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EVALUATION THE EFFICACY OF TWO INSECT GROWTH REGULATORS (IGRS) AGAINST EGYPTIAN COTTON LEAFWORM, *Spodoptera littoralis* AND THEIR LATENT EFFECT ON THE PUPATION AND THE DAILY RATE OF CONSUMED FOOD.

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ABSTRACT

Two insect growth regulators (IGRs), diflubenzuron and lufenuron were tested against cotton leafworm *Spodoptera littoralis* at Sakha Lab-field by feeding the 2nd, and 4th instar larvae on treated cotton leaves for 48 hrs and untreated leaves till pupation for four indicated intervals (zero, 7, 14, 21 days treatment). Also, the effecting of these compounds on the daily rate of consumed food by the, 4th, 5th, and 6th instar larvae was recorded.

The results showed the following:

1. The tested compounds were highly effective at 0-time interval (initial kill after 5 days post-treatment) recording 95 and 99 % mortality with diflubenzuron and lufenuron respectively on the 2nd instar larvae, while the percent mortality were 91 and 97 on the 4th instar larvae.
2. The tested compounds could be arranged according their residual effect (7 – 21 days post treatment) in descending order as follows, diflubenzuron (78 %) and (79.3 %) on the 2nd and 4th instar larvae respectively and lufenuron (97.6 %) and (87.6 %) on the 2nd and the 4th instar larvae.
3. Diflubenzuron induced zero % pupation on the 2nd instar larvae and 11.1 % on the 4th instar larvae, while lufenuron induced zero % pupation with the two instar larvae comparing with control, where the percent pupation were 91.7 % and 89.5 % with the 2nd and the 4th instar larvae.
4. Lufenuron was the highest effective toxicant, where it prevented the larvae to reach pupal stage for 7 and 14 days post treatment.
5. Significant differences were recorded between control and other treatments in the daily rate of consumed food treated with diflubenzuron and lufenuron by the 4th, 5th, and 6th instar larvae.

INTRODUCTION

The cotton leafworm, *Spodoptera littoralis* is one of the important insect pests attacking cotton, vegetables and field crops and causes serious damage to them. Chemical control in the field caused the pollution of the environment and developed tolerance acquired by its successive generations subjected to insecticides.

Insect growth regulators (IGRs) are insecticides acting on various insect orders by disrupting chitin synthesis. The major effect of members of this group is upon those period of the life cycle where chitin is being formed and where its incorrect or insufficient production can lead to malformation of later stages of the life cycle. Many authors investigated IGR's on *S. littoralis* , Ishaaya *et al.* (1986), El-Deeb *et al.* (1991), El-Shoura and Aly (1994), Gomaa *et al.* (1996), and Korkor *et al.* (1996).

The aim of this research is to study the effect of some insect growth regulators (IGRs) on the *S. littoralis* and the daily rate of consumed food with them.

MATERIALS AND METHODS

1. Insect used:

The cotton leafworm strain used in the present study was taken as a second generation of the field strain and reared on the laboratory conditions at 25±2 °C and 65±5 % relative humidity as described by El-Defrawy *et al.* (1964) at Sakha Agricultural Research Station.

2. Insect growth regulators compounds (IGR's):

a- Dimiline : Diflubenzuron.

b- Match : Lufenuron.

3. Bioassay:

Field experiments were carried out in Sakha Agricultural Research Station at Kafr El-Sheikh Governorate. In this study cotton Giza 89 variety was cultivated in April 2004 season, and an area of Experimental of about 1/2 feddan was used during the growing season. The treatments were arranged in completely randomized block design with four replicates of 1/16 feddan each. Cotton plants were subjected to normal agricultural practices.

Each treatment was sprayed after dilution with 200 liters water/feddan using the CP3 sprayer with one nozzle with diflubenzuron and lufenuron at the rate of 125 ml and 160 ml / feddan respectively according to the protocol of Ministry of Agricultural for bioassaying.

To evaluate the toxicity of the tested (IGRs) against *S. littoralis,* treated plant leaves were collected at random from each treatment at intervals after spraying *i.e*, zero time, 7, 14 and 21 days and offered to the 2nd and 4th instar larvae (100 larvae / treatment). Larvae were fed on treated leaves for 48 hrs. and then on untreated leaves for 3 days more and got the percent mortality. The survival larvae were fed on untreated leaves till pupation and the percentages of pupation were recorded for each interval. Individuals in the control were fed on untreated leaves through the experimental period.

The daily rate of consumed food of tested (IGRs) of diflubenzuron and lufenuron against the 4th, 5th, and 6th instar larvae of *S. littoralis* was evaluated also. After spraying with (IGRs), the treated leaves of the plants were weighed and introduced to larvae / replicate during two days of spraying, then the larvae of *S. littoralis* were fed on untreated leaves of plant even the pupation.

