EFFECT Of CERTAIN INSECTICIDES ON THE PIOTIC POTENTIAL OF THE COTTON LEAFWORM, *SPODOPTERA LITTORALIS* (BOISD.)

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Abstract

Treated leaves of Castor bean oil with Lc50 and Lc25 of Diflubenzuron were offered to 4th instar larvae of cotton leafworm, *Spodoptera littoralis* (Boisd.) for 48 hours . The percentage of mortality showed 60.71 % and 33.92 % respectively . The larval period was increased with 60.01 % and 37.5 % - The increase of pupal period showed 55.5 % and 42.67 % - Data gave an increase of the pre- oviposition period with 200.54 % , 81.96 % and decrease of pupal weight with 27.84 % , 14.76 % . The abnormal percentage of pupl stage reached 55.23 % and 32.14 % , while the abnormal percentage of moths stage increased with 41.67 % and 19.04 % . The number of eggs / female reduced by 86.27 % , 79.48 % ,while sterility percentage reached 90.32 % , 82.37 % compared with control . While, treated leaves of castor bean oil with Lc50 and Lc 25 of *B*acillus *thuringiensis* against 2nd instar larvae after feeding 48 hours proved the following : The percentage of mortality 72.41 % and 51.72 % . The larval period increased with 24.74 % , 13.31 % . Increase the pupal period with 38.5 % and 10.80 % . Increase the pre- oviposition period with 237.91 % and 115.16 % . Decrease pupal weight with 21.23 % , 14.60 % - Increase the abnormal percentage of pupa stage with 72.08 % and 26.57 % - Increase the abnormal percentage of moths stage with 70.83 % and 39.60 % - Reduce the number of eggs / female by 92.42 % and 84.79 % . Sterility percentage with 93.80 % , 86.74 % compared with control . Data revealed that Lc50 and Lc25 of Lettuce oil extract after 48 hours of feeding 2nd instar larvae on treated castor bean oil leaves increased the following : The percentage of mortality reached 67.24 % and 62.06 % . The larval period was decreased to 27.34 % , 12.57 % . The pupal period showed an decrease with 33.93 % , 14.91 % - decrease the pre- oviposition period with 57.97 % , 31.59 % - Increase pupal weight with 35.39 % , 30.97 % - Increase the abnormal percentage of pupa stage with 51.25 % , 12.39 % - Reduce the number of eggs / female by 85.93 % , 80.47 % - and didn't effect on moths , hatchability and sterility . compared with control .

INTRODUCTION

The cotton leafworm , *S. littoralis* is one of the most 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 enviroment and developed tolerance acquired by its successive generations subjected to insecticides .

Insect growth regulatrous (IGRS) are insecticides acting on various insect orders by disrupting chitin synthesis . The major effect of members of these 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 , Aly (1994), Gomaa et al .(1996) and Korkor et al. (1996).

The wide use of the chemical compounds has resulted many problems such as population outbreaks and chemical resistance, endangering human health and wealth. Therefore, the world decided to reduce chemicals use and tried to introduce predators and biocontrol agents such as virus, bacteria and fungi for controlling the pests through I.P.M. Programs. The present study was carried out to evaluate the sublethal doses of *B. thuringiensis* (agrein) , lettuce oil extract and diflubenzuran (I.G.R.) on some biological aspects of 2^{nd} and 4^{th} instar larvae of cotton leafworm , compared with profenofos .

MATERIALS AND METHODS

1. Chemical tests:

1.1. Insecticides: Organophosphorus insecticides: Profenofos (**Acron**, 72% E.C.)

1.2. Pyrethroids: **Lambda-cyhalothrin (**Lambda, 5% E.C.**)**

1.3. Insect growth regulators (I.G.R.): Diflubenzuron (Demeron, 10% E.C.)

2. Bacterial insecticides (biocide): *Bacillus thuringiensis*.
Agerin, 6.5% WP (contain 32000 IU/mg**) .**

3. Plant extracts: Oil extraction from lettuce leaves

Fifty grams of untreated lettuce plants *Lactuca sativa* (L.) were collected from Kafr El-Sheikh Farm then washed with distilled water to clean it from different soil wastes. Leaves were kept at room temperature to dry .

