J. Agric. Sci. Mansoura Univ., 32 (12): 10489 - 10496, 2007

EFFICACY OF SPINOSAD IN CONTROLLING THE CUTWORM, *Agrotis ipsilon* (LEPIDOPTERA: NOCTUIDAE).

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ABSTRACT

The present study was carried out to evaluate the effect of spinosad (0.02% W/W SL) against the 2nd, 4th and 6th larval instars of the black cutworm, *Agrotis ipsilon* (Lepidoptera: Noctuidae) by used various concentrations of spinosad under laboratory and the field conditions in Zefta district, Gharbiya Governorate during season of 2006, spinosad was applied at a rate of 50cm/fedan. Results indicated that a positive relationship existed between larval mortality and concentration except for 6th larval instar at 25 ml /50g bran, pupation percentage and adult emergence decreased gradually with increasing the concentration except in 10ml/50g bran. Generally, results indicated that abnormal larvae and pupae failed to transform to the next developmental stages during the normal periods as in check. The decrease in the percentage of normal pupation was correlated with increase of concentration of tested compound as well. In the field, cutworm damages in spinosad formulation treated plots were minimized 75.2% for larvae and 78.6% for cut plants. Therefore, spinosad reduced the natural occurrence of cutworm and its damage in cotton field.

INTRODUCTION

The black cutworm, *Agrotis ipsilon* (Hufn.) is considered one of destructive lepedopterous pests attacking cotton plants and other field crops and vegetables in Egypt. Poisonous baits are known to be used for the control of this pest. Possibility of replacing the conventional insecticides with safety environmental compounds (i.e. spinosad) to control *A. ipsilon* may protect the natural enemies in the agro-ecosystem.

Spionsad works by contact and ingestion. Salgado (1997&1998) reported that spiosad kills insects through action on their nervous system. Also, it could associate with the decrease of AchE activity and disturbance in the activities of other enzymes (Abd El-Mageed and El-Gohary, 2006).

Several laboratory studies were conducted to evaluate the potency of spinosad against various insect pests. Yee and Toscano (1998) reported that spinosad is considered as one of the most effective natural insecticides tested for reducing lettuce consumption of *S. exigua* since it cause 100% mortality, one day after treatment and prevented any detectable feeding on leaf diets by neonate larvae. Observations to the metamorphasis of the full grown larvae of *Spodoptera littoralis* shows failure of pupation, deformed prepupae and pupae (Aziz 2005). Al-Sarar *et al.,* (2006) found that there was no significant difference in the LD50 value of the susceptible reference strain (95%) of LD50 of fall armyworm *Spodoptera frugiperda* for all spinosad treatments. Pineda *et al.,* (2007) and Samuel *et al*., (2004) concluded that the combination of lethal and sublethal doses of methoxyfenozide and spinosad might exhibit significant effects on the population dynamics of *Spodoptera littolaris* and represent an important choice to be used in integrated pest management. Also, (Razaq *et al.*, 2007) recorded that the rotational use of spinosad, abamectin and indoxacarb could help to avoid the development of multiple resistant in *Helicoverpa armigera*. The aim of this work is through

light on the feeding toxicity of spionsad (0.02% W/WSL) at various doses to the black cut worm *A. ipsilon* under laboratory and field conditions.

MATERIALS AND METHODS

I. Laboratory experiment:

Spinosad (0.02% W/W SL) a thick yellow brown liquid was obtained form Dow Agrosciences company, was tested against the 2nd, 4th and 6th larval instars of the black cutworm, *A. ipsilon* in the laboratory. Insect larvae used in the present work were obtained from culture successfully maintained in the laboratory of Cutworms Department, PPRI, for several generations without any exposure to any pesticide. The cultures were reared at 27± 1°C & 60-70% R.H. with complete dark all day time. The different larval instars were fed on castor oil leaves.

Spinosad was applied through the poisonous baits of the black cutworm. Bait was prepared by mixing the diluted concentration of spinosad with bran until absorbtion. The 2nd instar larvae were fed on baits treated with concentrations of 0.8, 1.6, 3.2, 6.25 and 8 ml spinosad/50g bran. While the 4th larval instars were treated at concentrations of 3.2, 6.25, 8, 10 and 15 ml/50g bran. And the 6th larval instars were treated at concentrations of 8, 10, 15, 20 and 25ml/50g bran.

