Original Research Article

Antifeedant and Insecticidal activity of different solvent extracts of *Vitex negundo* (L) against *Spodoptera litura* (Fab.)

ABSTRACT

Spodoptera litura is a serious polyphagous pest causing damage to more than 150 species of host plants and it is distributed throughout the tropical and sub- tropical regions of world including India, Japan, China and South East Asia. The chemical pesticides affect the non- target organisms and human beings, directly or indirectly. To find environmentally safe alternative there is need of considering the pesticides of biological origin to replace synthetic pesticides. Anti-insect activity check of plant extract can play important role in ecofriendly control of insect pest. *Spodoptera litura* is a dangerous polyphagous pest found throughout the world's tropical and subtropical regions, including India, Japan, China, and South East Asia. It harms more than 150 species of host plants. Chemical pesticides have direct or indirect effects on both people and non-target creatures. Considering biological pesticides as a possible replacement for synthetic pesticides in order to develop an environmentally safe alternatives, plant extract with anti-insect efficacy can be crucial as sustainable eco-friendly control measure for insect pests.

The present work is aimed to identify a natural alternative to chemical pesticides for the control of insect pests by examining a variety of factors, including larval weight, duration, antifeedant activity, and mortality. Maximum larval mortality (10.30%) was noted in *Vitex negundo* chloroform extract. The larval duration is much longer in the *Vitex negundo* chloroform and methanol extracts (10.23 days and 10.56 days, respectively) as compared to the control group. The *Vitex negundo* chloroform extract (59.42%) and acetone (37.68%) have the strongest antifeedant effects. In comparison to the control, the larval weight was significantly reduced in the *Vitex negundo* chloroform (0.391 gm), acetone (0.401 gm), and methanol extract (0.420 gm) extracts (0.621 gms).

Key words- *Vitex negundo*, anti-insect activity, *Spodoptera litura* , plant extracts

Introduction

Insect population is a significant health and agricultural hazard. Ten to thirty percent of main crop loss in agriculture is attributable to insect pests, which inflict serious damage to crops and directly effect revenue (Ferry et al., 2004). The dangerous polyphagous pest Spodoptera litura, which is present in all tropical and subtropical parts of the world, including India, Japan, China, and South East Asia, damages more than 150 species of host plants (Rao, et. al. 1993, & Murgesan and Dhingara, 1995). Forty species of the 150 host plants are known to come from India (Mallikarjuna, et .al., 2004). Most farmers attempt to control the population of *S. litura* by using chemical insecticides. These insecticides have direct or indirect effects on both humans and non-target creatures. Due to a lack of host plant resistance to *S. litura* and inadequate management techniques, it is challenging to handle this pest in the fields. Consider biological pesticides as a possible replacement for synthetic pesticides in order to develop an environmentally safe alternative. The use of biopesticides to protect crops from insect pests has become more important in recent years due to rising awareness of the adverse effects of the chemical pesticides' indiscriminate use (Chari et. al., 1990).

The small tree *Vitex negundo* L, a member of the Verbenaceae family, has thin, gray bark. The herb is abundantly available and has pharmacological effects against a variety of diseases in the conventional medical system. Numerous secondary metabolites, including alkaloids, phenols, flavanoids, glycosidic irridoids, tannis, and terpenes, are present in all plant sections, but particularly in the leaves. Hepatoprotective, anti-inflammatory, anti-tumor, antioxidant, insecticidal, antimicrobial, anti-androgenic, anti-osteoporotic, anti-cataract, and anti-hyperglycemic activity were among the promising bioactivities that the crude extracts and purified components of Vitex negundo displayed (Zheng et al., 2015).

In the present investigation the attempt has made to study the effect of extract of *Vitex negundo* leaf against *Spodoptera litura*.

Material and Methods

Collection and Rearing of *Spodoptera litura* –

The eggs of *S. litura* were purchased from National Bureau of Agriculture Insect Resources (ICAR), Bangalore. The larvae were fed with castor leaves (*Ricinus communis*. L).

Collection and Extraction of plant extract

The fresh leaves of *Vitex negundo* were collected from the areas of Nivkane, Diwashi Khurd, Helwak, Rasati from taluka Patan district Satara (M.S). The leaves were washed separately with distilled water, shade dried, cut into small pieces and air dried for 14 days in the laboratory before pulverized into fine powders using an industrial electric pulverizing machine at the Department of Zoology, SGM College, Karad. The powders were further sieved to pass through mm2 perforations and kept in an air-tight plastic containers for storage before use at ambient temperature (28 ± 2) °C.

