Feeding deterrence activity of *Adhatoda vasica* L. against *Spodoptera litura* (Fab.)

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ABSTRACT

Laboratory study was carried out to evaluate the antifedent activity of *Adhatoda vasica* L. extracts on *Spodoptera litura* (Fab.) larvae. Various concentrations (25, 50, 75 and 100%) of *A. vasica* extracts were used against last instar of *S. litura*. *Adhatoda vasica* used as biopesticide because it showed a high degree of antifedent activity against this pest. *Helianthus annus* L. and *Hibiscus esculentus* are common oil producing vegetable crops respectively; they are very often infected by various pests. Among them *S. litura* is the major pest. When *A. vasica* plant extract of different concentrations were sprayed on the above two plants and observed, as the concentration of the plant extract increase the food consumption was decreased. The same trends were also noticed in the percent feeding and percent protection.

Key words: *Adhatoda vasica*, Crop pest, *Spodoptera litura*, antifeedent activity

INTRODUCTION

Plant derived extracts and phytochemicals have been intensively investigated for the past 30 years in an effort to develop alternatives to conventional insecticides but with reduced health and environmental impacts. Synthetic insecticides can leave potentially toxic residues in food products and can be deleterious to non-target organisms in the environment (Isman, 2006). Several workers have explored the utility of plant products as one of the potential source of managing agricultural pests in search for effective, eco-friendly and economically viable options, Bai and Kandasamy (1985) evaluated the effect of acetone/diethyl ether extract *Vitex negundo* leaf extract against the third instar larvae of *S. litura*. It is an important polyphagous pest distributed throughout the world. It has been reported to attack on 112 plant species belonging to 44 families, of which 40 species are known from India (Mallikarjuna *et al*., 2004). Sahayaraj and Paulraj (1998) evaluated the effect of relative toxicity of some plant extracts to this pest. Antifeedent action of neem seed kernel extracts and its commercial formulation have been found to be effective insecticide against many insect pests (Schmutterer, 1990 and 1995) and can be integrate them in Integrated Pest Management programme (Schmutterer, 1988; Gupta and Sharma, 1998).

Adhatoda vasica (L.) (Acanthaceae) is an insecticidal plant (Rathi *et al*., 2008), leaf extract has antifeedant activity against *Spodoptera littoralis* (Sadek, 2003). Two antifeedant compounds have been isolated from the petroleum ether extract of *Clausena anisata* (Rutaceae), against the larva of African armyworm (*Spodoptera exempta*), the compounds identified as the coumarins imperatorin and xanthoxyletin (Gebreyesus, and Chapya, 1989). Recently Ganesh Kumar and Sevarkodiyone (2009) reported that the seed extracts of *Annona squamosa* L. and *Lepidium sativum* L. showed a negative growth rate on the pupal development of *S. litura*. Limonoids from *Khaya senegallensis* having feeding deterrent and growth inhibitory properties against the cotton leafworm, *Spodoptera littoralis* (Aswad *et al*., 2003). In the present paper, we report the results of our studies on the relative toxicity of plant extract against the last instar larvae of *S. litura* and the main objective is to find out antifeedent activity of *A. vasica* against *S. litura* in the laboratory condition.

MATERIALS AND METHODS

Helianthus annus and *H. esculentus* were cultivated in the college garden. For the botanical extract *A. vasica* was chosen and it was collected from Trichy. After collection, the plants were washed thrice in tap water and the leaves were shade dried for two weeks and powdered in a domestic grinder and stored in refrigerator for further use. From the stock, 25 gm of powder was used for the extraction by cold method. The powder was dissolved in 80 % of ethanol (80 % ethanol + 20 % distilled water) in air tight glass container for about 5 days, filtered and the final volume was measured and considered as 100 %. From the condensed extract, different concentrations *viz.*, 25 %, 50 %, 75 % and 100 % were prepared by adding required quantities of distilled water.

Rearing of larvae and bioassay

The eggs and larvae of *S. litura* were collected from the field and reared and maintained in laboratory conditions (30 ± 3ºC) with sunflower leaves. The larvae were reared in plastic trough (10 x 11.5 x 7.5 cm) and the laboratory reared fifth instar larvae were used for the experiment. *H. annus* and *H. esculentus* leaves pieces (2 x 2 cm) were soaked in different concentrations of the plant extracts for few minutes. After that, the leaves were air dried for another few minutes and were supplied to the insects. The laboratory emerged last instar, prestarved one day old larvae were released on the plant extracts treated and nontreated (control) leaves placed in the plastic container (600 ml) and they were allowed to feed the leaves for a period of two days. Ten replicates were made for each concentration and control respectively. The antifeedent activity parameters like per cent feeding and per cent protection were studied by using the following formula

$$\text{Percent feeding} = \frac{\text{Area given for feeding} \;\; \text{corrected area left X 100}}{\text{Area given for feeding}}$$

$$\text{Percent protection} = \frac{\text{Protection in treatment (\%)} \;\; \text{Protection in control X 100}}{\text{100} \;\; \text{Protection in control (\%)}}$$

