ECO-FRIENDLY MANAGEMENT OF HADDA BEETLE (*Henosepilachna vigintioctopunctata* F.) (COLEOPTERA: COCCINELLIDAE) USING SLECTED BOTANICAL EXTRACTS

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Introduction

Brinjal (*Solanum melongena* L.) is a major vegetable crop grown in Sri Lanka. Insect pests are the major threat to brinjal cultivation. Hadda beetle (*Henosepilachna vigintioctopunctata* F.) (Coleoptera: Coccinellidae), whis is a polyphagous pest of economically important solanaceae and cucurbitaceae family crops, is a serious insect pest of brinjal cultivation in northern Sri Lanka next to the shoot and fruit borer. The adult and larval stages feed on epidermal tissues of leaves, flowers and fruits of brinjal and cause considerable economic losses [1]. Synthetic insecticides are preferred among the management strategies proposed and frequently being used by the farmers. Recently imposed government policy on organic agriculture to minimize the cumulative adverse effects agrochemicals on human and environment, pushed the farmers to use ecofriendly approaches. Therefore, the primary goal of this research was to study about the insecticidal activity and antifeedant activity of selected botanical extracts against Hadda beetle and qualitative analysis of phytochemicals present in the screened extracts.

Materials and Methods

The investigations were conducted at the Plant Protection & Bio Control Laboratory at the Department of Agricultural Biology, Faculty of Agriculture, University of Jaffna, ariviyal Nagar, Kilinochchi (Longitude: 80.4, Latitude: 9.32, Altitude : 46m), belongs to the dry zone. The mean annual rainfall is around 1125mm and the mean annual temperature is around 25-35 ◦C (Department of Meteorology, 2021).

Collection and rearing of Henosepilachna vigintioctopunctata

Adult beetles of *H. vigintioctopunctata* were collected from brinjal farms at Thirunelvely and Kayts of Jaffna district and were reared in the insect rearing cages on the host plants for multiplication.

Preparation of Aqueous extracts

The plant leaves of *Senna alata*, *Calotropis gigantea*, *Cascabela thevetia*, *Vitex negundo* and *Justicia adhatoda* were collected from the herbal garden at the

research veneue and neem (*Azadirachta indica*) seed kernels were bought from an ayurvedic shop. Collected plant parts were surface sterilized with 1% NaOCl and were shade dried for five days under room temperature. Dried plant parts were ground in to fine powder using electric blender under aseptic conditions.
Hot water method of extraction was used for the preparation of plant extracts. Each plant powder of 100 g was dissolved in 1000 mL hot water (60˚C) and mixed well. Then solution was kept at water bath at 85˚C for 2 hrs. The solution was intermittently shaken manually for every 30 minutes. The solution was left to cool and then filtered using muslin a cloth. The solution was centrifuged at 4000 rpm for 10 minutes and the supernatant of the extract was obtained separately and stored in the refrigerator at 4˚C for the experiments.

Testing antifeedant activity
Testing antifeedant activity was performed using leaf disc with no choice method [1]. The experiment was carried out using plastic containers of the same size (3L). Fresh brinjal leaves were collected from Biology home garden and they were cut into 5 cm diameter leaf discs. Leaf discs were dipped into plant extracts and left to air dried. Leaf discs were placed above wetted filter paper to prevent early drying. Then they were placed into plastic containers at the rate of 1 leaf disc/container. Adult beetles of same age and size were collected from the rearing cages. Adult beetles were placed into bottles at the rate of 1/container and the lid was closed. Distilled water treated leaf disc was used as control. Totally seven treatments were provided with ten replicates. Leaf area consumed by the beetle was recorded after 24 hrs and 48 hrs intervals. Graph sheet method was used to find the leaf area consumed. Leaf area consumed in plant treatments were corrected against control. The antifeedant index was calculated using the following formula [2];

$$\text{Antifeedant Index } (\%) = (\text{C-T})\ (\text{C+T})\ \text{X } 100\%$$

C – Leaf area consumed in control
T – Leaf area consumed in treatment

Testing Mortality
Testing mortality was carried out in the same way as testing antifeedant activity. Fresh brinjal leaves were dipped in each extract and placed inside bottles at the rate of one leaf per bottle. Wetted filter paper was placed under the leaf to prevent early drying of leaves [1]. Distilled water was used as control. Ten adult beetles were placed in each bottle and the number of dead beetles were counted at 12 hours, 24 hours and 48 hours of intervals. The mortality rate was calculated by the following formula,

Mortality rate=Number of dead beetlesNumber of beetles used for experiment X 100%

Qualitative analysis of phytochemicals

Secondary metabolites present in the botanical extracts such as alkaloids, phenols, terpenoids, saponin, flavonoids and quinones were measured qualitatively using standard methods [3].