About 300 g of *V. negundo* leaf powders were soaked separately in an extraction bottle containing 500 ml of chloroform, acetone and methanol for 72 hours. The mixture was stirred occasionally with a glass rod and extraction was terminated after three days. Filtration was carried out using a double layer of Whatman No. 1 filter papers and solvent evaporated using a rotary evaporator at 30 to 40 °C with rotary speed of three to six rpm for eight hours. The resulting extracts were air dried in order to remove traces of respective solvents. The extracts were kept in labeled plastic bottles till when needed.

Standard stock solutions were prepared by dissolving 1 g of the crude extracts in 100 ml of solvent.

Larvicidal activity-

1% mg/ml concentration of crude extract of *Vitex negundo* was applied using leaf disc method. The treated leaves were exposed to the 3^{rd} instar larvae. After 24 hrs of treatment, the larvae were continuously maintained on the non- treated castor leaves. Later the larvae were provided with fresh castor leaves at every 24hrs. Larval mortality was recorded after 96 hrs of treatment. Five replicates were maintained for each treatment with 10 larvae per replicates. Percent mortality was calculated by using Abbott's formula. (Abbott, 1925). The experiment was conducted at laboratory temperature of 27 ± 2^{o} C with 75 ± 5 % relative humidity.

$$\% \text{ Larval Mortality} = \frac{\text{Number of dead larvae}}{\text{Number of larvae introduced}} \text{ X } \frac{100}{1}$$

Percentage larvae mortality was calculated using Abbott corrected mortality formula

$$PT = \frac{Po-Pc}{100-Po} X \frac{100}{1}$$

Where P_T = corrected mortality (%)

P_O = observed mortality (%)

P_C = control mortality (%)

Antifeedant activity

Leaf discs no choice methods (Shrivastava., et al, 1990) were used for bioassay test, after washing with tap water. The crude extracts were dissolved in respective solvents. Fresh castor leaf discs of 4 cm diameter were punched using a borer. The leaf discs were dipped in different solvent extracts. Negative controls were dipped in the representive solvent. Treated leaves were air dried at room temperature and kept in petri plates (9cm diameter). Prestarved (3 hours) larvae of third instar were allowed to feed on the treated leaf disc for 24hours. Five replicated were maintained. For each treatment ten larvae per replicates (total number=50) with one control were maintained. Progressive consumption of the leaf area by the larvae after 24hours were recorded in control and treated discs using the leaf area metre. Area of the leaf eaten by the larvae in plant extract treatment was corrected from the control. Percentage of antifeedant activity was calculated using the formula of Isman et. al (1990).

$$\text{Antifeedant activity} = \frac{\text{Control - Treatment}}{\text{Control + Treatment}} X \frac{100}{1}$$

Larval duration-

The survived larvae were further continuously fed with non- treated castor leaves. The larval duration was calculated after treated larvae became pupae (Baskar,K., et al,2011).

Larval weight-

The data on the leaf area consumed was recorded and used for the calculation of the larval weight gain at 3 days after feeding.

Statistical analysis

The data obtained in present study was subjected to analysis of variant (ANOVA) significant difference between treatments and controlled were determined by Tukey's multiple range test ($P \leq 0.05$).

Result and Discussions

The *Vitex negundo* leaf extract in chloroform (10.30%) showed the highest level of larval death, followed by the extract in acetone (7.7%). The leaf extract in methanol showed the lowest mortality (3.09%). (Table 1 & Fig 1). In *P. xylostella*, the aqueous leaf extract of *A. squamosa* at 10% resulted in 66.70% larval death (Chandrashekharaiah et al., 2015). When used to combat *S. litura*, *Artemesia nilagrica's* ethyl acetate extract resulted in a 40.24% larval mortality rate (Raja et al., 2003).

To evaluate the antifeedant activity of *Vitex negundo* leaf extracts, the amount of leaf area that was consumed by larvae was noted. By comparing the leaf area consumed by the larvae in the treated and untreated groups (13.15%), it is evident that *Vitex negundo's* chloroform leaf extract (59.42%) and acetone leaf extract (37.68%) exhibit significant antifeedant activity, while the methanol leaf extract of *Vitex negundo* exhibits nonsignificant results (Table 2 & Fig.2). Our findings are consistent with Cassi's earlier observation from 1983 that an aqueous extract of *A. tagala* had antifeedant effect against *S. litura*.

