EFFECTIVENESS OF SOME BENZOYLPHENYLUREAS ON THE LARVAE OF THE SPINY BOLLWORM *EARIAS INSULANA* (BOISD.)

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Abstract

Hexaflumuron, chlorfluazuron and flufenoxuron were laboratory tested for their efficacy against larvae of the spiny bollworrn, *Earias insulana* (Boisd.). The compounds were incorporated at different concentrations in artificial diet. One-day-old and five-day-old larvae were introduced to the treated diets until pupation and adult emergence. Results obtained indicated that hexaflumuron was active at 0.5, 0.25 ppm and 0.75, 0.5 ppm against one and five-day old larvae, respectively. At the same larval instars, chlorfluazuron was active at 0.75, 0.5 ppm and 1.5, 0.75ppm, respectively. Flufenoxuron was active at 0.75, 0.5 ppm to one- and five-day old larvae. The results revealed that, one-day old larvae were more susceptible to all tested compounds than five-day old larvae, when cotton bolls were dipped in the compounds. Results showed that only 3 % and 8 % of the larvae penetrated inside the bolls with 0.5 and 0.75 ppm of hexaflumuron, respectively; while 75 % penetrated inside the untreated bolls.

INTRODUCTION

The spiny bollworm, *Earias insulana, is* a serious pest of cotton in Egypt and neighbouring countries. Larvae damage buds easily in the growing season and squares and bolls later in the season. In all areas of Egypt where cotton is grown, insecticides are used in controlling cotton pests. The heavy use of insecticides is causing many environmental hazards. The recent discovery of a new class of chemicals such as the chitin synthesis inhibitors has led many investigators to test their efficacy against a wide

variety of insect pests (Ascher & Nemny, 1976; Ascher *et al.,* 1979; Haga *et al.,* 1982; Moawad *et al.,* 1990, Hussin, 1992; El-Nemaky, 2000; Shalaby & Tawfik 2001; Shalaby, 2002).

In the current work, laboratory experiments were carried out to evaluate and detect the susceptibility of the spiny bollworm, *Earias insulana* to three insect growth regulators; hexaflumuron, chlorfluazuron and flufenoxuron against one- and five-day old larvae.

MATERIALS AND METHODS

Chemical used: The following formulations of materials were used in this study :

1- **Hexaflumuron 10%** emulsifiable concentrate.

2- 1- [(4-chlrophenyl) 3-(2,6-difluorobenzoyl] urea.

2- **Chlorfluazuron 5%** emulsifiable concentrate.

N-[4-(3-chloro-5 triflumuromethyl -2-pyridyloxy)-3,5-dichlorophenyl]-N-(2,6-difluorobenzoyl) urea.

3- **Flufenoxuron 10%**

l-[4-(2-chloro-α-α-α-trifluoro-p-tolyloxy)-2-fluorophenyl)-3-(2,6diflurobenzoyl) urea.

Rearing procedure: The spiny bollworm, *Earias insulana* larvae were obtained from infested cotton bolls. Full-grown larvae were transferred to clean Petri-dishes containing a soft layer of cotton and held at 27±1°C and 80-85% R.H. until pupation. The pupae were isolated daily and kept under the same conditions. Oviposition was studied by confining newly emerged moths in lamp-shape glass cages provided with 10 % sugar solution, the cage were covered with muslin secured with rubber bands and their bottoms were covered with screening mesh stimulating the egg laying response in the females. Eggs were deposited through the screening mesh on a piece of paper placed under the cage in an open Petri dish that served as oviposition site. The cages were maintained at 27°C and 80-85 % R.H. and were examined daily for collecting eggs. Muslin cloth containing eggs

were kept in glass jars 12 x 3.5 cm and covered with piece of cotton wool until hatching. Newly hatched larvae were fed individually in glass vials (2 x 7.5 cm) filled to one third with the artificial diet, covered with absorbent cotton and held in the same conditions. The vials were examined daily and individual pupae were transferred to clean vials for incubation until moth emergence.

Diet preparation: The semi-artificial diet in this study was based on kidney beans and was prepared according to the method of Rashad and Ammar (1985).

Method of application: In order to study the effect of the compounds against larvae of *E. insulana* in the diet, one and five-day old larvae were selected from the mass culture. The three tested compounds were incorporated into the diet as aqueous dilutions at the desired concentrations during the preparation of the diets. After gelling, the media were transferred into glass tubes (10cm height, x 2 cm diam.), 25 tubes were being used per concentration. The larvae of one and five-days old were transferred carefully to each tube. The larvae were fed on treated diet for 24 hours and then transferred to untreated diet till pupation. The same number of larvae that fed on untreated diet were used as untreated check. Insects were recorded as follows : death prior to moult, defective larvae, defective pupae, dead pupae and malformed adults, each test was repeated five times.

