

Biocidal activities of selected flora of Andaman and Nicobar islands against Rice stem borer, *Scirphophaga incertulas* (Walker)

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ABSTRACT

Antifeedant and insecticidal properties of thirty plants suggested by the tribes of Andaman and Nicobar Islands were studied by conducting laboratory bioassay against 3rd instar of *Scirphophaga incertulas* (W.). The higher antifeedant activity was noticed in *Annona muricata* (82.97%), *Amomum fenzlii* (82.11%) and *Oroxylum indicum* (81.66%). Insecticidal activity was more pronounced in *Derris scandens* (66.66%) and *Tetracera sarmentosa* (53.33%).

Keywords: *Scirphophaga incertulas*, botanical insecticide, antifeedant activity

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INTRODUCTION

Andaman and Nicobar Islands (Bay islands) are a group of 572 islands at the connection of the Bay of Bengal and Andaman Sea. Great Andamanese, Jarawa, Onge and Sentinelese (Negrito origin) (Awasthi, 1991) and Nicobarese and Shompens (Mongoloid origin) (Sharief and Rao, 2007) are the tribes of Andaman and Nicobar Islands and known for traditional wisdom and culture. Andaman and Nicobar Islands are rich in floral diversity. Pandey and Diwakar (2008) published an integrated check-list flora of Andaman and Nicobar Islands, which reports 2654 flora, including 228 infraspecific taxa under 1083 genera in 237 families belonging to 4 different plant groups, namely bryophytes, pteridophytes, gymnosperms and angiosperms. Poaceae (194 taxa), Orchidaceae (153 taxa), Rubiaceae (143 taxa), Euphorbiaceae (135 taxa), Fabaceae (110 taxa), Cyperaceae (106 taxa), Annonaceae (64 taxa), Moraceae (63 taxa), Asteraceae (49 taxa) and Arecaceae (46 taxa) are the top ten dominant families. The total geographical area of these islands is about 8249 sq.km. in which only 6% is cultivable land. Among which, rice occupies the maximum area of about 8,390 ha followed by vegetables, pulses and spices and rice is the major food of the island populations (Gautham, 2013). The moderate temperature,

high humidity and abundant rainfall provides niche for perpetuation of pests in these Islands. *Leptocorisa acuta*, *Cnaphalocrocis medinalis*, *Scirphophaga incertulas* and *Nilaparvata lugens* are the major pests on paddy. To go with organic way of pest control, a research was initiated to utilize flora of Pesticidal value. A survey conducted among the tribes of Andaman and Nicobar Islands assisted to select 30 plant species of Pesticidal value. However, literature related to the Pesticidal properties of flora of Andaman and Nicobar Island is scanty. Few species of Zingiberaceae endemic to Andaman Nicobar Islands were used as a bee repellent for honey hunt (Anju *et al.*, 2018) and even for repel insects (Ahmad, 1981). In this research laboratory studies were conducted to decode the Pesticidal properties of 30 plant species suggested by the tribes against *Scirphophaga incertulas* as test insect

MATERIALS AND METHODS**Preparation of botanical extracts**

The plant parts intended to study were collected with the help of tribes/local healers and brought to the laboratory and shade dried for two weeks. Then plant parts were ground using electric blender (mixer) each separately. Powdered plant parts were packed as 100g packets using Whatman No. 40 filter paper. These packets were extracted with HPLC grade water at room temperature in round-

bottom (5 L. capacity) stopper flasks. After 72 h, the paper packets were removed from the flasks and the extracts were labeled and stored in a refrigerator. For 100 g powder 1 L HPLC grade water were used to obtain 10% concentration. This is considered as stock material and used in bioassays at various dilutions.