The larval duration significantly increases in the *Vitex negundo* chloroform and methanol extracts (10.23 and 10.56 days, respectively) when compared to the control group. Results comparing the control group (9.2 days) with the acetone extract of *Vitex negundo* demonstrate the larval duration (Table 3, Fig. 3). The larval life of *H. armigera* was lengthened by the ethyl acetate extract of *Mundulea sericea* (Vendan et al., 2008). When treated group and control group were compared, it appeared that the chloroform extract of *Vitex negundo* (0.391 gms), which was followed by acetone (0.401 gms), methanol extract (0.420 gms), and then the control group (0.621 gms), had dramatically decreased larval weight (Table 4 & Fig 4).

Table. 1 Percent larval mortality observed after treatment of *S. litura*

	Acetone	Chloroform	Methanol
***Vitex negundo* (1%)**	7.7 ± 0.95 [a]	10.30 ± 0.69 [b]	3.09 ± 0.78 [b]
Control	0	0	0

Within column ± SD followed by the same letter donot differ significantly using Turkey's test, $P \leq 0.05$.

a- No significance
b- Significant
c- Highly significant
d- Very highly significant

Table.2 Percent antifeedant activity of plant extracts against S. litura

	Acetone	Chloroform	Methanol
***Vitex negundo* (1.0mg/ml)**	37.68 ± 3.19 [b]	59.42 ± 2.62 [b]	28.81 ± 3.83 [a]
Control	13.15 ± 1.72 [a]		

Within column ± SD followed by the same letter donot differ significantly using Turkey's test, $P \leq 0.05$,

a- No significance
b- Significant
c- Highly significant
d- Very highly significant

Table. 3 Total larval duration (days) of *S. litura* after treatment

	Acetone	Chloroform	Methanol
***Vitex negundo* (1.0mg/ml)**	9.3 ± 0.83 [a]	10.23 ± 0.28 [b]	10.56 ± 0.52 [b]
Control	9.2 ± 0.44 [a]		

Within column ± SD followed by the same letter donot differ significantly using Turkey's test, $P \leq 0.05$.

a- No significance
b- Significant
c- Highly significant
d- Very highly significant

Table.4 Effect of plant extracts on weight of larva (g)

	Acetone	Chloroform	Methanol
***Vitex negundo* (1.0mg/ml)**	0.401 ± 0.52 [b]	0.391 ± 0.81 [b]	0.420 ± 0.27 [b]
Control	0.621 ± 63 [a]		

Within column ± SD followed by the same letter donot differ significantly using Turkey's test, $P \leq 0.05$.

a- No significance
b- Significant
c- Highly significant
d- Very highly significant

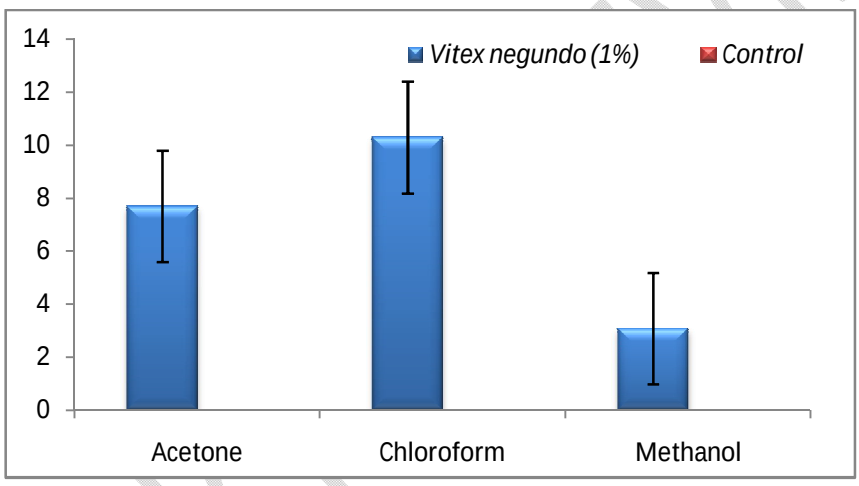

Fig. No. 1-Histogram showing Percent larval mortality observed after treatment of *S. litura*

