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Antifeedant activity of plant extracts to an insect *Helopeltis theivora*

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Abstract: *The different solvent extracts (viz Petroleum ether, Ethyl acetate and Methanol) obtained from leaves and flowers of Heliotropium indicum and Spilanthes calva were screened for antifeedant activity against Helopeltis theivora. All the six different extracts showed antifeedant activity at four different concentrations. The methanolic extracts of leaves of Heliotropium indicum and Spilanthes calva exhibited significant activity at 4% concentration. The numbers of spots produced were only 18.67 and 22.67 respectively, which are significantly less than the number of spots produced in control (104.00 and 93.33 respectively). The treatment with methanolic extracts of flowers of both the plants significantly reduced the number of feeding spots to 22.33 and 23.67 respectively in comparison to the control values of 101.33. All the activities are dose dependent. The mean results with SEM (mean±SE) were statistically significant at 1% level (p<0.01) for three observations.*

Key words: *Antifeedant activity, Heliotropium indicum, Spilanthes calva, Helopeltis theivora, Methanolic extract*
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Introduction

Tea is a gift of nature and is most widely used non – alcoholic beverage all over the world, prepared from the tender shoot of tea plant, *camellia sinensis* (L) O. Kuntze. It is one of the most important agro-industrial crops of India and sustains the economy of a large number of people in North East India.

Among the various insect pests that attack or cause severe damage to tea plant, one is the *Helopeltis theivora*, commonly known as tea mosquito bug. The pest was first noticed in India at Surma Valley of Cachar in 1868 (Watt and Mann, 1903.). The insect used to cause crop loss up to 25% (Prasad, 1992). The nymph or adult of this pest suck the sap of the young leaves and tender stem and can produce 100 spots within 24 hr (Banerjee 1978).

A number of methods are used for pest management. This is required not only to prevent crop loss but also to maintain quality products. Plant protection measures involving synthetic insecticides and/or conventional and natural insecticides have so far considered to be the most potent weapon to combat the war against pests (Ateyyat and Abu-Darwish, 2009).

The large-scale use of synthetic insecticides in agriculture and public health leads to adverse effects such as development of pesticide resistance, frequent pest out breaks, emergence of new pests, pollution and health hazards. In order to search an environmentally safe alternative, scientists considered the pesticides of biological origin in the place of synthetic insecticides. Replacement of synthetic insecticides by bio-rational insecticide is an universally acceptable and practicable approach worldwide (Rathi and Gopalakrishnan, 2006).

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The pool of plants possessing insecticidal substances is enormous (Kabaru and Gichia, 2001). These have generated extraordinary interest in recent years as potential sources of natural insect control agents. Today over 2000 species of plants are known that possess some insecticidal activity (Jacobson, 1989).

Based on the foregoing, present study is undertaken to evaluate the insecticidal activity (antifeedant activity) of different solvent extracts of leaves and flowers of *Spilanthes calva* and *Heliotropium indicum* against tea mosquito bug, *H. theivora*.

Materials and Methods

Plant species and sample preparation: The plants *viz*., *Heliotropium indicum* (F. Boraginaceae) and *Spilanthes calva* (F. Asteraceae), were collected from the adjoining areas of Dibrugarh University (Assam, India) and authenticated by Botanical survey of India, Shibpur, Howrah.

The leaves and flowers of the *Heliotropium indicum* and *Spilanthes calva* were dried separately at a temperature of 50 – 55°C and were coarsely ground. Each powdered material was extracted successively with petroleum ether, ethyl acetate and methanol in Soxhlet apparatus. The solvent from each extract was removed under vacuum and weighed quantity was redissolved in acetone to prepare the stock solution. Different concentrations were prepared from the stock by diluting in acetone.

Antifeedant tests: The insects (*Helopeltis theivora*) were collected from the unsprayed tea plant of our departmental garden and reared in the laboratory on freshly collected twigs of tea leaves.

Table - 1: Antifeedant properties of leaves and flowers of *H. indicum* against tea mosquito bug

Concentrations of extract (%)	No. of spots produced after 24 hr					
	Petroleum ether		Ethyl acetate		Methanol	
	Leaf	Flower	Leaf	Flower	Leaf	Flower
4.0	22.33 ± 0.88	26.00 ±0.00	21.33 ± 0.33	23.33 ±0.33	18.67 ± 0.33	22.33 ± 0.33
2.0	23.33 ± 0.88	29.33 ± 0.33	23.67 ± 0.67	28.00 ± 0.58	20.33 ± 0.33	27.67 ± 0.67
1.0	26.67 ± 0.33	33.67 ± 0.67	25.67 ± 0.33	31.33 ±0.67	24.00 ± 1.00	29.33 ± 0.67
0.5	34.33 ±0.33	47.00 ± 1.00	32.33 ± 1.20	43.33 ± 1.86	31.33 ± 0.33	42.33 ± 1.45
0.0	104. 00 ±1.00	101.33 ± 0.88	104.00 ±1.00	101.33 ± 0.88	104.00 ±1.00	101.33 ± 0.88
CD (p<0.01)	3.34	3.06	3.54	4.53	2.59	4.38