Dried leaves were cut into small parts and then were extracted with petroleum ether in a Blender at high speed and at room temperature. The petroleum ether extract was then filtered on a filter glass G4. The residues on the filter glass were washed twice with 50 ml of petroleum ether. The filtrates were combined and evaporated into a rotatory evaporator to dryness. The crude oil extract was cleaned on a chromatographic column using a granulated florisil (60-80^{o} mesh) and eluted with a mixture of acetone-petroleum ether (1: 3 v:v). The elution were combined and

evaporated in a vacuum rotatory evaporator to eliminate the solvents used in the above steps. The obtained oil was used in different experimental tests.

4. Laboratory strain of cotton leafworm:

Laboratory strain of cotton leafworm, *S - littoralis* were obtained from Agriculture Research Center at Kafr El-Sheikh, reared for several generation on castor bean oil leaves (*Ricinus communis*) under controlled conditions of 26 $\pm$ 2°C and 65 $\pm$ 5% RH.

5. Effect on some biological aspects of *S. littoralis*

This study was conducted to evaluate the effect of diflubenzuran (I.G.R.) on some biological aspects of the 4th instar larvae of *S. littoralis*, while *B. thuringiensis* (agerin) and lettuce oil extract were evaluated against 2nd instar larvae.

Diflubenzuron, *B. thuringiensis* and lettuce oil extract were tested at LC_{50} and LC_{25} concentration . Twenty larvae were placed into a glass jars and reared on treated castor leaves for 48 hours. Each treatment was replicated three times. The exposed larvae were transferred into a clean jars and then provided with untreated castor bean oil leaves until pupation.

Larvae were examid daily for mortality percentage, larval and pupal duration, percent of pupation, pupal weight, malformation in either pupal and adult stage, pre-oviposition period, hatchability and sterility of adult females . Percent sterility was calculated using Chamberlain formula (1962) which was modified by Toppozada *et al.* (1966) as follows:

$$\% \text{ sterility} = 100 - \frac{a \times b}{A \times B} \times 100$$

Where:

a = number of eggs laid/female in treatment.

b = % of hatchability in treatment.

A = number of eggs laid/female in untreated control.

B = % of hatchability in untreated control.

Equations used for estimating different bio-metric records of *S. littoralis*

1. Pupation % = $\frac{\text{Total number of pupae}}{\text{Total number of treated larvae}} \times 100$

2. Pupal malformation % = $\frac{\text{Number of abnormal pupae}}{\text{Number of (normal + abnormal) pupae}} \times 100$

3. Abnormal moths emergence % = $\frac{\text{Number of abnormal moths}}{\text{Total number emergent moths}} \times 100$

4. Reduction percent of pest numbers % = $100\ [1-\frac{T}{C}]$

5. Increment percent of pest numbers % = $100\ [\frac{T}{C}-1]$

Where:

T = Pest number in the treatment

C = Pest number in the control.

According to El-Dewy (2006).

RESULTS AND DISCUSSION

Data presented in Tables (1 and 2) showed that diflubenzuron at LC_{50} and LC_{25} levels exhibited (60.71%, 33.92%) mortality against 4th instar larvae. While *B. thuringiensis* (agerin) and lettuce oil extract showed (72.41%, 51.72%) and (67.24%, 62.06%) mortality against 2nd instar larvae, respectively.

Table 1 . Effect of agerin and lettuce oil extract on biotic potential of different stages of *S. littoralis* feeding as 2nd instar larvae .

Organic compounds		Agerin		Lettuce oil extract		Control
Developmental stages		LC_{25} (9.5×10^3 ppm)	LC_{50} (19.3×10^3 ppm)	LC_{25} (2.4×10^4 ppm)	LC_{50} (3.64×10^4 ppm)	
1	Mortality (%)during larval stage	51.72	72.41	62.06	67.24	3.34
2	Larval stage (days)	39.66±1.15 (+13.31)	43.66±1.15 (+24.74)	30.6±1.52 (-12.57)	25.43±1.52 (-27.34)	35±1
3	Pupal stage (days)	24.00±1 (+10.80)	30.00±2 (+38.50)	18.43±0.57 (-14.91)	14.31±1.52 (-33.93)	21.66±0.57
4	Pre-oviposition period (days)	13.62±2.08 (+115.16)	21.39±2.08 (+237.91)	4.33±0.57 (-31.59)	2.66±0.57 (-57.97)	6.33±0.57
5	Average weight of pupae (gm)	0.193±0.008 (-14.60)	0.178±0.004 (-21.23)	0.296±0.005 (+30.97)	0.306±0.006 (+35.39)	0.226±0.004
6	Pupation (%)	46.66 (-51.73)	26.66 (-72.42)	36.66 (-62.03)	31.66 (-67.24)	96.66
7	Abnormal pupae (%)	26.57 (+26.57)	72.08 (+72.08)	12.39 (+12.39)	51.25 (+51.25)	0.0
8	Abnormal moth (%)	39.60 (+39.60)	70.83 (+70.83)	0.0	0.0	0.0
9	Total number of eggs/female	132.5±37.5 (-84.79)	66.0±34 (-92.42)	170.1±25.5 (-80.47)	122.50±22 (-85.93)	871.2±20
10	Hatchability (%)	87.16 (-12.84)	81.81 (-18.19)	100	100	100
11	Sterility (%)	86.74	93.80	0.0	0.0	0.0

