obtained with Cypermethrin + Chlorpyrifos (5.05 %), Beta– Cyfluthrin 2.5 % EC (4.64 %), Spinosad 45 % SC (4.19 %) and Indoxacarb 14.5 % EC (4.71 %). EL-Mageed *et al.* (2007) mentioned that the programme of (Beta–Cyfluthrin, Malathion and Spinosad for the 1st, 2nd and 3rd spray, respectively) resulted in the greatest reduction (81.04 and 81.08 %) in pink bollworm larval population. The percentage of infestation by the spiny bollworm was very low. Abd EL-Rahman *et al.* (2009) indicated that the highest biological performance against the pink bollworm (*P. gossypiella*) was achieved by using of ά -cyhalothrin at 100 ml / fed. (92.7 %).

-Effect of certain insecticides on cotton yield

The higher percentage of cotton yield increase than the untreated check was recorded after application with the insecticide- Sumi-alfa KZ®, which gave 63.3% increase followed by Lamda-Z® (61.7 %), versus, the lower increase of cotton yield (41.7 %) after Buldock® application. For the other treatments, the calculated percentage values of cotton yield increase ranged from 51.7% for Pulsar® to 56.7 % for the organophosporous one-Dora® (56.7 %) (Table, 6).

Table 5. The calculated percentage of reduction of infested bolls with bollworms after application of evaluated insecticides

N. Spray	Inspections	Replicates	The percentage Reduction %						
			Insecticides						
			Icton®	Lamda-Z®	Bulsar®	Bulldock®	'Sumi-alfa'KZ®	Dora®	Fenerate-S
1st Spray	1st inspection	1	88	94	82	73	82	82	88
		2	89	83.5	89	78	78	83.5	83.5
		3	92	84	84	84	84	89.3	89.3
		4	88.5	88.5	88.5	84.7	77	88.5	88.5
		M. R.%	89.4	87.5	85.9	79.9	80.3	85.8	87.3
	2nd inspection	1	89.3	89.3	76	84	84	84	89.3
		2	91	86.5	82	91	82	86.5	86.5
		3	89	78	78	89	89	92.7	92.7
		4	85	85	85	90	70	85	70
		M. R.%	88.6	84.7	80.3	88.5	81.3	87.05	84.6
General Means Reduction % of Spray			89	86.1	83.1	84.2	80.8	86.4	86
2nd Spray	3rd inspection	1	77.5	85	90	85	90	77.5	85
		2	75	75	87.5	75	87.5	75	75
		3	82	82	82	82	82	82	82
		4	77	77	77	77	88.5	77	77
		M. R.%	77.9	79.8	84.1	79.8	87	77.9	79.8
	4th inspection	1	79	86	90.7	72	90.7	86	86
		2	77	77	77	77	88.5	77	77
		3	70	85	70	70	85	70	70
		4	75	75	75	75	87.5	75	75
		M. R.%	75.3	80.8	78.2	73.5	87.9	77	77
General Means Numbers of Spray			76.6	80.3	81.2	76.7	87.5	77.5	78.4
3rd Spray	5th Inspection	1	82.7	80.5	80.5	87	74	80.5	87
		2	79	79	79	79	79	79	79
		3	83.5	89	83.5	78	89	83.5	83.5
		4	81	81	81	81	81	81	71.5
		M. R.%	81.6	82.4	81	81.3	80.8	81	80.3
	6th Inspection	1	82.7	80.5	80.5	83.8	80.5	80.5	87
		2	84	84	84	84	84	84	84
		3	82	88	82	76	88	88	82
		4	83	83	83	83	83	83	74.5
		M. R.%	82.9	83.9	82.4	81.7	83.9	83.9	81.9
General Means Reduction of Spray			82.3	83.2	81.7	81.5	82.4	82.5	81.1
Overall Mean of Reduction			82.6	83.2	82	80.8	83.60	82.1	81.1

Table 6. Effect of tested insecticides on cotton yield

Insecticides	Cotton Yield	
	Weight /fdd. Kg (Kent.)	% * Increase
Icton®	1464.8 Kg (9.3 Kent.)	55 %
Lamda-Z®	1527.8 Kg (9.7 Kent.)	61.7%
Pulsar®	1433.3 Kg (9.1 Kent.)	51.7 %
Buldock®	1338.8 Kg (8.5 Kent.)	41.7 %
Sumi-alfa KZ®	1543.5 Kg (9.8 Kent.)	63.3 %
Dora®	1480.5 Kg (9.4 Kent.)	56.7 %
Fenerate-S®	1464.8 Kg (9.3 Kent.)	55 %
Untreated Check	945 Kg (6 Kent.)	—

* expressed as % of increase than the untreated check, according to Hussein *et al*. (2002).

Identical results were mentioned in the works of Ali *et al.* (1988) who reported that Carbaryl, Permethrin, Chlorpyrifos insecticides and Moncrotophos increased seed cotton yield. Karner *et al.* (2003) who mentioned that cotton yields in insecticides- treated plots was 9 % more compared to untreated plots.

Younis *et al.* (2009) showed that the synthetic pyrethroids induced the greatest reduction in bollworms infestation that was associated with the highest amount of seed cotton yield.

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الملخص العربي

تقييم كفاءة بعض مركبات منظمات النمو الحشرية والمركبات التقليدية على خفض مستويات الإصابة بأفات القطن الحشرية من رتبة حرشفية الأجنحة

حمدى أمين عوض، على زكريا النجار، هشام محمد البسيونى، هايتى مكرم تادرس

إجريت الدراسة فى محافظة البحيرة خلال موسم ٢٠١٣ بهدف دراسة تأثير ٤ مركبات من منظمات النمو الحشرية (أجيرون، ماتش، ديميلين، توبرون) ضد دودة ورق القطن. وكذلك دراسة تأثير ستة مركبات بيروثرويد (أكتون، لمدا زد، بالسار، بولدوك، سومى ألفا- كزد، فينيرات إس) بالإضافة إلى مركب دورا كمركب فوسفورى ضد ديدان اللوز(القرنفلية والشوكية) بالإضافة إلى دراسة تأثيرها على إنتاجية محصول القطن.

أوضحت النتائج أن مركب توبرون أعطى معدل خفض عالى ضد دودة ورق القطن (٨٥,٧%) يليه مركب ماتش (٨٣.٥%) بينما كان أقل معدل خفض هو ٨٢.١% مع مركب أجيرون. أما بالنسبة لديدان اللوز فقد تم تسجيل أعلى معدل خفض لمركب سومى ألفا- كزد (٨٣.٦٠%) يليه مركب لمدا-زد (٨٣.٢) بينما أعطى مركب بولدوك أقل نسبة خفض (٨٠.٨%). بينما قدرت نسب الخفض المئوية للمركبات الأخرى مالتى كانت ٨٢.٦% لمركب أكتون ٨٢% لمركب بالسار، ٨٢.١% لمركب دورا، ٨١.١% لمركب فينيرات- إس. كذلك أعطت كل المبيدات تأثير غير مباشر فى زيادة محصول القطن مقارنة بالكنترول.