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Antifeedant activity of different solvent extracts of *Gliricidia sepium* against third instar larvae of *Helicoverpa armigera* (Hubner) (Lepidoptera : Noctuidae)

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Abstract

Plant based pesticides are known as phytopesticides. Phytopesticide formulations offer a more eco-friendly approach to Insect Pest Management than chemical pesticides. The biological compounds present in these formulations have several biological activities against insect pests. In the present work, an attempt has been made to study the antifeedant activity of *Gliricidia sepium* leaf extracts using three solvents, i.e; petroleum ether, ethyl acetate and methanol against third instar larvae of *Helicoverpa armigera.* All extracts exhibited as significant antifeedant activity at LC_{50}. Methanol extract deterred feeding potential of the insect larvae by 62.38% at 1000 ppm, followed by ethyl acetate (46.67%) and petroleum ether (40.37%). Hence this naturally occurring plant extracts could be useful for managing the *Helicoverpa armigera* population.

Keywords: *Helicoverpa armigera*, *Gliricidia sepium* , antifeedant, chemical pesticide, Pest management.

1. Introduction

Helicoverpa armigera (Lepidopteria; Noctuidae) is one of the serious cosmopolitan polyphagous pest attacking more than 180 plants in India. This insect causes damages to cultivated crops such as cotton *(Gossypiam Sp.)*, tomato (*Lycopersicon lycopersicum*), pigeon pea(*Cajanum Cajan*), chick pea (*Cicer arietinum*), maize (*Zea mays*) etc. Insect population increases significantly during reproduction phase. Infection of pest was observed both at vegetation and reproduction phase of coriander (Chaudhary *et al*, 2003). The management of *Helicoverpa armigera* is very difficult in crops, which relies heavily on the area of chemical insecticides (Romesis *et al*., 1999). Indiscriminate use of chemical insecticide has developed high levels of resistance to the insects. (Armes *et al*., 1996). The scientists all over the world are struggling to develop a safer method of pest control. Taking that as a challenge, biopesticide is one of the best option as its is ecofriendly and can be integrated with other pest management strategies. The plant based pesticides are biopesticides, more over they are not hazardous chemical insecticides to the environment. Natural plants possess multifaceted pest management properties such as antifeedant, insecticidal, growth disruptive, antimicrobial, antiovipositional etc., through several mode of action. More than 2000 plant species have insecticidal properties (Jacobson and Crosby, 1971). Plant derivatives are highly toxic to many insect species without phytotoxic properties (Schmutter, 1992).

Gliricidia sepium a leguminous tree belongs to the family *Fabaceae* (Chadhokar, 1982). *Gliricidia*, which literally means "Rat poison" originated in central America and its plantation, has spread to many parts of the world specifically South Asia. *Gliricidia* means Mouse or Rat killer, which is derived from its bark & leaves which when cooked with grain can be used as poisonous bite for rodent. Though poisonous to rodents and insects, the leaves contain 3-4% dry weight of nitrogen and small amount of phosphorus, potassium, calcium and magnesium, so they can be used as excellent green manure and fodder (Csurhes & Edwards, 1998). . Researches have been conducted on both the antifungal and antimicrobial properties of *Gliricidia* plant extracts. Nochebuena & O'Donovan, (1986). The present study were focused on the ability of the plant to control insects

2. Materials and Methods

2.1 Plant Material

Fresh leaves were collected from in and around Kerala during the month of August to October in 2013 and the biological authentication was carried out by professor Mary Josephine, Head of the Department of Botany, Nirmala College, Coimbatore. Leaves of *Gliricidium sepium* was washed, shade dried for two weeks. After that, they were crushed up and ground to get homogenous fine powder by an electric blender. 500 gm of powder was macerated with 1.5 litters of petroleum ether, ethyl acetate and methanol separately. Each extract is concentrated at reduced temperature on rotary evaporator and stored at $4^{\circ}C$. In the present study, preliminary phytochemical analysis of leaves crude extract of *Gliricidium sepium* revealed that terpenoids, coumarin and phenols present in the methanol extracts. These compounds indicates the higher insecticidal potential of *Gliricidium sepium.*

2.2 Test Insect

Cotton boll worm,*Helicoverpa armigera larvae* were collected from the tomato field, Chittur, Palaghat district, Kerela. The larvae were reared on chickpea seeds under controlled condition in laboratory ($25+2^{0}C$ and 65% + 5 RH) throughout the study period. The larvae were reared according to El- Defrawi *et al.*, 1964). The third instar larvae were preferred for the experiment as they were voracious feeders.

