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Effect of some Host Plants on Susceptibility of American Bollworm, *Helicoverpa armigera* (Hübner) for some Insecticides

Zaki, A. A. A. ; A. E. Amer and A. A. A. El-Sayed
Plant Protection Research Institute, Agric. Res. Center, Dokki Giza, Egypt

ABSTRACT

Effect of host plants pea, okra and lettuce on the efficacy of emamectin benzoate SC 1.5% + indoxacarb EC 7.5% (Penny), Thiomethoxam WG25% (Actara) and lufenuron EC 5 % (Match) against the 1st inster larvae of *Helicoverpa armigera* (Hübner) were studied under laboratory conditions. Results showed that the larvae fed on pea treated with penny were more susceptibility followed by okra, lettuce and finally diet. The LC_{50} values were 0.032, 0.040, 0.072 and 0.274 ppm, respectively. While, the larvae fed on pea treated with Actara was most susceptible followed by okra, lettuce and diet. The LC_{50} values were 0.074, 0.571, 1.951 and 6.010 ppm, respectively. In case of Match, the larvae fed on okra was most susceptibility and the LC_{50} values were 0.068 ppm. The order of relative toxicity of different insecticides against *H. armigera* was maximum in larvae fed on lettuce (27.094), diet (21.934), okra (14.275) and pea (2.813) with Penny, respectively. The larvae fed on treated lettuce with three insecticides was less susceptibility than other two host plants. The used host plants were affected the susceptibility of 1st instar larvae of *H. armigera* against different insecticides.

Keywords: *Helicoverpa armigera,* host plants, susceptibility, emamectin benzoate, indoxacarb, thiomethoxam, lufenuron

INTRODUCTION

The cotton bollworm, *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae), is a highly destructive polyphagous pest causing severe loss to many economically important crops, such as cotton, maize, tobacco, pigeonpea, chickpea, soybean, okra and tomato (Talekar *et al.* 2006). Effect of different hosts viz. cotton, pigeonpea and chickpea of *H. armigera* on the induction of carboxylesterase and cytochrome p-450 enzymes were studied. The variability in toxicity was observed, and the strain reared on chickpea showed tolerance against indoxacarb, spinosad and emamectin benzoate, whereas, strain reared on pigeonpea showed higher LC_{50} for lambdacyhalothrin. Larvae fed on cotton was found to be comparatively susceptible Ugale *et al.* (2011). Indoxacarb and spinosad were most toxic against *S. littoralis* reared on castor and soybean host plants, followed by emamectin benzoate on soybean and castor Deshmukh *et al.* (2016). Imidaclopride and thiamethoxam in particular very high relative toxicity values indicating less stomach to *S. littoralis* as compared to indoxacarb and methomyl Ramanagouda and Srivastava (2009). Relative toxicity after 24h of exposure the 3rd instare larvae of *S. littoralis* was indoxacarb > novaluron > lufenuron > methoxyfenozide Ghosh et al. (2008). Spinosad showed variable degree of toxicity against 4th instar larvae of *S. littoralis* when different host plants were used feeding Mohamed *et al.* (2015). LC_{50} values for emamectin benzoate was 2.783 and 1.656 ppm against the second larval instar of *S. littoralis* and first larval instar of *Pectinophora gossypiella,* respectively. Charmillot *et al.* 2007. The efficiency of Abamectin for dipping technique was attainted 24 h against the 4th larval instar of the American bollworm *H. armigera* was LC_{50} , LC_{90} and slope 93.51 , 236.71 and 2.08, respectively Adly (2015).

The aim of this work is to study the effect of some host plants on susceptibility of some insecticides against *H. armigera*

MATERIALS AND METHODS

1-Laboratory rearing of *H. armigera*:

The full grown larvae were collected from Pea plants during November and December. The larvae were transferred to the laboratory, the newly hatched larvae of the American bollworm were obtained from the mass rearing culture of Bollworms Research Department, Plant Protection Research Institute, (Sharkia, Branch). The larvae were reared on artificial diet described previously by Amer (2015) in glass tubes individually in the laboratory under constant conditions at 26+ 1°C and 70± 5 % RH. The emergence moths were reared as five pears in glass cage (male and female). Larvae were reared for one generation on different host plants lettuce, okra , pea and diet. Commercially available insecticide formulations of Penny, Actara and match were used in the present study for toxicity assay against 1st instar larvae of *H. armigera*.