RESUTLTS AND DISCUSSION

In the present investigation the results obtained in the treatment of *A. vasica* leaf extract on *S. litura* were presented in the Table 1. The average food consumption in control, 25, 50, 75 and 100 % category were 78.8 ± 3.65, 78.8 ± 3.0, 70.2 ± 4.11, 68.8 ± 3.17 and 44.0 ± 10.9 respectively. The result showed that when the concentration increased from control to 100% the food consumption was decreased. The average food consumption in control to 100 % category were 62.2 ± 13.1, 73.8 ± 1.71, 64.6 ± 2.50, 52.4 ± 5.68 and 43.6 ± 10.4 respectively. The results showed a negative correlation when the concentration increased form control to 100 % the food consumption was decreased (Table 1). The andifeedent activity of the plant extract might be due to the presence alkaloids. The common alkaloids containing plants being *Fabaceae* and *Solanaceae*: pyrolizzidine and quinolizzidine alkaloids are effective feeding deterrents against several insect pests (Bennett and Wallsgrove, 1994). The same results were notified in all the concentration and duration, irrespective of the plant extracts treatment. It decreased food intake and probably the passage of food through the gut. The same results were also observed by Sahayaraj (1998). Among the extract *A. vasica* showed a high antifeedent activity.

A. vasica extract treated on *H. annus* were exposed to *S. litura* showed an average per cent feeding in control to 100 % category were 19.7 ± 0.91, 19.1 ± 0.53, 18.3 ± 0.88, 17.7 ± 1.08 and 11.0 ± 2.75 respectively (Table 1). The results showed when the concentration increased from control to 100 % the percent feeding was decreased. The same results were observed *H. esculentus* the average percent feeding in control to 100 % category were 20.3 ± 0.29, 19.0 ± 0.44, 16.15 ± 0.62, 13.1 ± 1.42 and 11.1 ± 2.46, respectively. Monoterpenes act as attractants/repellants, whereas sesquterpenes and diterpenes exhibit considerable biological activity in relation to toxins and hormones produced by plants, many of which act as antifeedents. Many plants belonging to *Leguminaseae* and *Solanaceae* contain alkaloids such as tomatin chaconine, leptine, demissive, solanin etc., which act as feeding deterrents (Ananthakrishnan, 1999; Bennet and Wallsgrove, 1994).

Percent protection

In *H. annus* the average percent protection treated by *A. vasica* leaf extract was presented in Table 1. The average percent protection in control, 25, 50, 75 and 100 % category were 9.2 ± 2.18, 12.7 ± 2.75, 43.3 ± 14.3 and 74.2 ± 2.24 respec tively. In the observation from control and experiment when the concentration increased the plant protection also increa sed. In *H. esculentus* the average percent protection treated by *A. vasica* leaf extract showed the same results in (Table 1). The average percent protection in control, 25, 50, 75 and 100 % category were 7.56 ± 2.19, 15.7 ± 4.37, 35.6 ± 6.68 and 45.4 ± 11.9 respectively. The repelling properties increased as concentration increased. The decreased in the values denotes the decreased in the preference of the larva to particular concentration. Sahayaraj and Paulraj (2000) observed the *S. litura* repells the groundnut leaves treated with *Tridax procumbens* leaf extract and further stated that the repellents increased as the concentration of the extracts increased.

Table 1. Antifeedent activity of *Adhatoda vasica* leaf extract on *Spodoptera litura*

Concentration of extract (%)		Control	25	50	75	100
Mean Feeding	*H. annus*	78.8 ± 3.65	72.8 ± 3.0	70.2 ± 4.11	68.8 ± 3.17	44.0 ± 10.9
	H. esculentus	62.2 ± 13.1	73.8 ± 1.71	64.6 ± 2.5	52.4 ± 5.68	43.6 ± 10.4
Per cent feeding	*H. annus*	19.7 ± 0.91	19.1 ± 0.53	18.3 ± 0.88	17.7 ± 1.08	11.0 ± 2.75
	H. esculentus	20.3 ± 2.29	19.0 ± 0.44	16.1 ± 0.62	13.1 ± 1.42	11.1 ± 2.46
Per cent protection	*H. annus*	-	9.2 ± 2.18	12.7 ± 2.75	43.3 ± 14.3	74.2 ± 2.24
	H. esculentus	-	7.5 ± 2.19	15.7 ± 4.37	35.6 ± 6.68	45.4 ± 11.9

The feeding deterrent effect in the study was also calculated by the mean feeding ratio of the botanical sprayed leaf consumed by the *S. litura* further, it suggests that the amount of botanicals consumed in 24 hours was sufficient to disrupt feeding mechanism of the *S. litura* (Sahayaraj, 1998). According to Pathrose *et al*. (2007), growth rate of *S. litura* was affected by the methanolic extract of *Andrographis paniculata* than the hexane extract. This plant extract was found to be antifeedent and growth inhibitory in nature, since *S. litura* polyphagous pest on the species of plant like cotton, tobacco, castor, sunflower and okra crops. Hence, the extract of *A. vasica* can be exploi ted for the control of this pest. This promising result would help to evaluate and implement in control strategies. More over this finding needs to be confirmed by actual field trials.

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