Data collection and Statistical analysis

Complete randomized design (CRD) was used to perform analysis of variance (ANOVA) and Tukey's HSD multiple comparison test was administrated to identify the best treatment at P <0.05 using SAS 9.1 (SAS Institute Inc., Cary, NC, USA).

Results and Discussion

The experimental results show that the antifeedant efficacy of different plant extracts were significantly different at P <0.05 (Table 1). Data pertaining to results presented in Table 1 shows that antifeedent efficassy of *C. gigantea*, *C. thevetia* and *J. adhatoda* was 100 % even after 48 hours. *Senna alata* expressed lowest antifeedant index after 48 hours among all other six plant extracts. After 48 hours the antifeedant index of *A. indica* reduced from 100 % to 78.58 %.

Table 1: Antifeedant index after 24 hours and 48 hours

Plant extract	After 24 hours	After 48 hours
Azadirachta indica	100 %	78.58 %
Senna alata	85.24 %	56.5 %
Calotropis gigantea	100 %	100 %
Cascabela thevetia	100 %	100 %
Vitex negundo	80.71 %	74.23 %
Justicia adhatoda	100 %	100 %
Water	15.75%	5.8%

Values are means of four replicates based on the formula of calculating antifeedant index

Insecticidal activity of crude extracts was significantly on par compared to the control treatment at P <0.05. The mortality percentage of *H. viginitioctopunctata* after 12 hours, 24 hours and 48 hours were varied from 2.5±5-12.5±12.58, 2.5±5-30±14.14 and 2.5±5-62.5±15, respectively (Table 2). The highest mortality rate was observed for *A. indica* at each time intervals. High mortality rate of insects normally indicates the higher insecticidal activity.

Table 2: Mean mortality percentage of adult beetles against different plant extracts

Plant extract	After 12 hours	After 24 hors	After 48 hours
Azadirachta indica	12.5 ± 12.58^{a}	30 ± 14.14^{b}	62.5 ± 15^{b}
Senna alata	7.5 ± 5^{a}	12.5 ± 5^{ab}	30 ± 8.16^{b}
Calotropis gigantea	5 ± 5.77^{a}	27.5 ± 12.58^{abc}	50 ± 14.14^{c}
Cascabela thevetia	10 ± 8.16^{a}	15 ± 12.91^{abc}	25 ± 10^{c}
Vitex negundo	2.5 ± 5^{a}	5 ± 5.77^{ac}	15 ± 5.77^{c}
Justicia adhatoda	5 ± 5.774^{a}	12.5 ± 9.57^{c}	27.5 ± 9.57^{ac}
Control (Distilled water)	2.5 ± 5^{a}	2.5 ± 5^{c}	2.5 ± 5^{ac}

Values are means of four replicates. Within the column similar alphabets are statistically not significant according to the Tukey's HSD multiple comparison test at $\alpha = 0.05$.

As per the qualitiative analysis of the phytochemicals present in the different botanical extracts, Tannins and Saponin are present in all the extracts. All the phytochemicals tested were present in *A. indica* and *C. gigantea* except the Coumarin which is not present in *A. indica* (Table 3). Phenols were absent in *S. alata* and *V. negundo*.

Table 3: Screening for phytochemicals present in plant extracts

Phytochemicals	***Azadirachta indica***	***Senna alata***	***Calotropis gigantea***	***Cascabela thevetia***	***Vitex negundo***	***Justicia adhatoda***
Phenols						
Iodine test	+	-	+	+	-	+
Potassium dichromate test	+	-	+	+	-	+
Alkaloids	+	-	+	+	+	+
Tannins	+	+	+	+	+	+
Saponin	+	+	+	+	+	+
Coumarin	-	-	+	+	-	+
Flavonoids						
Conc H_2SO_4	+	+	+	-	-	-
Ammonia test	+	+	+	-	-	-

+ = present - = absent

Saljoqi *et al.* [3] reported that botanical extracts of *Melia azadarach*, *Perthenium hysterophorus*, *Phlogocanthus thyrsiflorus*, *Vitex trifolia*, *Zanthoxylum acanthopodium*, and *A. indica* were tested on rice weevils and M. azadarach caused highest mean mortality of 80.54% at 35 days after treatment. Aqueous leaf extracts of *Calotropis gigantea* outperformed *Croton laccifera* in terms of mortality and reduction of fecundity of 1st and 2nd instar nymphs, and newly emerged apterous females of cowpea aphid (*Aphis craccivora*) [4]. Among the various herbs, *A. indica* based insecticides has been the most accepted bio-pesticides and It acts as an antifeedant, repellent, and repugnant agent and induces sterility in insects by preventing oviposition and interrupting sperm production in males [5].

Conclusions and Recommendations

Botanical extract *C. gigantean* and *A. indica* are best botanicals among the tested showing highest antifeedant and mortality against *H. viginitioctopunctata*. various phytochemicals present in them are responsible for the insecticidal properties. Quantitative anlysis and repetitive field studies are recommended for recommendation.

References

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