2.3 Antifeedant Activity : (Isman *et al* .1990)

Leaf discs no choice methods were used for bioassay test, after washing with tap water. The crude extracts were dissolved in respective solvents. Fresh tomato leaf discs of 4 cm diameter were punched using a borer. The leaf discs were dipped in different concentration (250, 500, 750 and 1000 ppm). Negative controls were dipped in the representive solvent. Treated leaves were air dried at room temperature and kept in petri plates (9cm diameter). Prestarved (6hours) 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

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

2.4. Statistical analysis

All datas were analysed statistically by ANOVA to evaluate the different treatments and the mean values were compared at significant levels of 1% and 5%, LC 50 values were calculated using probit analysis (Finney, 1971).

3. Results and Discussion

Antifeedant activity of each extracts were assessed by comparing the averages of the leaf consumed in the treated and control leaves. Efficacy of plant extracts was assayed against the third instar larvae of *Helicoverpa armigera* for antifeedant activity. When compared to control, reduced food intake was observed in all extracts namely Petroleum ether, Ethyl acetate and Methanol treated leaf discs consumed by *Helicoverpa armigera*. Most potent insect antifeedants are quinones, phenols, alkaloids, lactones, diterpinoids and tripinoids (Schoonhoven, 1982). In the present study, preliminary phytochemical analysis of leaves crude extract of *Gliricidium sepium* revealed that terpenoids, coumarin and phenols present in the methanol extracts (Table-1). These compounds indicate the higher insecticidal potential of *Gliricidisepium.* The tested botanical extracts clearly

showed different antifeedants against, third instar larvae of *Helicoverpa armigera* (Table 2). Antifeedant activity of solvent crude extracts was assessed based on antifeedant index. Higher antifeedant index normally indicated decrease rate of feeding. In the present study irrespective of concentration and solvents used for extraction the antifeedant activity varied significantly. The study clearly reveale that maximum feeding deterrent activity of 72.3% was recorded in methanol extract of *Gliricidium sepium* at 1000 ppm followed by Petroleum ether and ethyl acetate extract of *Gliricidium sepium*, compared to control. Similar results were reported in crude ethanolic extracts of five medicinal plants (*Berberis lyceum* L, *Hedera nepalensis* L, *Acorus calamus* L, *Zanthoxylum armatum* L and *Valeriana jatamansi* L.) with specific mode of action against insects in a complex mixture of compounds (Tewary *et al.*,2005).

In the present study Methanol extract of *Gliricidium sepium* exhibited significant antifeedant activity at a higher concenteration (1000 ppm). This indicated that the active compounds present in the plant inhibit the larval feeding behaviour or make the food unpalatable. These active substance may directly act on the chemosensilla of the larvae resulting in feeding deterrence (Yasui *et al*., 1991). Several authors have reported that plant extracts possess similar type of antifeedant activity against *Helicoverpa armigera* (Raja *et al*., 2005; Baskar *et al*., 2009; Akhtar and Isman, 2004). Some compounds present affect the feeding behaviour of the insects and inhibit feeding,while others disrupt hormonal balance (Ulrichs *et al*., 2008). Some plants have been reported as insect repellents, antifeedants, insecticides, ovicides and oviposition deterrents (Dubey *et al*., 2010).

Table- 1 Phytochemical analysis of *Gliricidia sepium* leaf Extract

		Solvents				
S .No	**Secondary metabolites**	**Distilled water**	**Ethyl acetate**	**Methanol**	**Chloroform**	**Petroleum Ether**
1	Alkaloids	+	+	++	-	-
2	Terpenoids	-	-	+++	+	+
3	Phenolics	+	-	+++	-	-
4	Coumarin	-	+	+++	++	-
5	Tannins	+	-	++	-	+
6	Saponins	-	-	-	-	-
7	Flavonoids	++	++	+++	-	+
8	Quinones	+	-	+	-	++
9	Proteins	++	-	-	+	-
10	Sterols	-	+	++	+	-

(+) - Positive (-) Negative (+++) - Strongly positive

Table -2 Antifeedant activity of crude extracts of *Gliricidium sepium* against third instar larvae of *Helicoverpa armigera*.

Crude extracts	250 ppm	500 ppm	750 ppm	1000 ppm
Petroleum ether	17.45± 5.50^{b}	24.58± 4.42^{a}	31.83± 3.57^{b}	40.37± 4.56^{a}
Ethyl acetate	13.65± 3.98^{a}	25.54± 3.11^{a}	36.15± 4.42^{b}	54.67± 6.72^{b}
Mehanol	19.46± 3.56^{c}	30.21± 5.35^{b}	50.61± 4.83^{c}	72.38± 7.41^{c}

Within the column data with different superscripts are statistically significant (P< 0.05 by LSD).

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