The amount of the used concentration was added to 50gr. bran. This amount of treated bait was divided into three replicates. Each one poured into 10 plastic cups. Thirty healthy larvae, starved for 2 hrs, were transferred individually to the cups. The cups covered with muslin and then tightened with rubber bands. The cups were maintained under controlled conditions of 27±°C and 60 – 70% R.H. Similar number of larvae were transferred to biocide-free bait and considered as check. After 48hrs all of the larvae were individually transferred to new plastic cups containing untreated baits. Dead larvae were recorded after 1, 3, 5 and 7 days after feeding, the cumulative mortality was calculated at the end of the larval stage and illustrated graphically. The percentages of pupation and adult emergence and deformities of various stages were recorded.

II. Field experiment:

Field treatments were conducted during the spring growing season 2006 at Zefta district, Gharbiya Governorate. This field had a history of high population of cutworm *A. ipsilon*.

The present experiment decided to study the effect of spionsad treatment on the black cut worm throughout May in cotton field.

The cutworm larvae used for open plot experiments depended on the natural population, the commonly spinosad was applied at a rate of 50cm/fadan. The experiment was conducted at 4 kirrats (1kirrat = 175m^2) of cotton seedling (Giza 86)three kirrats plots treated with spionsad and one untreated (control). The damage by cutworm usually evaluated when the cotton plants had 2-3 leaves. The evaluation of damage was based on the number of plants damaged (i.e.) cut above or below the soil surface and marked after and before treatments. The bran wheat was applied manually

immediately after as recommended traditional application around the base of the plants. The bran control treatment was formulated without spinosad. After 72hrs the selected plants / treatments was excavated to a depth of 5-10cm and the soil was examined for the presence of living and dead cutworms larvae.

Percentage of reduction in No. dead larvae and No. of cut plants was calculated up to Hindrson & Tilton (1955).

RESULTS AND DISCUSSION

I. Laboratory experiment:

Table (1) & Fig.1-C shows the results of feeding 2nd, 4th and 6th larval instars of *Agrotis ipsilon* on various concentration of spinosad to detect the age-specific mortality. Data indicated that a positive relationship existed between larval mortality and concentration except for 6th larval instar at 25 ml/50g bran, this may be back to high concentration of spinosad play a role as antifeedant to tested larvae.

Table (1): Effect of different concentrations of spinosad on the 2nd, 4th and 6th larval instars of *Agrotis ipsilon*.

Concent-ration (ml/50g bran)	% Mortality after different periods				%pupation	% adult hood
	1-day	3-days	5-days	7-days		
2nd. instar						
0.8	16.6	76.6	83.2	100.0	-	-
1.6	50.0	86.6	96.6	100.0	-	-
3.2	63.3	96.6	100.0	-	-	-
6.25	73.3	100.0	-	-	-	-
8	80.0	100.0	-	-	-	-
4th. instar						
3.2	0.0	10.0	20.0	33.3	56.6	0.0
6.25	0.0	10.0	33.3	50.0	33.3	0.0
8	6.6	19.9	63.2	63.2	6.6	0.0
10	63.3	79.9	86.5	86.5	13.3	10.0
15	53.3	96.6	100.0	100.0	86.6	0.0
6th. instar						
8	0.0	0.0	6.7	20.0	66.7	60.0
10	0.0	10.0	23.3	40.0	33.3	23.3
15	6.7	26.7	40.0	90.0	3.3	3.3
20	6.7	23.4	43.4	90.0	10.0	10.0
25	3.3	20.0	50.0	83.3	13.3	13.3

The obtained results of the spinosad effect on the 2nd larval instar are shown in Table 1, no alive prepupae were found for all tested concentrations (0.8, 1.6, 3.2, 6.25 and 8 ml /50g bran), where percentages of mortality reached 100% in (6.25 & 8 ml/50g); 3.2ml/50g and 0.8, 1.6ml/50g at 3 days, 5 days and 7 days, respectively (Fig. 1-A).

Results of spinosad treatment for the 4th larval instars showed that all treated larvae were dead after five days for 15 ml /50g bran. Disindingly, the highest percentage of mortality was recorded and after 5days for concentrations 8 and 10 ml /50g bran (63.3% and 86.7%, respectively), as shown in (Fig. 2). while it was 33.3% and 50%in concentrations of 3.2 and 6.25 ml/50g bran, respectively after 7days.

In Table (1) it is clearly obvious that pupation percentage decreased sharply with the increase of spionsad concentrations (56.6%, 33.3%, and 6.6% pupation for concentrations 3.2, 6.25 and 8 ml /50g bran, respectively). While, in 10ml/50g & 15ml/50g concentrations of pupation% increases to reach 13.3 & 86.6%, respectively.