Culturing of *S. incertulas*

Adults of *S. incertulas* collected from the field of Annamalainagar were released on 50 days old potted rice plants (variety- TN1) kept in oviposition cages (5' x 3' x 3') (3 pots /cage and 20 to 25 tillers/ pot). For each cage ten pairs of moths were released and feed is given in the form of 10% honey water soaked in cotton wool. Egg masses laid on the leaves were collected by cutting off the entire leaf. Petiole of the cut leaves were wrapped by moist cotton wool and placed on moist filter papers in the laboratory under controlled conditions (25 ± 1°C temperature, 70 ± 5% relative humidity and 12L:12D photoperiod) until hatching. Newly emerged larvae were transferred to cut stalks of 50 days old rice plants (variety - TN1). The stalks were cut in 12 to 15 cm sections in such a way that each cut stalk had a node about 2 to 3 cm from the bottom. The stalks were packed tightly in clay pots (40 to 50 cut stalks/pot)- and placed in plastic trays which contained water up to 3 cm height and covered using muslin cloth held by elastic band. Water permeates the bottom of the clay pots and provides high humidity whereas the upper halves of the pots remain relatively dry. The larvae (25/pot) released were allowed to bore into cut stalks. Later, larvae which left the stalks and crawled to the rims of the pot in search of food were picked up with a fine camel's hair brush and transferred to another pot containing fresh cut stalks. Stalks were normally changed about 2 times in a week. Pupation took place in the cut stalks where they fed and the stalks hold the pupae were transferred to the oviposition cage (Waldbauer and Marciano, 1979). The culture was maintain continuously and when ever

needed third instars were taken and used in experiments.

Antifeedant and Insecticidal assay

Fifty days old TN1 rice plants were selected and stalks at the length of 15cm with a node about 2 to 3 cm from the bottom used for this experiments. Extracts were sprayed @ 5% concentration. 10 stalks / pot were packed tightly and placed in small mud pot these pots were kept in a plastic tray which contained water up to the height of 5 ml and covered using muslin cloth. Then third instars @ 5/pot were released. Treated cut stalks were observed after 6 hrs and 12 hrs on the establishment of larvae. The experiment was completed when the stalks was completely scraped in control. The stalks from the experiments were collected and length of stem feeding was measured. Each treatment was replicated thrice. There were 32 treatments including absolute and positive controls. Per cent stalk length protection over control was computed using the below mentioned formula and graded. The method described for antifeedant assay was followed for insecticidal assay but 2% concentration of extracts was used. After 48 h fresh stalks were supplied by withdrawing the treated stalks and reared up to adult emergence. Mortality in the larval and pupal stages was recorded once in 24 hrs and the cumulative mortality was furnished. Each treatment was replicated thrice.

| Rating Scale | |
|-------------------------------|------------------------------|
| Per cent leaf area protection | Grade |
| > 80 | Strong Inhibition (++++) |
| 50-80 | Medium Inhibition (+++) |
| 20-50 | Weak Inhibition (++) |
| < 20 | Insignificant inhibition (+) |

$$\text{Per cent stem length protection over control} = \frac{\text{Per cent protection in treatment} - \text{Per cent protection in control}}{100 - \text{Per cent protection in control}} \times 100$$

RESULTS AND DISCUSSION

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The data obtained from antifeedant assay @ 5% concentration against larvae of *S. incertulas* showed that among thirty plants leaf extract of *Annona muricata* (82.97%) exhibited strong inhibition followed by leaf extract of *Amomum fenzlii* 82.11% and bark

extracts of *Oroxylum indicum* (81.66%). The highest antifeedant activity in *A. muricata* may be due to the presence of cyclohexapeptides and acetogenins which were reported as the major phytochemical compound of *A. muricata* by Gajalakshmi *et al.* (2012).

