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Effect of *Calotropis procera* leaf extract on *Spodoptera litura* (Fab.)

Ga. Bakavathiappan*, S. Baskaran, M. Pavaraj and S. Jeyaparvathi

ABSTRACT

The study was carried out to determine the antifeedant activity of different solvent extracts (0.625, 1.25, 2.5 and 5%) of *Calotropis procera* leaves against third instar larvae of *Spodoptera litura* by leaf dip method. The maximum activity was recorded in chloroform extract followed by hexane, ethanol, acetone, ethyl acetate and methanol. Chloroform extract exhibited the best larvicidal activity against the *S. litura.* The antifeedant activity was directly proportional to the concentration of the extract. Antifeedant effect in insect is one of the major parameters to assess the efficacy of crop protections. The results clearly indicate that the chloroform extract of *C. procera* possesses many useful properties to control insect pests.

Key words: Antifeedant activity, *Calotropis procera,* pest control, *Spodoptera litura*

INTRODUCTION

The production in agriculture is reduced by losses as high as 45% before or after harvesting due to attack of a variety of pests, including insects, nematodes, virus and bacteria induced diseases and competition by weeds (Oerke *et al*., 1994). An estimated one third of global agricultural production valued at several billion dollars is destroyed annually by over 20,000 species of insect pests in field and storage (Mariapackiam and Ignacimuthu, 2008). *Spodoptera litura* is an obiquitous, polyphagous, multivoltine, Lepidopteron pest that feeds on 112 cultivated crops all over the world (Moussca *et al.*, 1960). The *Spodoptera* moths are found primarily active during night and due to its high mobility, female ovipositing on a wide range of host plants, which promotes or even ensures survival of *S. litura* individual over a broad range of environmental conditions (Chelliah, 1985). The outbreaks of this pest occurs due to resistance to insecticide, favorable weather conditions, cyclonic weather and heavy rainfall after a long dry spell (Thanki *et al.,* 2003).

Indiscriminate use of chemical pesticides over the years has adversely affected human health, non-target organisms, extensive ground water contamination and environment has also promoted development of pesticides resistance in insect species. In such a scenario, botanicals and bio pesticides are being considered viable alternative to synthetic pesticides in developing biorational pest management strategies. Botanical pesticides are ecofriendly economic, target specific and easily biodegradable (Ignacimuthu, 2004). Botanical pesticides are derived from plants. They degrade rapidly and therefore are considered safer to the environment than the common synthetic chemicals. Botanicals act quickly to stop feeding of insect pests and often cause immediate paralysis or cessation of feeding, but they may not cause the insect's death for hours or days (Malarvannan *et al.*, 2008). Most botanicals are not toxic to plants. Botanicals generally act in one of two ways; either as a contact poison when sprayed on the insect, or as a stomach poison when applied to the plant and eaten by the insect (Hillock and Pat Bolin, 1990). Hence, the present investigation was conducted to study the antifeedant activity of different solvent extracts of *Calotropis procera* leaves against third instar larvae of *S. litura.*

MATERIALS AND METHODS

Extraction of plant materials

Calotropis procera (Ascalepediacea) leaves were collected in and around Sivakasi area and washed with tap water. The plant leaves were shade dried and powered in a domestic grinder and stored in refrigerator for further use. The powder was extracted with hexane, chloroform, ethyl acetate, Methanol, Acetone and Ethanol in a Soxhlet apparatus separately.

Collection and rearing of *Spodoptera litura*

Egg masses of *Spodoptera litura* were collected from castor fields in and around Sivakasi area and cultured on tender castor leaves (*Ricinus communis* Linn.) at laboratory conditions 12-hrs photoperiod 28±2°C and 65-75% R.H. Laboratory emerged adults were maintained in 5% sugar solution. Eggs were maintained in the laboratory conditions. Laboratory emerged third instar *S. litura* larvae were used for this experiment.

Concentrations and antifeedant bioassay

The crude extracts were tested at four different concentrations *viz*., 0.625, 1.25, 2.5 and 5%. The antifeedant activity was tested by no-choice method (Bentley *et al*., 1984). *Spodoptera litura* fed with crude extract coated castor leaf discs (4 cm in diameter). The experiment was performed in a 9 cm diameter petridish containing moist filter paper to avoid early drying of the leaf disc. Four hours pre-starved *S. litura* larvae were introduced to treated and control leaf disc taken in the petridish. Leaf area consumed by the larva in control and treatments was determined after 24 hrs using a leaf area meter (Delta-T Devices, Serial No. 15736 F 96, UK). Antifeedant activity was calculated by the modified formula of Bentley *et al*. (1984).

Insecticidal bioassay

The insecticidal activity of crude extracts was also tested at four different concentrations *viz.*, 0.625, 1.25, 2.5 and 5 %. The treatments were given castor leaf discs by the same procedure as described in the antifeedant bioassay test. After 24 h treatment period the larvae were reared on fresh untreated leaves. The mortality in treated and control groups was recorded by the method of Abbott (1925) and LC_{50} and LC_{90} values were determined using probit analysis (Finney, 1971).