6th instar larvae of *A. ipslon*, seemed to be more tolerant to the effect of spionsad concentration than tested other tested larval instars. Concentrations of 15, 20 & 25 ml/50g bran caused mortality 83.3- 90% larval and decreasing the pupation percentage and adult emergence (3.3, 10 and 13% pupation and 3.3, 10 and 13.3% adult for 15, 20 and 25 ml/50g bran, respectively) (Table 1).

The above results, suggest that spinosad seemed to be promising formulation for control of second instar larvae of *A. ipsilon* at 8ml/50g bran which caused 80% larval mortality after 24hrs, while the other concentration caused mortality varyin between 76.6 to 100% at 72hrs after treatment.

II. Field experiment:

Data in Table (2) showed that, in cotton field, the rate of mortality among cutworm larvae were increased after spinosad bran bait formulation treatment depending on the number of collected dead larvae and (cut) damaged plants compared to control (only treated with barn bait without spinosad) at Zefta district, Gharbia governorate.

The minimized of cutworm damages in spinosad formulation treated plots was 75.2% for larvae and 78.6% for cut plants.

Therefore, spinosad reduced the natural occurrence of cutworm and its damage in cotton field.

Table (2): The efficacy of spinosad as bait formulation for the control of cutworm larvae in cotton field at Zefta district, Gharbia governorate during cotton season of 2006.

Treatment	Rate/fadann	No. of larvae		% Reduction in No. larvae	No. of cut plant		% Reduction in No. of cut plant
		Before	After		Before	After	
Control	-	18	23	-	79	88	-
Spinosad	50ml	19	6	75.2	84	20	78.6

The commercial form of bioinsecticide (spinosad) was able to affect *A. ipsilon* larvae and induce certain signs and features during the bioassay, resulted in some malformations observed in caterpillars, pupae and moths as shown in Fig. (2-4). The present results showed a great reduction in numbers of survived individuals through the whole developmental stages.

Generally the present study revealed that abnormal larvae and pupae failed to transform to the next developmental stages during the normal periods as in untreated check, but invariably die, without transforming. It was observed also that adult emergence didn't occur and formation of adult was incomplete in most cases. This study showed that the decrease in the percentage of normal pupation was correlated with increase of concentration of tested compound as well. This observation agree with Nedal (2005).