Table 1. Antifeedancy of certain botanicals against *S. incertulas*

| Treatment (5% concentration) | Part extracted | Per cent Stalk length protection over control | Antifeedant grading |
|---|----------------|---|---------------------|
| <i>Annona muricata</i> | Leaves | 82.97 | (++++) |
| <i>Orophea katschallica</i> | Leaves | 26.19 | (++) |
| <i>Semecarpus prainii</i> | Nuts | 70.32 | (+++) |
| <i>Alstonia kurzii</i> | Leaves | 26.19 | (++) |
| <i>Tetracera sarmentosa</i> | Roots | 47.64 | (++) |
| <i>Aegiceras corniculatum</i> | Leaves | 34.49 | (++) |
| <i>Avicennia marina</i> | Leaves | 34.49 | (++) |
| <i>Grewia calophylla</i> | Bark | 34.49 | (++) |
| <i>Barringtonia asiatica</i> | Bark | 75.55 | (+++) |
| <i>Calophyllum inophyllum</i> | Leaves | 70.32 | (+++) |
| <i>Macaranga tanarius</i> | Leaves | 29.26 | (++) |
| <i>Oroxylum indicum</i> | Bark | 81.66 | (++++) |
| <i>Pometia pinnata</i> | Leaves | 55.89 | (+++) |
| <i>Pajanelia longifolia</i> | Leaves | 53.71 | (+++) |
| <i>Rhizophora mucronata</i> | Bark | 51.96 | (+++) |
| <i>Cerbera odollam</i> | Leaves | 62.89 | (+++) |
| <i>Hibiscus tiliaceus</i> | Leaves | 57.21 | (+++) |
| <i>Caesalpinia bonduc</i> | Seeds | 43.23 | (++) |
| <i>Canarium euphyllum</i> | Leaves | 40.60 | (++) |
| <i>Hornstedtia fenzlii</i> | Leaves | 74.68 | (+++) |
| <i>Amomum fenzlii</i> | Leaves | 82.11 | (++++) |
| <i>Duabanga grandiflora</i> | Stem | 65.50 | (+++) |
| <i>Murraya paniculata</i> | Leaves | 63.32 | (+++) |
| <i>Atalantia monophylla</i> | Leaves | 72.50 | (+++) |
| <i>Aglaia spectabilis</i> | Bark | 26.63 | (++) |
| <i>Chukrasia tabularis</i> | Leaves | 51.53 | (+++) |
| <i>Mallotus Philippensis</i> | Leaves | 51.53 | (+++) |
| <i>Excoecaria agallocha</i> | Leaves | 44.10 | (++) |
| <i>Astragalus hamosus</i> | Leaves | 32.74 | (++) |
| <i>Derris scandens</i> | Leaves | 44.53 | (++) |
| Positive control -Neem commercial formulation (1500ppm azadiractin) | - | 69.43 | (+++) |
| Control | - | 0 | - |

Table 2. Insecticidal activity of certain botanicals against *S. incertulas*

| Treatment (2% concentration) | Part extracted | Cumulative percent | |
|---|----------------|--------------------|-----------------|
| | | Larval Mortality | Pupal mortality |
| <i>Annona muricata</i> | Leaves | 0.00 | 0.00 |
| <i>Orophea katschallica</i> | Leaves | 0.00 | 0.00 |
| <i>Semecarpus prainii</i> | Nuts | 33.33 | 26.66 |
| <i>Alstonia kurzii</i> | Leaves | 0.00 | 0.00 |
| <i>Tetracera sarmentosa</i> | Roots | 53.33 | 46.66 |
| <i>Aegiceras corniculatum</i> | Leaves | 6.66 | 6.66 |
| <i>Avicennia marina</i> | Leaves | 6.66 | 0.00 |
| <i>Grewia calophylla</i> | Bark | 6.66 | 6.66 |
| <i>Barringtonia asiatica</i> | Bark | 46.66 | 33.33 |
| <i>Calophyllum inophyllum</i> | Leaves | 40.00 | 46.66 |
| <i>Macaranga tanarius</i> | Leaves | 0.00 | 0.00 |
| <i>Oroxylum indicum</i> | Bark | 0.00 | 26.66 |
| <i>Pometia pinnata</i> | Leaves | 20.00 | 33.33 |
| <i>Pajanelia longifolia</i> | Leaves | 40.00 | 13.33 |
| <i>Rhizophora mucronata</i> | Bark | 40.00 | 20.00 |
| <i>Cerbera odollam</i> | Leaves | 40.00 | 26.66 |
| <i>Hibiscus tiliaceus</i> | Leaves | 13.33 | 40.00 |
| <i>Caesalpinia bonduc</i> | Seeds | 0.00 | 0.00 |
| <i>Canarium euphyllum</i> | Leaves | 0.00 | 13.33 |
| <i>Hornstedtia fenzlii</i> | Leaves | 13.33 | 13.33 |
| <i>Amomum fenzlii</i> | Leaves | 0.00 | 26.66 |
| <i>Duabanga grandiflora</i> | Stems | 0.00 | 26.66 |
| <i>Murraya paniculata</i> | Leaves | 13.33 | 26.66 |
| <i>Atalantia monophylla</i> | Leaves | 40.00 | 40.00 |
| <i>Aglaia spectabilis</i> | Bark | 0.00 | 0.00 |
| <i>Chukrasia tabularis</i> | Leaves | 0.00 | 0.00 |
| <i>Mallotus Philippensis</i> | Leaves | 0.00 | 33.33 |
| <i>Excoecaria agallocha</i> | Leaves | 0.00 | 20.00 |
| <i>Astragalus hamosus</i> | Leaves | 6.66 | 13.33 |
| <i>Derris scandens</i> | Leaves | 66.66 | 33.33 |
| Positive control -Neem commercial formulation (1500ppm azadiractin) | | 26.66 | 26.66 |
| Control | | 0.00 | 0.00 |
| C.D | | 11.27 | 12.78 |