2-Insecticides used:

Table 1. Commercial insecticides assayed against *H. armigera* 1st instar larvae

Common name	Trade name	Formulation and % a.i.	Rate /Feddan
Emamectin benzoate+ Indoxacarb	Penny	SC1.5+EC7.5 %	150ml
Thiomethoxam	Actara	WG -25%	160ml
Lufenuron	Mach	EC 5 %	120ml

3-Insect Bioassays:

Three host plants Lettuce, (*Lactuca sativa*), Okra, (*Abelmoschus esculentus*) and Pea (*Pisum sativum*) were collected from non-treated fields with pesticides and washed to remove any impurities by water. A series of concentrations of each tested pesticide were prepared as follows: 1.054, 0.263 0.065 and 0.016 ppm for Penny & 12.500, 3.125, 0.781, and 0.195 for Actara & 0.468, 0.117, 0.029 and 0.014 ppm for Match. Immersing centuries pea plants, fruits of Okra and leaf of lettuce in the previous concentrations for 10 seconds and one ml from each concentration were spread on the surface of the diet. The treated host plants and diet were left to dry in the laboratory atmosphere. 25 newly hatched larval of *H. armigera* were transferred to each treated host plants and diet and repeated three times. The treatments were investigated after 24 h of treatment. Numbers of live and dead larvae were recorded.

Data analysis the toxicity values were estimated slope, LC_{50} and LC_{90} were calculated by Finney (1971).

The toxicity index and relative toxicity of different insecticides to *H. armigera* larva reared on each host plants was calculated by taking the LC_{50} of insecticides by using sun's equation (1950) as follows

$$\text{Toxicity index} = \frac{LC_{50}\text{ of the most effective compound}}{LC_{50}\text{ of the other tested compound}} \text{X100}$$

$$\text{Relative toxicity (fold)} = \frac{LC_{50}\text{ value of less toxic compound}}{LC_{50}\text{ value of more toxic compound}}$$

RESULTS AND DISCUSSION

Toxicity studies:

Influence of host plants on toxicity of some insecticides against 1st instar larvae of *H. armigera*

Results in Tables (2 and 3) were represented on the effect of selected host plants on toxicity of some insecticides. The toxicity of insecticides against 1st inster larvae of *H. armigera* fed on each treated host plants and diet were differed from host to anther one.

The larvae fed on pea treated with penny were more susceptibility followed by okra, lettuce and finally diet. The LC_{50} values were 0.032, 0.040, 0.072 and 0.274 ppm, respectively. The lowest slope value was 0.321 for larvae fed on diet treated with penny. The larvae fed on pea treated with Actara were most susceptible followed by okra, lettuce and diet. The LC_{50} values were 0.074, 0.571, 1.951 and 6.010 ppm, respectively. The lowest slope value was 0.307 to larvae fed on diet treated with Actara. The okra treated with Match compound was more toxic to 1st instar larvae than that fed on lettuce and pea. The LC_{50} and LC_{90} were 0.068 and 2.266 ppm, respectively. The lowest slope value was 0.552 for larvae fed on diet treated with Match. The LC_{90} value, of Penny, Actara and Match were highest when 1st instar larvae fed on diet.

Table 2. LC_{50}, LC_{90} and slope values of Penny, Actara and Match insecticides on 1st instar larvae of *H. armigera* fed on treated host plants and diet for 24 h.

Insecticides	Hosts and diet	LC_{50}	LC_{90}	Slope±SE	X^2
Penny	Lettuce	0.072	5.444	0.683±0.073	4.366
	Okra	0.040	1.729	0.787±0.104	1.485
	Pea	0.032	3.395	0.631±0.101	0.787
	Diet	0.274	2650.077	0.321±0.094	0.984
Actara	Lettuce	1.951	57.877	0.864±0.103	0.499
	Okra	0.571	60.586	0.633±0.100	0.768
	Pea	0.074	229.057	0.366±0.070	1.631
	Diet	6.010	88942.969	0.307±0.094	0.398
Match	Lettuce	0.095	5.375	0.732±0.114	1.555
	Okra	0.068	2.266	0.842±0.116	3.700
	Pea	0.090	16.671	0.565±0.112	3.378
	Diet	0.488	102.109	0.552±0.114	2.068

X^2= Chi-square

Toxicity index

Data in Table (3) indicated that the most effective toxicant was Penny (100.00) on all host plants and diet followed by Match 75,789 and 58,824, 35.556 and 56.148% for the three host plants and diet, respectively. Toxicity index of Actara was the lowest compared with Penny and Match.

Generally, the host plants was effected the efficacy of insecticides against 1st instar larvae of *H. armigera*. According to LC_{50} value, the high compound effects were as follows Penny and Actara on pea plant followed by Match on okra plant comparing with diet treatment. In case of the effect of three tested compounds as toxicant was Penny on the host plants and diet treatment followed by Match on lettuce and okra host plants, then Match on pea host plant as comparing with diet treatment.

Deshmukh *et al.* (2016) they reported Indoxacarb and spinosad were most toxic effect against *S. littoralis* reared on castor and soybean host plants, followed by emamectin benzoate on soybean and castor. The efficiency of Abamectin for dipping technique was attainted 24 h against the 4th larval instar of the American bollworm, *H. armigera* was LC_{50}, LC_{90} and slope 93.51, 236.71 and 2.08, respectively Adly (2015). Spinosad showed variable degree of toxicity against 4th instar larvae of *S. littoralis* when fed on host plants (cotton, castor, lablab, maize and okra) Mohamed *et al.* (2015).

