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INSECTICIDAL ACTIVITY OF *Lantana wightiana* (Wall.) ON FOURTH INSTAR LARVAE OF *Spodoptera litura* (Fab.) (LEPIDOPTERA: NOCTUIDAE)

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Leaf-dip method was carried out to assess the impact of the different solvent extracts of *Lantana wightiana* Wall., on the fourth instar larvae of *Spodoptera litura* (Fab.). The order of toxicity is found to be methanol, benzene, chloroform, petroleum ether (40 – 60 °C), water. Presence of phenolic compounds and tannins may be responsible for the insecticidal activity of the methanol extract of *Lantana wightiana*.

Spodoptera litura, leaf-dip method, insecticidal activity, *Lantana wightiana, Verbenaceae*

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Metodom uranjanja listova provedeni su pokusi da se ustanovi djelotvornost različitih otopina ekstrakta biljke *Lantana wightiana* (Wall.) na četvrti stadij gusjenica *Spodoptera litura* (Fab.). Ustanovljena je djelotvornost u poretku: metanol-benzen, kloroform, petrolej, eter, voda. Prisutnost fenolskih spojeva i tanina može pridonijeti insekticidnom djelovanju ekstrakta biljke *Lantana wightiana* u metanolu.

Spodoptera litura*, metoda uranjanja, insekticidnost, *Langhtana wightianą, Verbenaceae

Introduction

The tobacco caterpillar*, *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae) is a cosmopolitan and polyphagous pest affecting several crops like cotton, pulses, oil seeds, vegetables, etc. all over the world and causing extensive loss of agricultural production. The management of this pest using synthetic chemicals has failed due to insecticidal resistance (MEHROTRA, 1993). Consequently, intensive efforts have

* *S. litura* (Fab) is named also Asian cotton leafworm as distinguished from African (Egyptian) cotton leafworm *S. littoralis* (Boisduval). – Editorial.

been made to find alternatives, especially insecticides of plant origin, that are safe, effective and ecologically acceptable. This has been enhanced by the prohibitive costs of synthetic pesticides to the resource poor farmers of developing countries who produce the bulk of their nations' food. Several workers have explored the utility of plants and their products in insect control. Toxic effects of plant products on this pest have been studied by many workers (STEVENSON et al., 1993; KOUL et al., 1996; SAHAYARAJ & SEKAR, 1996; SENTHIL KUMAR et al., 1997; SAHAYARAJ, 1998; SAHAYARAJ & PAULRAJ, 1998b; NARENDRAN et al., 1999). *Lantana wightiana* (Wall.) belongs to the family *Verbenaceae*. *Lantana* is one of the smallest genera, which includes about six species. There are only limited studies on the toxicity of the genus *Lantana* (PANDEY et al., 1982; JAIPAL et al., 1983; PAUL et al., 1997; SHUKK et al., 1997; SINU et al., 2002) on various pests. However no information is available on the insecticidal activity of *Lantana wightiana* on any pests. In the present study, effect of petroleum ether, benzene, chloroform, methanol and water extracts of *Lantana wightiana* aerial parts have been tested with the median lethal dose (LD_{50}) on *Spodoptera litura*. Furthermore, qualitative analysis of phytochemicals present in the petroleum ether, benzene, chloroform, methanol and water extracts and quantitative analysis of tannins, phenols and alkaloids have also been performed.

Materials and Methods

Insects

Larval stages of *S. litura* were collected from the groundnut fields in Tirunelveli District, Tamil Nadu and were used to maintain the laboratory nucleus cultures. All the larvae were maintained on castor leaves under laboratory conditions (29 ± 1°C temperature; 65 ± 10% relative humidity and 11L:13D hour photoperiod) in plastic troughs (21.0 x 28.0 x 9.0 cm). Laboratory-emerged fourth instar larvae were used for the experiments.