The residual leaves of feeding / replicate were dried daily at 80 °C for 24 hours and the dry weight of the residual food were calculated.

The daily rate of consumed food was calculated (as dry of weight/larvae).

The larvae were weighed daily and the average weight of each larvae was recorded also. The number of days of instar larvae were recorded and the daily rate of consumed food was determined by the formula represented by the protocol of the Ministry of Agriculture.

$$\text{Daily rate of consumed food} = \frac{W}{dl}$$

Where:

W = is the average of weight of consumed food by one larva during each instar period.

d = is the number of days of the instar larva

l = is the average weight of each larva at the end of each feeding period.

The same steps were repeated with every instar larvae and with control.

RESULTS AND DISCUSSION

The activity of the tested two IGRs on the percent mortality and the pupation of the 2nd and the 4th instar larvae of *S. littoralis* were recorded in Tables 1, 2 and 3. Also, the daily rate of consumed food against the 4th, 5th, and 6th instars was evaluated in table 4.

1. Larval mortality:

Data presented in Table (1) showed the toxicity of the tested compounds on the 2nd and the 4th instar larvae of *S. littoralis* fed on treated leaves for 48 hrs. and on untreated leaves for 3 days more (5 days for every interval). The tested compounds were highly effective at zero time interval (initial kill after 5 days) recording 95 and 99 with diflubenzuron and lufenuron respectively on the 2nd instar larvae and recorded 91 and 97 with diflubenzuron and lufenuron respectively on the 4th instar larvae of *S. littoralis*

Table (1): The percentage of initial kill and the residual effect of insecticide growth regulators (IGRs) against the 2nd and the 4th instar larvae of *S. littoralis*.

Instar larvae	Compound	Rate/fed.	The initial kill		The residual effect							
			2 days	5 days	7days post treatment		14days post treatment		21days post treatment		The average of residual effect	
					2 days	5 days	2 days	5 days	2 days	5 days	2 days	5 days
The 2nd instar larvae	Diflubenzuron	125 ml	44	95	37	86	29	77	22	71	29.3	78
	Lufenuron	160 ml	57	99	51	99	41	98	32	96	41.3	97.6
The 4th instar larvae	Diflubenzuron	125 ml	35	91	28	90	22	80	18	68	22.6	79.3
	Lufenuron	160 ml	54	97	41	92	35	88	28	83	34.6	87.6

These results were similar to that obtained by Ibrahim and Barakat (1991 – 1992) who mentioned that some insect development inhibitors synthesis such as chlorfluazuron, triflumuron induced 100 % mortality against 4th instar larvae of *S. littoralis* when fed for 48 hrs. on treated leaves and 3 days on untreated leaves. The same results were obtained by El-Seady *et al.*

(1998) who mentioned that the initial effect (3 days after treatment) of IGR chlorofenapyr was good and the reduction percentage was 95 %.

After 7 days interval, it was also observed that diflubenzuron and lufenuron were still highly effective and causing 86 and 99 percent mortality respectively with the 2nd instar larvae and were 90 and 92 % mortality with diflubenzuron and lufenuron respectively in case of the 4th instar larvae of *S. littoralis*.

After 14 days interval the percentage of cumulative mortality were 77 and 98 with diflubenzuron and lufenuron respectively on the 2nd instar larvae of *S. littoralis* and were 80 and 88 % mortality in case of the 4th instar larvae.

At 21 days interval, the percentages were 71 and 96 on the 2nd instar larvae and were 68 and 83 on the 4th instar larvae with diflubenzuron and lufenuron respectively.

These results were similar to that obtained by Korkor *et al* (1996) who mentioned that chlorfluazuron and flufenoxuron decreased the % mortality to 55.10 and 66.33 % mortality, respectively, when larvae were fed on leaves treated with them.

It was observed that the 2nd and the 4th instar larvae of *S. littoralis* seem to be more susceptible to lufenuron than diflubenzuron during each interval.

El-Seady *et al.* (1998) indicated that no significant difference was found between the IGR chlorofenapyr and other insecticides (lannet and Quack), where the percentage of reduction was 93 % compared with 94.3 and 94.5 for the other insecticides, respectively at the residual effect (5 – 7 days).

Table (2) illustrated the average percent mortality of the initial kill and the residual effect of the (IGR)s, diflubenzuron and lufenuron on the 2nd and 4th instar larvae on the 5th day of each interval. Data showed that the tested compounds (diflubenzuron and lufenuron) gave high initial kill with long residual effect against the 2nd and the 4th instar larvae of *S. littoralis* where the mean initial kill to the two instars larvae were 93 and 98 % in case of diflubenzuron and lufenuron respectively, while the residual effect were 78.6 and 92.6 % with diflubenzuron and lufenuron respectively. Similar results were obtained by Attia et al., (1984) and Morsi (1985), who found that IKI 7899 gave high initial kill with long residual effect against the 4th instar larvae of *S. littoralis*.