Table 3. Toxicity index, relative toxicity and index of relative toxicity values of Penny, Actara and Match compounds on 1st instar larvae of *H. armigera* fed on treated host plants and diet after 24h.

Host Plants and diet	Insecticides	Toxicity index	Relative toxicity (Fold)	Index of relative toxicity*
Lettuce	Penny	100.000	27.097	26.097
	Actara	3.690	1.000	
	Match	75.789	20.536	
Okra	Penny	100.000	14.275	13.275
	Actara	7.005	1.000	
	Match	58.824	8.397	
Pea	Penny	100.000	2.813	1.813
	Actara	43.243	1.216	
	Match	35.556	1.000	
Diet	Penny	100.000	21.934	20.934
	Actara	4.559	1.000	
	Match	56.148	12.315	

***=The difference between the highest and lowest values of relative toxicity**

Data in Table (3) showed that the relative toxicity of various insecticides to 1st inster larvae of *H. armigera* on each of the three host plants. On the basis of their LC_{50} values for lettuce was 27.097 folds with Penny compound as compared to Actara compound on lettuce. Penny regarded 14,725 fold on okra plant, while the high fold was 2.813 with Penny compound on pea. While the lowest influence was 1.00 fold with Match on pea plant. Also, results showed the high fold record was 21.934 with Penny on diet treatment, but the lowest fold was 1.000 with Actara on diet treatment. The index of relative toxicity variation was maximum in the larvae fed on lettuce host plants (26.097) followed by diet (20.934), okra (13.275) and finally pea host plants (1.813).

Ugale *et al.* (2011) they stated that the variability in toxicity was observed, and the *H. armigera* reared on chickpea showed tolerance against indoxacarb, spinosad and emamectin benzoate, whereas, *H.armigera* larvae reared on pigeonpea showed higher LC_{50} value for lambdacyhalothrin. Also the larvae fed on cotton plant were found to be comparatively susceptible. Imidaclopride and thiamethoxam in particular very high relative toxicity values indicating less stomach to *S. littura* as compared to indoxacarb and methomyl Ramanagouda and Srivastava (2009). The relative toxicity for tested compounds were as follows :indoxacarb (93,93)>fibronil (5,41)> novaluron (1,48)> Lufenuron (1,03)> methoxyfenozide (1,00), respectively on 1st instar larvae of *S. littura* Ghosh *et al.* (2008). Thus in the present finding there are differences in the relative toxicity of different insecticides, this because of host plants may be influenced on physiology of *H. armigera* showing differential susceptibly to insecticides. Deshmukh *et al*. (2016).

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تأثير بعض العوائل النباتية علي حساسية دودة اللوز الأمريكية لبعض المبيدات

أحمدعطا عبدالله زكي ، عادل السيد عامر و علي أحمد أحمد السيد
معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي – جيزة - مصر

دراسه تأثير العوائل النباتية (البسلة والبامية والخس) علي حساسية العمر اليرقي الأول لدودة اللوز الأمريكية لمبيدات إيمامكتين بنزوات 1,5%+إندوكسا كارب7,5% (بيني) والثيوميزكسام 25% (أكتارا) و ليوفنيورون 5% (ماتش) .أوضحت النتائج أن البسلة المعاملة بمبيد بيني كانت الأعلي حساسية علي يرقات العمر اليرقي الاول لدودة اللوز الأمريكية يتبعها البامية والخس وفي النهاية البيئة وكانت قيم الجرعة النصفية القاتلة (LC_{50}) 032, - 040,- 072, - 274, جزء في المليون علي التوالي. بينما اليرقات التي تغذت علي البسلة المعاملة بمبيد أكتارا كانت أعلي حساسية يتبعها تلك التي تغذت علي البامية والخس والبيئة وكانت قيم LC_{50} هي 074, - 571, - 1,951 -6,010 جزء في المليون علي التوالي. في حالة مبيد الماتش اليرقات التي تغذت علي البامية المعاملة كانت أعلي حساسية وكانت قيم LC_{50} 068, جزء في المليون . السمية النسبية لمختلف المبيدات تجاة دودة اللوز الأمريكية كانت الأعلي في اليرقات التي تغذت علي الخس (27,094) والبيئة (21,934) والبامية (14,275) و البسلة (2,813) مع مبيد البيني علي التوالي . معاملة الخس بالثلاثة مبيدات كانت ذات حساسية منخفضة علي العمر اليرقي الاول عن العائلين النباتيين الآخرين . العوائل النباتية المستخدمة كانت تؤثر علي حساسية المبيدات المختبرة تجاة العمر اليرقي الأول لدودة اللوز الأمريكية