Each Figure is the Mean ±SE for 3 replicates. Significant at 1% level since ($p < 0.01$)

Table - 2: Antifeedant properties of leaves and flowers of *S. calva* against tea mosquito bug

Concentrations of extract (%)	No. of spots produced after 24 hr					
	Petroleum ether		Ethyl acetate		Methanol	
	Leaf	Flower	Leaf	Flower	Leaf	Flower
4.0	26.00 ±0.58	28.67 ± 0.33	23.33 ± 0.88	26.67 ± 0.33	22.67 ± 0.33	23.67 ±0.33
2.0	30.67 ± 0.68	38.33 ± 0.67	28.67 ± 0.67	31.33 ± 0.88	27.33 ± 0.33	30.33 ±0.33
1.0	35.33 ± 0.33	48.67 ± 0.88	33.33 ± 0.67	41.33 ± 0.33	32.33 ± 0.67	39.33 ±0.67
0.5	40.33 ± 0.67	59.00 ± 1.00	37.67 ± 1.20	56.33 ± 0.67	37.00 ± 1.00	54.67 ±0.33
0.0	99.33 ± 0.88	101.33 ±1.20	99.33 ± 0.88	101.33 ±1.20	99.33 ± 0.88	101.33 ±1.20
CD (p<0.01)	2.91	3.89	3.95	3.41	3.13	2.99

Each Figure is the Mean ±SE for 3 replicates, Significant at 1% level since ($p < 0.01$)

All the extracts were assessed for antifeedant activity against *H. theivora*. Fresh tea shoots were collected from the unsprayed departmental garden and were sprayed with different concentrations (*viz.* 0.5, 1, 2 and 4%) of each extract (*i.e.* Petroleum ether, ethyl acetate, Methanol) and air dried for ten minutes (Pandey *et al.,* 1987). Three numbers of treated shoots were then kept in a conical flask of 50 ml having water inside it by wrapping with absorbent cotton (Kalita *et al.*, 1995).

Two numbers of 6 hr starved adult *H. theivora* were released on the treated shoots and covered with glass chimney and one end of which was covered with nylon net. There were three replications for each treatment and control. The insects were then allowed to feed for 24 hr and the numbers of feeding spots were recorded. The shoots in control were sprayed with acetone only.

Statistical analysis: The results are expressed as Mean ± SEM and data were statistically analyzed by one-way ANOVA, with the level of significance set at $p<0.01$.

Results and Discussion

The present study reveals that different solvent extracts of *Heliotropium indicum* and *Spilanthes calva* have more or less antifeedant effects on the insects, *Helopeltis theivora*. There is however, diversity in the range of activity among the extracts with three different solvents. The most potent bioactive plant species is *Heliotropium indicum*, the methanol extract of it exhibited very significant effect against *Helopeltis theivora*. The number of feeding spots after treatment with 4% methanol extract of *Heliotropium indicum* was only 18.67 whereas in control the number was 104.00. The other two extracts, *viz.* petroleum ether and ethyl acetate extract, also showed very promising result. In each concentration of treatment there was significant reduction in feeding ($p<0.01$). The numbers of spots of petroleum ether extracts of leaves of *Heliotropium indicum* at 4, 2, 1 and 0.5% concentrations were 22.33, 23.33, 26.67 and 34.33 respectively. The ethyl acetate extract of leaves also gave excellent results (Table 1). Leaves of *Spilanthes calva* also possessed very strong antifeedant results; here too methanolic extract (4%) gave the best results (Table 2).

In case of flower extracts, the *Heliotropium indicum* showed very promising results. Here also, the methanolic extract was found to be best. The number of spot after treatment with methanolic extract at 4% was 22.33, which was significantly less than the other treatment. The other solvent *viz.* petroleum ether and ethyl acetate also possesses very good antifeedant property (Table 1). Different solvent extracts of flowers of *Spilanthes calva* at various concentrations were also found to have very dominating antifeedant activity (Table 2). In all the treatment the numbers of spots produced by the insects were less than those of control ($p<0.01$).

Control of *Helopeltis* bug with some indigenous plant extracts were reported by Gogoi *et al.,* 2003; Deka *et al.*, 1998. The present results are in agreement with the findings of the other workers.

Today, the environmental safety of an insecticide is considered to be of paramount importance due to their biodegradable nature (Bhattacharya, 1994). An insecticide does not have to cause high mortality on target organisms in order to be acceptable. Antifeedant activity reduces pest damages to products even without killing the pest. Further in the long run, populations are reduced through disrupted metamorphosis (Schmutterer, 1995). This antifeedant activity can therefore be incorporated into other insect control techniques in the strategy of integrated pest management (IPM). Further study is required to isolate antifeedant compound from *Heliotropium indicum* and *Spilanthes calva* which may be similar to antifeedunt compounds present in *Azadirachta indica* (Rembold, 1984; Schmutterer, 1995).

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