Table (2): Average of percent mortality for the effecting of the two (IGRs) on the 2nd and the 4th instar larvae.

Compound	Rate/fed.	% mortality of the initial kill			Average of % mortality of the residual effect			General average of two instars larvae
		The 2nd instar larvae	The 4th instar larvae	Average of the two instars	The 2nd instar larvae	The 4th instar larvae	Average of the two instars larvae	
Diflubenzuron	125 ml	95	91	93	78	79.3	78.6	85.8
Lufenuron	160 ml	99	97	98	97.6	87.6	92.6	95.3

2. Percent of pupation:

Table (3) illustrated the effect of feeding the 2nd and the 4th instar larvae of *S. littoralis* on treated leaves with two IGRs for 2 days and on untreated leaves till pupation on the percent of pupation.

Data showed that diflubenzuron induced zero % pupation after zero time of application on the 2nd instar larvae and 11.1 % on the 4th instar larvae, while lufenuron induced zero % pupation with the two instars larvae comparing with the larvae which feeding with untreated leaves where the % pupation were 91.7 and 89.5 % with the 2nd and the 4th instar larvae respectively. After 7 days post treatment, lufenuron was the highest effective toxicant in this respect where it prevented larvae to reach pupal stage on the two instar larvae, while the percent of pupation were 7.1 % and 20.0 % with diflubenzuron on the two instars larvae comparing with control, where the percent pupation were 89.4 and 86.3 % to the 2nd and the 4th instar larvae respectively.

After 14 days post treatment the percent of pupation reached 13.0 % and 25 % with diflubenzuron on the 2nd and the 4th instar larvae respectively, while lufenuron gave zero and 16.6 % pupation on the 2nd and the 4th instar larvae respectively, while control induced 83.3 % and 86.1 % pupation on the two instar larvae respectively.

Similar results were obtained by Korkor *et al.* (1996) who found that chlorofluazuron and flufenxuron were the highest effective toxicants, where they prevented treated larvae to reach pupal stage for 15 and 18 days post treatment.

After 21 days post treatment diflubenzuron gave 20.7 % and 31.2 % pupation with the 2nd and the 4th instar larvae, while lufenuron gave 25 % and 23.5 % pupations for the two instars respectively. Control in this interval induced 80.6 % and 83.1 % pupation with the 2nd and the 4th instar larvae respectively. These results were agree with that obtained by Radwan *et al.* (1985a) who found that the subsequent developed of treated 4th instar larvae of *S. littoralis* with IKI 7899, XRD 473, DowCo – 439 and Dimilin was highly prevented, where pupation was greatly reduced.

Similar results were obtained by Awad *et al.* (1990), who metioned that the 4th instar larvae of *A. ipsilon* fed treated leaves with XRD 473 for 48 hrs exhibited significant reduction in percent of pupation.

Table (3): Effect of feeding, the 2nd and the 4th instar larvae of *S. littoralis* on treated leaves with two (IGRs), Diflubenzuron and Lufenuron on percent pupation.

The instar larvae	Compound	Rate/fed.	Zero time post treatment			7 days post treatment			14 days post treatment			21 days post treatment		
			No. of survival larvae	No. of pupae	% pupation	No. of survival larvae	No. of pupae	% pupation	No. of survival larvae	No. of pupae	% pupation	No. of survival larvae	No. of pupae	% pupation
The 2nd instar larvae	Diflubenzuron	125 ml	5	0	0	14	1	7.1	23	3	13	29	6	20.7
	Lufenuron	160 ml	1	0	0	1	0	0	2	0	0	4	1	25
	Control		96	88	91.7	94	84	89.4	96	80	83.3	93	75	80.6
The 4th instar larvae	Diflubenzuron	125 ml	9	1	11.1	10	2	20	20	5	25	32	10	31.2
	Lufenuron	160 ml	3	0	0	8	0	0	12	2	16.6	17	4	23.5
	Control		95	85	89.5	96	83	86.3	94	81	86.1	89	74	83.1