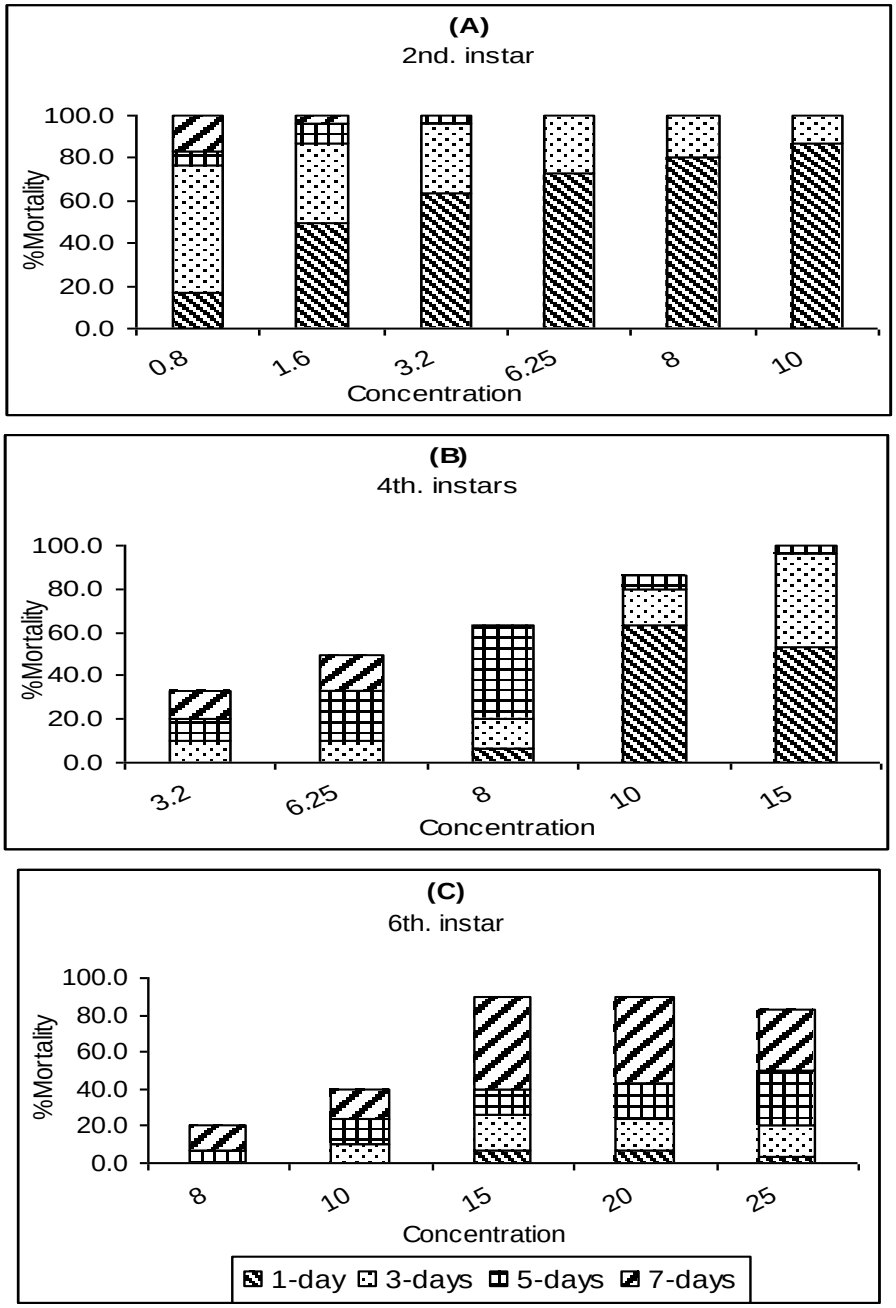

Fig. (1): Cumulative mortality of 2nd, 4th and 6th larval instars of *Agrotis ipsilon* after different periods from treatment with different concentrations of spinosad.

The resulted malformations described in the following figures as follows:

Fig. (2): shows the undersized tread larvae "b" compared with normal one "a" malformation may occurred larvae exposed to spionsad they failed to free themselves from their previous larval instar skin.

Fig. (3): shows the undersized pupae "d" due to the larval treatment with spionsad as compared with normal one "c" shows larval – pupal or some pupal – adult intermediate showing chacters from both stages.

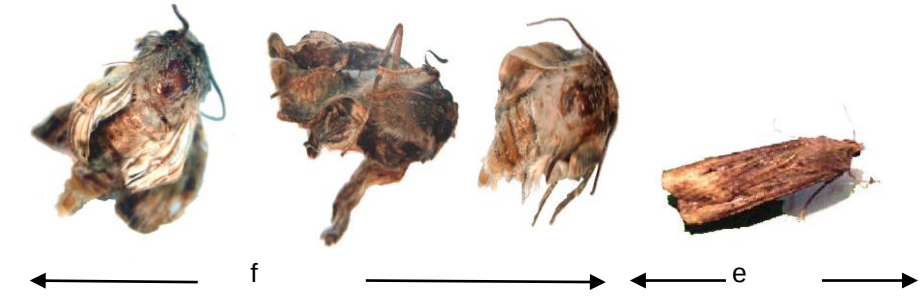

Fig. (4): other moths morphological abnormalities compared to the "e" normal one, "f" moth unable to extend its legs and shortened and unextended wings.

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تقييم مركب سبينوساد لمكافحة الدودة القارضة

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اجريت الدراسة لتقييم تأثير السبينوساد علي الاعمار اليرقية الثاني و الرابع و السادس لحشرة الدودة القارضة و ذلك باستخدام تركيزات مختلفة ، كما اجري ايضا تجربة حقلية في منطقة زفتى (محافظة الغربية) في موسم 2006 لاختبار تأثير السبينوساد في الحقل علي محصول القطن و ذلك بمعدل 50سم/فدان. و اشارت النتائج إلي أنه يوجد علاقة ايجابية بين موت اليرقات و الزيادة في تركيز السبينوساد فيما عدا يرقات العمر السادس علي تركيز 25مل/50جرام رده. كما اتضح ايضا ان النسبة المئوية للتعذير و خروج الفرشات الكاملة تتناقص تدريجيا مع زيادة التركيز فيما عدا تركيز 10مل/50جرام رده ، كما ان بعض اليرقات و العذاري فشلت في التطور إلي المرحلة العمرية التالية بالمقارنة بالكنترول. بينما في الحقل عمل السبينوساد علي خفض تعداد اليرقات في الحقل بنسبة 75.2% ، و خفض عدد النباتات المقروضة بنسبة 78.6% و بالتالي علي تقليل الضرر الحادث في حقول القطن.