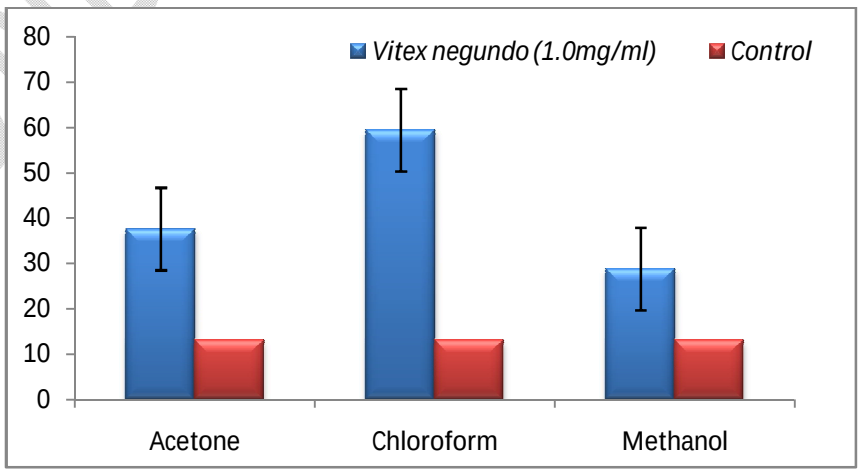

Fig.No.2 - Histogram showing Percent antifeedant activity of plant extracts against *S. litura*

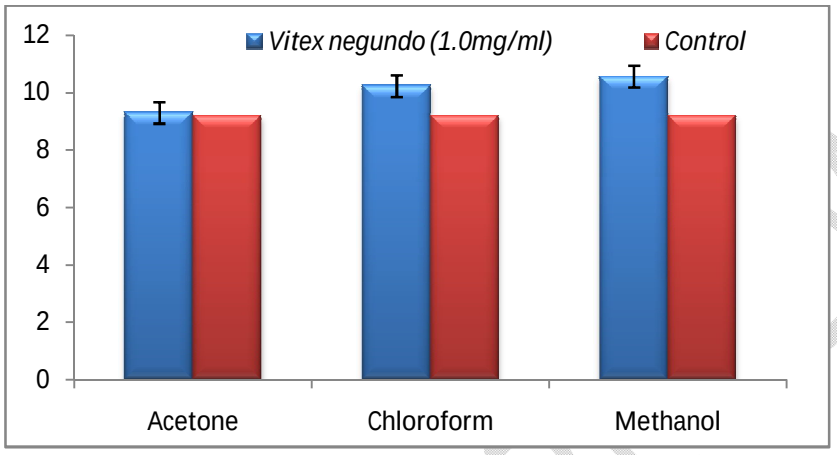

Fig.No.3- Total larval duration (days) of *S. litura* after treatment

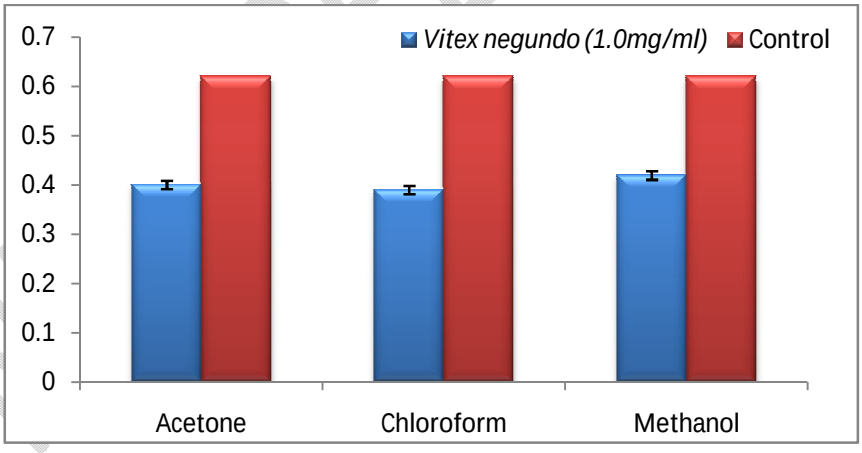

Fig.No.4- Effect of plant extracts on weight of larva (g)

Conclusion

For the management of insects, pest control professionals are increasingly turning to pesticides generated from natural sources as an alternative to traditional chemical pesticides. When the effect leaf extract of *Vitex negundo* (L) was investigated for evaluation of percent mortality, larval duration, percentage of antifeedant activity, and larval weight, it was shown that the plant extracts displayed pesticidal capabilities. According to the findings of the current experiment, *Vitex negundo* leaf solvent extracts with 1.0 mg/ml concentrations of effective antifeedant properties. While studying all aspects of *Spodoptera litura's* life cycle, the chloroform extract of *Vitex negundo* leaf shown the greatest impacts. The leaf extract of *Vitex negundo* in various solvent mediums will be the most effective, according to the findings of the current investigation. As a result of the current experiment, it has been determined that the leaf extract of *Vitex negundo* in various solvent mediums will be the ideal substitute for chemical pesticides against *Spodoptera litura* due to its anti-insect potential.

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