RESULTS AND DISCUSSION

Chloroform extract showed maximum antifeedant activity followed by hexane, ethanol, acetone, ethyl acetate and methanol extracts. Maximum antifeedant activity 63.42 was observed at 5 percent concentration of chloroform extract (Table 1). Joshi *et al.* (1984) and Pathipati Usharani and Pala Rajasekhara Reddy (2009) reported that antifeedant activity was found to be concentration dependent. Plant–based antifeedant can be of great value in protecting crops from insect attack and pest infestation and may replace synthetic insecticides in future. Antifeedants causing the pests insects to stop feeding and perhaps starve or to move from the treated crop to another plant. Plant extracts often consist of complex mixtures of bioactive constituents plant metabolites may produce toxic effects if ingested leading to rejection of the host plant (Russel and Lane, 1993). The active compounds may act as antifeedants, disturb insect growth, development and inhibit oviposition (Gerard and Ruf, 1991; Emimal Victoria, 2010). Crude chloroform extract from *C.procera* had higher activity of feeding deterrence and reduced the food consumption, acetone, ethyl acetate, and methanol extracts were found to have only moderate activity of feeding deterrence antifeedant. Similar findings were reported earlier by Sahayaraj and Paulraj (2000) in *S.litura* exposed to *Tridax procumbens* leaf extract. In general antifeedants have profound adverse effects on insect feeding behaviour (Hummelbrunner and Isman, 2001; Echereobia *et al*., 2010). Frazier (1986) reported that antifeedants can be found amongst all major classes of secondary metabolites (alkaloids, flavanoids, terpenoids and phenolics). According to Isman (2002) antifeedants have some physiological or toxic actions on insects, depending on the treatment concentrations.

In this present study, chloroform extract of *C.procera* showed maximum 67% larvicidal activity at 5% concentration (Table 2), whereas, LC_{50} and LC_{90} values are presented in Table 3. Irrespective of the concentrations and the solvents used for extraction the larvicidal activity has been varied. The larvicidal properties of chloroform extracts might be due to the presence of phytochemical compounds. In the present finding higher larval mortality was recorded at higher concentrations which

Table 1. Effect of *C. procera* against the antifeedant activity of *S. litura* third instar larvae

Solvent extract	Concentration (%)			
	0.625	1.25	2.50	5
Hexane	25.63 ± 2.92^{cd}	29.32±2.10^{c}	37.52±2.56^{bc}	47.53±2.83^{b}
Chloroform	28.21 ± 3.45^{cd}	47.31±2.83^{b}	55.96±4.45^{ab}	63.42±3.09^{a}
Ethyl acetate	13.11 ± 1.04^{ef}	18.65±2.30^{de}	25.21±1.34^{cd}	32.55±2.89^{c}
Methanol	5.32 ± 0.55^{fg}	7.55±0.34^{f}	19.55±1.58^{de}	23.61±2.53^{d}
Acetone	11.07 ± 1.65^{ef}	19.75±2.04^{de}	26.99±4.05^{cd}	33.84±5.92^{c}
Ethanol	3.84 ± 0.26^{g}	16.25±1.02^{e}	29.53±1.88^{c}	41.67±2.40b^{c}

Within columns, mean ± SD followed by the same letter do not differ significantly using Tukey's test, *P* d" 0.05. * Reference control used 25ppm concentration.

Table 2. Effect of *C. procera* against the larvicidal activity of third instar larvae *S. litura*

Solvent extract	Concentration (%)			
	0.625	1.25	2.50	5
Hexane	4	8	17	25
Chloroform	17	25	46	67
Ethyl acetate	8	21	29	37
Methanol	12	17	25	29
Acetone	17	25	42	42
Ethanol	4	8	25	29

Table 3. Toxicity of *C. procera* different solvent leaf extracts against third instar larvae of *S. litura*

Solvent extract	**LC_{50}[a]**	**LC_{90}[a]**	**Slope ± SE**	**Chi square (χ^2)**
Hexane	18.04	220.930	0.891±0.20	2.58*
Chloroform	2.854	17.940	1.60± 0.207	1.018*
Ethyl acetate	8.748	130.89	1.09±0.21	1.428*
Methanol	28.45	2019.37	0.692±0.21	0.246*
Acetone	6.65	182.58	0.891±0.20	2.586*
Ethanol	10.76	93.69	1.36±0.25	2.896*

Units LC_{50} and LC_{95} = % / w, applied for 96h, [a]95% lower and upper fiducial limits are shown in parenthesis.

correlate with the earlier findings of Mikolajczale *et al.* (1988) who reported that higher mortality was recorded even at low feeding. According to Rao and Subramanyan (1986) cholorom extract of the neem contained active compound and it reduced the feeding activity in *Schistocerca gregaria*. *C.procera* showed potent antifeedant and larvicidal activities against *S.litura*. This could be used for the development of new pesticide formulations for the control of this serious polyphagous pest.

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Ga. Bakavathiappan*, S. Baskaran, M. Pavaraj and S. Jeyaparvathi

Post-graduate and Research Department of Zoology Ayya Nadar Janaki Ammal College (Autonomous), Sivakasi – 626 124, Tamil Nadu, India. *E-mail : ga.bakavathiappan@gmail.com

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