Numbers between brackets represent percent increase or decrease than control.
Means ± SD

Table 2 . Effect of diflubenzuron on biotic potential of 4th instar larvae of *S. littoralis*.

Organic compound / Developmental stages		Diflubenzuron (I.G.R.)		Control
		LC_{25} (4.8 ppm)	LC_{50} (11.39 ppm)	
1	Mortality (%) during larval stage	33.92	60.71	6.67
2	Larval stage (days)	36.66±1.15	42.66±3.05	26.66±0.57
		(+37.50)	(+60.01)	
3	Pupal stage (days)	36.14±1.15	39.39±1.52	25.33±1.15
		(+42.67)	(+55.50)	
4	Pre-oviposition period (days)	6.66±0.57	11.00±1	3.66±0.57
		(+81.96)	(+200.54)	
5	Average weight of pupae (gm)	0.202±0.008	0.171±0.01	0.237±0.01
		(-14.76)	(-27.84)	
6	Pupation (%)	61.66	36.66	93.33
		(-33.94)	(-60.72)	
7	Abnormal pupae (%)	32.14	55.23	0.0
		(+32.14)	(+55.23)	
8	Abnormal moth (%)	19.04	41.67	0.0
		(+19.04)	(+41.67)	
9	Total number of eggs/female	152.4±23	102.0±15	743±57
		(-79.48)	(-86.27)	
10	Hatchability (%)	83.59	68.62	97.30
		(-14.09)	(-29.47)	
11	Sterility (%)	82.37	90.32	0.0

Numbers between brackets represent percent increase or decrease than control.
Means ± SD

Effect on larval duration

Tables (1 and 2) indicated that effect of feeding 4th instar larvae (in case of diflubenzuron) and 2nd instar larvae (in case of *B. thuringiensis* and lettuce oil extract) on treated castor bean leaves at LC_{50} and LC_{25} on larval duration. It is obvious that

tested compounds (diflubenzuron and B.t Agerin) significantly prolonged the larval duration than control.

Regarding diflubenzuron, it increase the larval period by 60.01% and 37.5% at LC_{50} (11.39 ppm) and LC_{25} (4.8 ppm), respectively. In case of *B. thuringiensis* (agerin), the larval duration was extended by 24.74% and 13.31% for the 2^{nd} instar larvae at two tested levels, LC_{50} (19.3 x 10^3 ppm) and LC_{25} (9.5 x 10^3 ppm) respectively.

The above mentioned results proved that diflubenzuron (I.G.R.'s) seem to be more effective in increasing larval duration than *B. thuringiensis*.

While, 2^{nd} instar larvae (in case of lettuce oil extract) at LC_{50} (3.64 x 10^4 ppm) and LC_{25} (2.4 x 10^4 ppm) levels reduced the larval duration by 27.34% and 12.57% comparing with that of control, respectively.

Effect on pupal duration

Tables (1 and 2) showed the effect of feeding 4^{th} instar larvae (in case of diflubenzuron) and 2^{nd} instar larvae (in case of *B. thuringiensis* and lettuce oil extract) on treated castor bean leaves at LC_{50} and LC_{25} levels on duration of the resulting pupae. It is obvious that (diflubenzuron and *B. thuringiensis*) significantly prolonged the duration of pupal period than that of the untreated check . The effect of diflubenzuron , showing an increase in the pupal period by 55.5% and 42.67% at the tested levels than that of the control, respectively. In the case of *B. thuringiensis* (agerin), the pupal duration was extended by 38.50% and 10.8% for the 2^{nd} instar larvae at two tested levels, respectively. The above mentioned results proved that diflubenzuron seems to be more effective in increasing pupal duration percentage than *B. thuringiensis*, while lettuce oil extract was least effective against 2^{nd} instar larvae at two tested concentrations showing a decrease in the pupal duration by 33.93% and 14.91% at the two tested levels, respectively.