Phytochemical tests

Aerial parts of *Lantana wightiana* was collected from Panagudi, Tirunelveli District, Tamil Nadu, India and were washed thoroughly (2 times) with tap water and once with distilled water and then shade-dried for two weeks. It was successively extracted with petroleum ether (40 – 60 °C), benzene, chloroform, methanol and water by using Soxhlet apparatus (300 g, 500 ml). The last trace of solvent were removed under reduced pressure distillation and the crude extract was dried in a vacuum desicator and used for the experiments. The different extracts were tested for steroids, alkaloids, reducing sugar, phenolic compounds, saponins, xanthoproteins, tannins and flavonoids

Entomol. Croat. 2004, Vol. 8 Num. 1-2: 5-11.
MATRTIN RATHI, J.A., GOPALAKRISHNAN, S.: Insecticidal activity of *Lantana wightiana* ...

(BRINDHA et al., 1981). Total amount of tannins (SCHANDERL, 1970), phenolid compounds and (MALICK & SINGH, 1980) were also determined.

Preparation of plant extracts

Different concentrations of the plant extracts *viz.*, 0.01, 0.02, 0.04 and 0.08 % were prepared by adding respective solvents and used for the study. These different concentrations were prepared on the basis of quantity of plant extract in 100 ml solvents and the actual concentration of active ingredients were not taken into consideration.

Treatment

Ten grams castor leaves were dipped in the different concentrations of plant extracts separately for 15 minutes. For the control, the leaves were dipped in the respective solvents. After 15 minutes the leaves were taken out and shade-dried for 20 minutes and supplied to the pest larvae. Four laboratory reared fourth instar *S. litura* larvae were released on the treated and non-treated (control) leaves taken in the plastic vials (600 ml) and the vials were covered by muslin cloth. Five replications were made for each concentration and control respectively. The larvae were allowed to feed the treated leaves for a period of 4 days and the mortality was recorded for every 24 hrs starting from first day to the fourth day.

Statistical Analysis

Statistical analysis of the experimental data were performed using probit analysis to find out the LD_{50}, regression, chi-square and variance (FINNEY, 1971). The data was analysed by completely randomized, one-way Analysis of Variance (ANOVA) and the means were separated using Duncan's multiple range test (DMRT) (DUNCAN, 1955).

Results and Discussion

The percent of mortality of fourth instar larvae against different concentrations of various solvent extracts of *L. wightiana* is shown in Table 1. It is clear from the results that *S. litura* larvae were severely affected by chloroform extracts of *L. wightiana* and the larval mortality was recorded as 100% mortality at higher concentration at 72 hours. In the same concentration the percent mortality was observed even at

48 hours when *S. litura* was fed with benzene extracts of *L. wightiana*. The same mortality was observed in the methanol extracts too. Water extract of *L. wightiana was* the least toxic plant product to *S. litura* followed by petroleum ether (40 – 60 °C), chloroform, benzene and methanol. The comparison between the petroleum ether (40 – 60 °C) and water extracts with other extracts showed higher significance (p 0.05). The LD_{50} results are presented in Table 2. It is clear from the results that the LD_{50} value of *L. wightiana* water extract was 33.5 times higher than that of the benzene extract. The order of toxicity is found to be methanol benzene chloroform petroleum ether water. TRIPATHI & RATHORE (2001) have reported bioactive constituents such as phenolic compounds, terpenoids, steroids and lipid derivatives as repellents, cytotoxins and insect growth regulators.

Table 1. Solvent extracts of *L. wightiana* on the larval mortality of *S. litura* (in %)

Solvents	Concentrations (in %)			
	0.01	0.02	0.04	0.08
Petroleum ether (40 – 60 °C)	35.0 ^{e}	50.0 ^{e}	55.0 ^{e}	60.0 ae
Benzene	60.0 ^{d}	75.0 d	100.0 d	100.0 d
Chloroform	20.0 ^{c}	35.0 ^{c}	80.0 ^{c}	100.0 c
Methanol	85.0 ^{b}	95.0 b	100.0 ^{b}	100.0 b
Water	25.0 ^{a}	30.0 a	40.0 ^{a}	55.0 a

Different letters with in a column are significantly different using Duncan's Multiple Range Test (DMRT) at 5 % level.