Effect of the compounds which used on cotton bolls: Bolls of cotton were collected from the field and immersed briefly in various aqueous dilutions of the compounds. The bolls were allowed to dry and then put in glass jars 12 x 3.5 cm, two bolls per jar. Two 5-day old larvae were introduced to each jar and the jars were covered with muslin. Five jars were considered one replicate. Each replicate was repeated five times. The number of larvae which were unable to penetrate into the bolls was recorded.

RESULTS AND DISCUSSION

The results obtained of feeding E. *insulana* larvae on diet incorporated with the moulting inhibitors are summarized in Table 1.

Data in Table 1 show the cumulative mortality and abnormalities during larval, pupal and adult stages. The results indicated that the great percent of mortality occurred during the larval stage, followed by pupal and adult stages for one and five old ages. There are positive correlations between larval mortality and the concentration of all compounds. The larvae were unable to change the old skin and head capsule leading to larval mortality. The one day-old larval instars were more sensitive to all concentrations of the tested compounds as compared with that of five-day old larvae. The percentage mortality for one- and five-day old larvae were (35 %, 29 %), (33.30 %, 21.30 %) and (45 %, 28 %) for hexaflumuron, chlorfluazuron and flufenoxuron, respectively. Hexaflumuron produced 100 % kill against one and five day old larvae at concentrations 0.75 and 1.5 ppm. While chlorfluazuron produced 100 % to the same larval stages at concentrations 1.5 and 2.5 ppm. Flufenoxuron gave 100 % kill at the concentration to the same larval instars.

As for the pupal stage, there was no correlation between the concentration and percentage of mortality or abnormalities in all cases. No latent mortality occurred as a result of larval treatment. There was no correlation between the adult deformity and the concentration of the compound.

When one and five-day old larvae were fed on artificial diet treated with hexaflumuron at the concentrations 0.75, 0.5, 0.25 and 0.1 ppm, percentages of adult inhibition were 100, 98, 77 & 49.25 %and 90.25, 62.50, 64.50 & 38.50 %, respectively. Flufenoxuron at the same concentrations inhibited adult emergence resulting from feeding 1 day-old larvae by 98, 76, 80.5 and 52.26 %, respectively, while the corresponding values for one day-day old larvae were 98, 84.5, 66.5 and 39 %, respectively. In case of

chlorfluazuron, the feeding of one and five-day old larvae on the same concentrations resulted in adult inhibition by 93.75, 75, 62.50 & 47.15 % and 80.5, 66, 50.5 & 31.25%, respectively.

Based on the LCso value of the compounds used, *i.e.* hexaflumuron, chlorfluazuron and flufenoxuron against one-day old larvae and five-day old larvae of the spiny bollworm E. *insulana,* it could be indicated that hexaflumuron was more toxic than chlorfluazuron and flufenoxuron in larval stage of one-day old larvae. LC50 value of hexaflumuron was 2.1, while LC50 value of flufenoxuron was 2.5. Whereas in the pupal stage, chlorfluazuron was more toxic than other compound, where LC50 value was 313.3. Hexaflumuron was more toxic in larval stage of five-day old larvae, where LC50 value was 3.1, whereas flufenoxuron was more toxic in the pupal stage of five-day old. LC50 value of flufenoxuron was 195.5.

In general, the tested urea derivatives; hexaflumuron, chlorfluazuron and flufenoxuron prevented the development of *E. insulana* when fed on treated diet at different concentrations. *E. insulana* showed various morphological abnormalities in response to the tested compounds. The three compounds produced similar deformities in larvae, pupae and adults. There was no positive correlation between the concentration and percentages of aberrations during the different stages for compounds. Deformity percentage was high in larvae. The observed larvicidal activity is attributed to disruption of chitin deposition. Larvae lost some fluid, gradually blackened and finally died.

Penetration of larvae inside cotton bolls treated with different concentrations of chlorfluazuron, hexaflumuron and flufenoxuron is shown in Table 2. The results showed that hexaflumuron which was the most effective in artificial diet experiments had a repellent effect, thus prohibiting larvae from penetrating the bolls. The two highest concentrations 0.5 and 0.75 ppm prevented 97 and 92 % of the larvae to penetrate inside the treated bolls, while in the untreated bolls, 75 % of the larvae were able to penetrate.

Table 1. The *effect* of insect growth regulators on one and five day old larvae of *Earias insulana fed on* a semi - artificial diet treated with different concentrations.