Effect on pre-oviposition period

Tables (1 and 2) represent the effect of the tested compounds on the pre-oviposition period of *S. littoralis* adult females. It is apparent that 4^{th} instar larvae reared on castor been leaves treated with diflubenzuron , significantly increased the pre-oviposition period . The percentages of increasing were 200.54% and 81.96% at the two tested levels LC_{50} and LC_{25}, respectively. The same trend was observed when 2^{nd} instar larvae were reared on castor been leaves with *B. thuringiensis* (agerin) at the concentrations of LC_{50} and LC_{25}. The rate of treated increase in pre-oviposition period were (237.91% and 115.16%), respectively than that of control. On the contrary, lettuce oil, significantly decreased the pre-oviposition period with 57.97% and 31.59% than that of control.

Our results are in agreement with the results obtained by Zidan *et al.* (1996) who found that *B. thuringiensis* had prolonged larval duration and adult longevity.

Effect on pupal stage

As shown in Tables (1 and 2) is apparent that feeding newly moulted 4th instar and 2nd instar larvae for 48 hours on castor bean oil leaves treated with diflubenzuron, *B. thuringiensis* and lettuce oil extract at LC_{50} and LC_{25} levels induced (60.72%, 33.94%) and (72.42%, 51.73%) and (67.24%, 62.03%) percent reduction in the pupation, respectively.

Effect on pupal weight

Results in Tables (1 and 2) showed that diflubenzuron and *B. thuringiensis* caused a moderate reduction in pupae weight by (27.84%, 14.76%) and (21.23%, 14.60%) in comparison with control, while lettuce oil extract caused an increase in pupal weight with (35.39%, 30.97%) for the two concentration tested comparing with that of control .

Abnormalities in pupal stage

Data presented in Tables (1 and 2) showed that all tested compounds had a great effect on the abnormalities in the resulting pupae with different degrees. The rate of pupal abnormalities were (55.23%, 32.14%) (72.08%, 26.57%) and (51.25%, 12.39%) for diflubenzuron, *B. thuringiensis* and lettuce oil extract, respectively in comparison with control.

1.3.4. Abnormalities in adult stage

Data in Tables (1 and 2) showed that *B. thuringiensis* was the most effective compound for abnormalities of adult stage followed by diflubenzuron showing (70.83%, 39.60%), (41.67%, 19.04%) for *B. thuringiensis*, and diflubenzuron, respectively. While lettuce oil extract had no effect in this respect .

Our results are in agreement with those of El-Ghar *et al.* (1995) who found that thuringiensin, abamectin and diflubenzuron especially abamectin, resulted in a pronounced decrease of pupation in both susceptible (16-26%) and field (9.4-36.0%) strains compared with the control (78.7 and 70.8%, resp). The mean weight of pupae was deceased. Also, El-Lakwah *et al.* (1998) found that mortality and malformation rates of larval instars, pupae and adults were clearly increased with neemazal treatment.

Effect on egg production

The effect of larval treatment with diflubenzuron, *B. thuringiensis* (agerin) and lettuce oil extract on the egg production of the resulted adult are given in Tables (1 and 2) . Examination of the tabulated data indicated that diflubenuzron reduced

number of eggs at LC_{50} and LC_{25} concentration with 86.27% and 79.48% reduction than control, respectively.

The same trends were observed in *Bacillus thuringiensis* and lettuce oil extract treatments which reduced significantly the number of eggs of adult females treated as 2^{nd} instar larvae at LC_{50} and LC_{25} levels. The percent reduction were (92.42%, 84.79%) and (85.93%, 80.47%) than control in case of *B. thuringiensis* and lettuce oil extract, respectively.

Results proved that *B. thuringiensis* (agerin) seem to be more effective in decreasing the numbers of eggs percentage than diflubenzuron and lettuce oil extract.