Table 2. *L. wightiana* solvent extracts on the LD_{50} (96 hours), regression equation, variance and chi-square value for *S. litura*

Solvents	LD_{50}	Regression equation	Variance	Chi-square
Petroleum ether (40 – 60 °C)	0.028	Y = 0.168x + 4.69	0.0440	0.25
Benzene	0.009	Y = 2.625x + 5.14	0.0132	1.70
Chloroform	0.022	Y = 3.568x + 3.78	0.0032	1.98
Methanol	0.002	Y = 1.515x + 6.12	0.2890	0.22
Water	0.067	Y = 0.887x + 4.27	0.0561	0.17

The results of preliminary phytochemical screenings of the various extracts of the aerial parts of *L. wightiana* are presented in Table 3. The methanol extract showed the presence of steroids, reducing sugars, phenolic compounds, saponins, xanthoproteins and tannins. Though the petroleum ether, benzene, methanol and chloroform extracts showed the presence of only steroids, all the extracts caused more mortality than the water extract. The water extract showed the presence of alkaloids, phenolic compounds and tannins. Quantitative phytochemical studies showed that 100 mg of the crude methanol extract consists of 90.0 and 76.87 g of phenolic compounds (MALICK & SINGH, 1980) and tannins (SCHANDERL, 1970), respectively. A diverse range of chemicals of low molecular weight (allelochemicals) are present in plants and they play an important defensive role against insects. Among these compounds, saponins (APPLEBAUM & BRIK, 1979), tannins (SWAIN, 1979), terpenoids (MABRY & GILL, 1979), alkaloids (BELL, 1978) play a very important role. Recently the workers of SUGANTHY (2000); SUNDARARAJAN & KUMUTHAKALAVALLI (2000); ANANTHAKRISHNAN (2002) also supported the same views. These compounds may serve as powerful toxicants to deter insects and other herbivores from feeding and in some cases they serve as a starting point for developing novel insecticides, as in the case of the synthetic pyrethroids (ELLIOTT et al., 1978). Many terpenoids can also act as insect repellents, attractants, oviposition cues, and antifeedents, as well as killing agents in numerous insects (DUKE, 1991; LEE et al., 1997; THAYUMANAVAN & MOHAMAD BIN ZAKARIA, 2002). Similarly tannins and phenolic compounds which are widely distributed in a variety of plants, often in high concentrations reduce the availability of dietary protein and the palatability (FENNEY, 1976) and inhibit the growth and caused mortality (ANANTHAKRISHNAN, 2002). The present study has clearly revealed the fact that *L. wightiana* significantly reduce the population of *S. litura* even at 0.02 % within 96 hours after exposure. Hence this plant can be used in the Integrated Pest Management (IPM) programme.

Table 3. Phytochemical tests for *Lantana wightiana*

Chemicals	Petroleum ether (40 – 60 °C)	Benzene	Chloroform	Methanol	Water
Steroids	+	+	+	+	-
Triterpenoids	-	-	-	-	-
Reducing sugar	-	-	+	+	+
Alkaloids	-	-	-	-	+
Phenolic compounds	-	-	-	-	+
Saponins	-	+	+	+	+
Xanthoproteins	-	-	-	+	-
Tannin	-	-	-	+	+
Flavonoids	-	-	-	-	-
Anthraquinones	-	-	-	-	-
Aromativ acids	-	-	-	-	-

+ indicates positive and – indicates negative

Entomol. Croat. 2004, Vol. 8 Num. 1-2: 5-11.
MATRTIN RATHI, J.A., GOPALAKRISHNAN, S.: Insecticidal activity of *Lantana wightiana* ...

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Entomol. Croat. 2004, Vol. 8 Num. 1-2: 5-11.
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