Values are mean of three replications Values in parenthesis are arc sine transformed Values with various alphabets differ significantly

Sonali *et al.* (2006) reported tranquilizing property of *A. fenzlii* and Dev *et al.* (2010) antifeedant property of *O. indicum* due to the presence of alkaloid, glycoside, flavanoids and phenolic compounds. About 15 treatments showed medium inhibition with the range from 51.53 to 75.55%. Least per cent stalk

length protection over control was observed in *chukrasia tabularis* and *Mallotus philippensis* @ 5%, whereas maximum per cent stalk length protection over control was observed in *Barringtonia asiatica*. Our findings coincide with the finding of Syahputra (2013) who indicated the extract of *Barringtonia* possess antifeedant activity against cabbage head

caterpillar. *Atlantia monophylla* (72.50%) and *Semecarpus prainii* (70.32%) nuts showed medium inhibition. Ahmad *et al.* (1981) isolated the tetrahydroamto flavones from the genus of *Semecarpus*. Muthu *et al.* (2009) revealed that the hexane extracts at 5% of *Atlantia monophylla* showed pronounced effect against *Earias vitella*. Thirteen treatments showed weak antifeedancy and ranges from 26.19 to 47.64%. *Tetracera sarmentosa* root extracts revealed 47.64% antifeedancy. Uddin Mazumdar *et al.* (2017) reported that *T.sarmentosa* contain phenol, flavonoids, saponins and steroid. Regarding insecticidal activity @ 2%, the highest larval mortality was found in *Derris scandens* (66.66%) which was followed by *Tetracera sarmentosa* (53.33%) and *Barringtonia asiatica* (46.66%). Rani *et al.* (2013) reported prenylated isoflavones of *Derris scandens* as insecticidal. It was cleared that *Annona muricata* possessed strong antifeedant activities followed by *Amomum fenizlii* and *Oroxylum indicum* against *Scirpophaga incertulas*. Whereas *Derris scandens*, *Tetracera sarmentosa* and *Barringtonia asiatica* were also contain insecticidal properties among thirty plants. Thus the detailed survey for Pesticidal value from the flora of Andaman and Nicobar Islands, revealed the availability of rich sources. The plants belonging to the family Annonaceae, Anacardiaceae and Zingiberaceae have pronounced Pesticidal value. Further characterization may end with the new molecule for the pesticide industry. This will support to save the environment in future by reducing the level of harmful residues. The farmers who are all involved in organic farming will be benefitted with the output of the research.

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