Effect on hatchability

It is obvious that the two tested compounds diflubenzuron and *B. thuringiensis* (agerin) reduced significantly, the fertility of deposited eggs. Also, it is noticed that diflubenzuron at the tested levels LC_{50} and LC_{25} reduced the percent hatchability with 29.47% and 14.09% than control, respectively (Table 2). Regarding the effect of *B. thuringiensis* (agerin) on the egg hatchability (Table 1), it is clear that this compound at the two tested levels obtained from the treated 2^{nd} instar larvae, reduced egg hatchability by 18.19% and 12.84%, while lettuce oil didn't have any effect in this respect .

The above results are strongly supported by those of El-Ghar *et al.* (1995), who found that fecundity of the field strain was greatly reduced, especially in *thuringiensin* (65.2-89%) and abamectin (57.6%-87.4%) treatment compared with that of control. Also, El-Lakwah *et al.* (1998) found that the mean number of eggs laid and hatching were reduced for neemazal treatment . .

Effect on sterility:

The two tested compounds (diflubenzuron and *B. thuringiensis*) exhibited a high sterilizing effect showing 90.32% and 82.37% percent of sterility at LC_{50} and LC_{25} for diflubenzuron , respectively (Table 2) while *B. thuringiensis* (agerin) (Table 1), exhibited (93.8%, 86.74%) of sterility. Results concluded that *B. thuringiensis* was more effective than diflubenzuron on sterility of adult stage resulted from treated larvae of *S. littoralis*.

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تأثير بعض المبيدات الحشرية على الاقتدار الحيوي لدودة ورق القطن

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أدت معاملة يرقات العمر الرابع بالجرعة النصف مميتة Lc50 ونصفها Lc25 لمدة 48 ساعة على ورق خروع معامل بمركب دايفلوبنزيورون الى :

- نسبة موت 60.71 % ، 33.92 % . - طول فترة العمر اليرقي بمقدار 60.01 % ، 37.5 % .
- اطالة فترة التعذير بمقدار 55.5 % ، 42.67 % . - اطالة مدة ما قبل وضع البيض بمقدار 200.54 % ، 81.96 % .
- خفض وزن العذاري الناتجة بمقدار 27.84 % ، 14.76 % . - زيادة نسبة العذاري المشوهه بمقدار 55.23 % ، 32.14 % .
- زيادة نسبة الفراشات المشوهه بمقدار 41.67 % ، 19.41 % . - خفض عدد البيض لكل انثى بمقدار 86.27 % ، 79.48 % . - نسبة عقم فى البيض بمقدار 90.32% ، 82.37 % وذلك مقارنة بالكنترول .

أدت معاملة يرقات العمر الثانى بالجرعة النصف مميتة Lc50 ونصفها Lc25 لمدة 48 ساعة على ورق خروع بمركب الباسيلس ثيورنجنسز الي :

- موت اليرقات بنسبة 72.41 % ، 51.72 % . - زيادة فترة الطور اليرقي بمقدار 24.74 % ، 13.31% .
- اطالة فترة التعذير بمقدار 38.5 % ، 10.80% . - اطالة مده ما قبل وضع البيض بمقدار 237.91 % ، 115.16% .
- خفض وزن العذاري الناتجة بمقدار 21.23 % ، 14.60 % . - زيادة العذاري المشوهه بنسبة 72.08 % ، 26.57 % .
- زيادة نسبة الفراشات المشوهه بمقدار 70.83 % ، 39.60 % . - خفض نسبة البيض لكل انثي بمقدار 92.42 % ، 84.79 % . - نسبة العقم فى البيض بمقدار 93.80 % ، 86.74 % وذلك مقارنة بالكنترول .

أدت معاملة يرقات العمر الثانى بالجرعة النصف مميتة Lc50 ونصفها Lc25 لمدة 48 ساعة على ورق خروع بمركب زيت الخس الي :

- موت اليرقات بنسبة 67.24 % ، 62.06% . - خفض فترة الطور اليرقي بمقدار 27.34 % ، 12.57% .
- خفض فترة التعذير بمقدار 33.93 % ، 14.91%. - خفض مده ما قبل وضع البيض بمقدار 57.97%، 31.59% .
- زيادة وزن العذاري الناتجة بمقدار 35.39 % ، 30.97 % . - زيادة العذاري المشوهه بنسبة 51.25%، 12.39 % .
- خفض عدد البيض لكل انثي بمقدار 85.93 % ، 80.47 % . - لم يؤثر زيت الخس على الفراشات وعلى نسبة فقس البيض والعقم وذلك مقارنة بالكنترول .