3. Food response:

The results which are shown in Table (4) represented the average of daily rate of consumed food with (IGRs) diflubenzuron and lufenuron by the 4th, 5th, and 6th instar larvae of *S. littoralis*. Data indicated that significant differences were observed between control and other treatments, where the daily rate of consumed food by the 4th instar larvae were 0.816, 0.672 and 1.66 mg/larva/day to diflubenzuron and lufenuron and control respectively. Significant differences were recorded also between the two treatments and control in case of the 5th instar larvae of *S. littoralis*, where the consumed food were 0.958, 0.734 and 1.22 mg/larva/day with diflubenzuron, lufenuron, and control respectively. The same results were observed with the 6th instar larvae, where the daily rate of consumed food were 1.256, 1.396 and 1.966 with diflubenzuron and lufenuron and control respectively. These results agreed with the results obtained by Taman (2002) who mentioned that after 48 hrs, feeding high concentration of quercetin against 4th and 5th instar larvae of *S. littoralis* showed a significant decrease in the consumed food/larva/ day compared with that of control. Gomaa *et al.* (1996) mentioned that diafenthiuron revealed great reduction in areas consumed (33.3 %) and buprofezin treatment showed a slight reduction for the food response (7.4 %).

Table (4): The average daily rate of consumed food treated with diflubenzuron and lufenuron for two days and untreated leaves till pupation by the 4th, 5th, and 6th instar larvae of *S. littoralis*.

Instar larvae	Treatment	Average of 4 replicates			
		W	L	D	W/LD
4th instar	Diflubenzuron	1.369	0.146	11.5	0.816 b
	Lufenuron	1.288	0.187	10.25	0.672 a
	Control	5.588	0.384	9.0	1.616 c
5th instar	Diflubenzuron	1.302	0.194	7.0	0.958 b
	Lufenuron	1.176	0.213	7.5	0.734 a
	Control	2.6	0.341	6.0	1.22 c
6th instar	Diflubenzuron	1.238	0.219	4.50	1.255 a
	Lufenuron	1.708	0.288	4.25	1.396 b
	Control	2.832	0.384	3.75	1.966 c

Where:
W = is the average weight of consumed food by one larva during each instar period.
L = is the average weight of each larva at the end of each feeding period.
D = is the number of days of the instar larvae.

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تقدير كفاءة أثنين من منظمات النمو الحشرية على دودة ورق القطن المصرية وكذلك دراسة التأثير المتأخر على نسبة التعذير وعلى المعدل اليومى من الغذاء المستهلك

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أجريت التجربة فى مزرعة محطة البحوث الزراعية بسخا وذلك بغرض تقييم كفاءة أثنين من منظمات النمو الحشرية وهما الداى فلوبنزيورون والليوفينيورون على نسبة الموت وكذلك نسبة التعذير على كل من العمرين الثانى والرابع من دودة ورق القطن بعد تغذيتهم على ورق معامل لمدة ٤٨ ساعة ثم تغذية المتبقى من اليرقات على ورق غير معامل حتى الوصول إلى طور العذراء، وكانت تتم تغذية اليرقات على أربعة مراحل مختلفة وهى (صفر، ٧، ١٤، ٢١ يوماً) من رش المركبات. كذلك أختبر تأثير هذه المركبات على المعدل اليومى من الغذاء المستهلك على كل من الأعمار الرابع والخامس والسادس.

وقد أوضحت النتائج مايلى:-

١- أعطى المركبان تأثير عالى الفعالية عند زمن صفر من المعاملة (التأثير الفورى) حيث كانت نسبة الموت ٩٥ ، ٩٩ % على العمر الثانى من دودة ورق القطن مع الداى فلوبنزيورون و الليوفينيورون على التوالى بينما كانت نسبة الموت حوالى ٩١ ، ٩٧ % على التوالى بالنسبة للعمر الرابع.

٢- أما بالنسبة لتأثير المتبقى الفعال على دودة ورق القطن وذلك عند الفترات الزمنية (٧، ١٤، ٢١ يوماً من الرش) فقد أوضحت النتائج أن الداى فلوبنزيورون اعطى نسبة موت ٧٨ ، ٧٩,٣ % مع كل من العمرين الثانى والرابع على التوالى ، بينما أعطى مركب ليوفينيورون نسبة موت ٩٧,٦ ، ٨٧,٦ % مع كل من العمرين الثانى والرابع على التوالى.

٣- أوضحت النتائج أيضاً أن مركب داى فلوبنزيورون أعطى نسبة تعذير بمقدار صفر% على العمر الثانى و ١١,١ % على العمر الرابع ، بينما أعطى مركب ليوفينيورون نسبة تعذير بمقدار صفر % على كل من العمرين الثانى و الرابع بالمقارنة بالكنترول حيث كانت نسبة التعذير حوالى ٩١,٧ % للعمر الثانى و ٨٩,٥ % على العمر الرابع وذلك فى الإبادة الفورية.

٤- أما بالنسبة للمعدل اليومى من الاستهلاك الغذائى فقد وجد أنه هناك اختلافات معنوية بين الكنترول وباقى المعاملات على كل من الأعمار الرابع والخامس والسادس من دودة ورق القطن.