Compound	Conc.	% of insect effect according to critical stage														
		One - day old larvae								Five - day old larvae						
		Larvae			Pupae			Adult	Cum.	Larvae			Pupae			Adult	Cum.
		Dead	Defec-ted	LC_{50}	Dead	Defec-ted	LC_{50}		mort-ality %	Dead	Defec-ted	LC_{50}	Dead	Defec-ted	LC_{50}	Defec-ted	mort-ality %
Hexaflumuron	0.1	30.0	5.0		4.25	2		–	49.25	16.5	12.5		7.5	2.5		–	38.5
	0.25	41.0	16.5		7.0	7.5		5.0	77.0	39.5	14.0		6.0	–		5.5	64.5
	0.5	84.0	5.0	2.1	5.0	4.0	325.8	–	98.0	70.0	17.5	3.1	–	–	332.7	5.0	92.5
	0.75	82.0	7.5		–	5.0		5.5	100.0	80.5	5.75		4.50	–		–	90.25
	1.5	100	–		–	–		–	100.0	95.0	5.0		–	–		–	100
Chlorfluazuron	0.1	21.25	12.5		6.25	7.50		–	47.5	12.50	9.25		5.5	–		4.0	31.25
	0.25	40.0	15.0		5.0	2.5		–	62.5	35.00	5.5		5.0	–		5.0	50.5
	0.5	50.0	5.0	17.5	10.0	10.0	313.3	–	75	35.50	10.5		5.0	9.5	297.1	5.0	66.0
	0.75	70.0	6.25		11.25	1.25		5.0	93.75	60.00	5.0	148.3	10.5	5.0		–	80.5
	1.5	*85.0*	7.5		*2.5*	*5.0*		–	100.0	*80.00*	–		*5.0*	–		–	*85.5*
	2.5	100	–		–	–		–	100.0	95.00	–		–	–		–	100
Flufenoxuron	0.1	40.0	5.0		4.2	3.0		–	52.2	15.0	13.0		7.5	3.5		–	39
	0.25	45.0	15.0		6.0	8.5		5.0	80.5	40.0	15.0		6.0	–		5.5	66.5
	0.5	66.0	3.0	2.5	3.0	–	325.7	4.0	76.0	61.0	18.5	3.3	–	–	195.5	5.0	84.5
	0.75	85.0	5.0		4.0	1.0		3.0	98.0	80.0	15.0		–	3.0		–	98
	1.5	100.0	–		–	–		–	100.0	100.0	–		–	–		–	100

* Cum. : Cumulative mortality .

Table 2 . Mortality percentages of 5-day old larvae of *Earias insulana* on cotton bolls treated with different concentrations of urea derivatives

Compound	Concentration (ppm)	Percent (+ SE) of larvae unable to penetrate into the cotton bolls
Hehaflumuron	0.5	97±2.6
	0.75	92±5.5
Chlorfluazuron	2.5	94±2.6
	1.5	87±1.1
Fluefenoxuron	1.5	95±5.5
	0.75	91±2.6

These results are in a.greement with the findings of Ishaaya *et al.* (1984). They found that chlorfluazuron prevented adult emergence of *Spodoptera littoralis*. Meisner *et al.* (1986) found that chlorfluzuron and Dimilin were more effective against five-day old larvae of spiny bollworm. El-Nemaky (2000) found that chlorfluazuron was effective against the newly hatched larvae of the pink and spiny bollworms.

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فعالية بعض مركبات البنزويل فينايل يوريا ضد يرقات دودة اللوز الشوكية

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أختبرت فعالية مركبات كونصلت ، أتابرون ، كاسكيد ضد يرقات دودة اللوز الشوكية ، معمليا علي بيئة صناعية مختلطة بتركيزات هذه المركبات ٠ عرضت اليرقات عمر يوم واحد وخمسة أيام للبيئة الغذائية المعاملة لمدة ٤٢ ساعة مع كل تركيز علي حدة ، ثم نقلت بعد ذلك علي بيئة غير معاملة حتي التعذير وخروج الفراشات الكاملة ٠ أظهرت النتائج أن مركب كونصلت كان فعالا عند تركيز ٠,٥ و ٠,٢٥ و ٠,٥ و ٠,٧٥ جزء في المليون ضد يرقات العمر الأول والخامس بالترتيب ؛ بينما في نفس أعمار اليرقات أعطي الأتابرون أعلي كفاءة عند تركيز ٠,٥ و ٠,٧٥ و ١,٥ و ٠,٧٥ جزء في المليون بالترتيب ٠ ، أما مركب الكاسكيد قد أعطي نتائج عند تركيز ٠,٥ و ٠,٧٥ جزء في المليون ليرقات عمر يوم واحد وعمر خمسة أيام ٠ وقد أظهرت النتائج أن يرقات عمر يوم واحد كانت أكثر حساسية للمركبات المختبرة عن اليرقات عمر خمسة أيام ٠ وعند عمر لوز القطن في تركيزات المركبات المختبرة وعرضت ليرقات العمر الخامس أظهرت النتائج أن ٣ % و٨% من اليرقات تمكنت من اختراق اللوز مع تركيز ٠,٥ و ٠,٧٥ جزء في المليون لمركب الكونصلت بالترتيب ، بينما كانت نسبة اختراق اليرقات للوز غير المعامل ٥٧% ٠