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Bioefficacy of *Nerium oleander* leaf extract on the growth of *Heliothis armigera* H. (Lepidoptera: Noctuidae)

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Abstract
The current study evaluated the effect of various solvents extract from *Nerium oleander* leaves on developing stages in *Heliothis armigera.* To study the reproductive aspects of *Heliothis armigera*, leaf extract of *Nerium oleander* was prepared in chloroform and methanol solvents. After 24 and 96 hours of treatment, both chloroform and methanol extract were interrupt their life cycle and the notable changes had been observed such as increased mortality and emergence of adults were decreased.

Keywords: *Nerium oleander*, *Heliothis armigera*, chloroform, methanol, mortality, antifeedant, etc.

Introduction
There are three species of *Heliothis* are occurs i.e. *Heliothis armigera*, *H. assulta* and *H. peltigera*. Out of these *H. armigera* is the most destructive species and relatively having less economic importance. This insect, which is global and polyphagous, seriously harms cultivated crops in India, including cotton, tomatoes, chickpeas, pigeon peas, maize, and sorghum, etc. *H. armigera* populations are able to grow constantly throughout the cropping season because of their capacity to feed on a variety of plants and take advantage of a succession of hosts. (Bhatnagar *et al*., 1982; Nyambo, 1988) [1, 2]. It is available in several Indian states, including Andhra Pradesh, Maharashtra, Meghalaya, New Delhi, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Kerala, Madhya Pradesh, and others. It feeds on more than 170 species of plants belonging to 41 families most notably in cotton (King, 1994) [3]. *H. armigera* causes an estimated 2,000 crores in losses to India each year (Ignacimuthu and Jayaraj, 2003) [4].
In warm climates around the world, *Nerium oleander* is a common decorative plant that is grown. It grows in tropical and subtropical regions. It has been demonstrated to be harmful to both humans and animals when used in medicine (Al-Yahya *et al*., 2000; Langford and Boor, 1996) [5, 6]. It possesses antibacterial, anti-inflammatory, and antinociceptive properties (Mostaqul *et al*., 1999) [7] (Erdemoglu *et al*., 2003) [8]. According to reports, *N. oleander* has a very high level of toxicity, and in certain situations, ingesting even a small amount can have fatal or severely dangerous effects (Goetz *et al*., 1998) [9]. Chemical insecticides are mostly employed to shield crops from infestations of *H. armigera.* The issue of chemical resistance has not improved in recent years, as seen by the 20-30% crop loss attributed to pests in India (Bhargava *et al*., 2008) [10] and causing widespread hardship especially amongst poor farmers.

Materials and Methods
The *H. armigera* larvae were collected from fields of tur (*Cajanus cajan*), tomato (*Lycopersicon esculentum*), chickpea (*Cicer arietinum*), and other plants. To prevent cannibalism, each larva was raised in a separate plastic bottle with an artificial feed that was changed every day in accordance with the Central Institute for Cotton Research's standard protocol (CICR). *Nerium oleander* leaves that were still green were picked from the field, dried in the shade, and oven. After being crushed into a powder in a grinder, the dried leaves were sealed in plastic bags for storage. The powder had been wrapped in filter paper, and Soxhlet's apparatus was used to do extractions using a 1:10 ratio of methanol and chloroform solvents.

Following eight hours of nonstop extraction, the finished extract was allowed to evaporate the solvent and refrigerated at 4 ºC until needed. To prepare different concentrations, the artificial diet was prepared and incorporated into each extract before being put into the vials. To prevent cannibalism, 10 vials with varying concentrations of each extract were made. Meanwhile, in a separate experimental set, each vial containing food without extract was let to grow as a control. To find the growth of the life cycle stages of *H. armigera*, concentrations of the extracts were prepared in food so as to get 2 ml/Kg, 4 ml/Kg, 6 ml/Kg and 8 ml/Kg of food and observations were made with respect to the effect of extract on duration of the development and on their morphological characters till the emergence of the adults.

Observation and Results

Increased time intervals are required to reach a satisfactory death rate. The results of this investigation support past findings that the majority of plant extracts contain insecticide characteristics and suppress pests by altering their biological processes (Tinzaara *et al*., 2006) [11].

High toxicity of *N. oleander* leaf extract is observed against H. armigera larvae. When the concentration was increased from 2 to 8 ml/Kg and the exposure times were 24 and 96 hours, the mortality rate significantly increased.

In control, the egg hatched in about four days and the larvae passed through six instars in an average 19.87±1.12 days and pupation in 15.12±0.83 days. Also it seems that, the larvae were active and voracious feeders on the artificial diet which results 100% emergence of the adults from the pupae.

Table No. 1 shows the effect of leaf extract of *Nerium oleander* extracted in 2 solvents i.e. chloroform and methanol on the larvae and pupae. At the lowest concentration 2.0 ml/Kg the larvae were repelled in methanol solvent while antifeedant activity was observed in chloroform. There was slight decrease in the duration of larval and pupal period as compared to control. In 4.0 ml/Kg concentration extract in chloroform the anti-feedency was observed in larvae which resulted in 70% mortality and larval period lasted for 17.33±1.52 and pupal period 15.50±0.70 days. In methanol solvent repellency was observed in larvae which resulted in 40% mortality, while larval period lasted for 19.50±1.22 days and pupal period 16.75±0.95 days. Complete antifeedency resulted at 6.0 ml/Kg concentration of chloroform extract leading to 100% mortality with repellent action. 40% larval mortality was observed in methanol extract and larval period lasted for 20.40±1.51 and pupal period 17.20±0.81 days. In 8.0 ml/Kg concentration antifeedency noted and 70% mortality in methanol extract was observed. The larval period lasted for 21.25±1.73 days and pupal period were 18.50±0.70 days. The survived larvae in all cases pupated completely or partially but the emergence was reduced in both solvents. Thus even at low concentration of the doses, the extracts of *N. oleander* has property to reduce the growth of the population of *H. armigera*. The observed data were represented in Fig. 1 and 2.

Discussion

Today's agricultural output relies on chemical pesticides that are sold commercially to fight a wide range of weeds, insects, fungi, and other agricultural pests. Certain pesticides are thought to be either immediately or chronically hazardous to humans and other environmental components, and they may also seriously endanger the health of non-target creatures and species. These potentially hazardous substances, which are made to resemble synthetic pesticides, must be substituted by using plant-based products. Certain plants have been found to provide an adequate defense against store grain pests, including *M. piperita*, *A. calamus* (sweet flag), *P. nigrum* (black pepper), *P. pinnata* (pongam), and *A. indica* (neem). As novel formulations are developed for the control of Locusts, Gypsy moths, Cockroaches, and other insects, neem has garnered attention on a global scale. In recent years, there has been an increased focus on these plant resources. These plant-based compounds include insecticides, ovicides, antifeedents and attractants, among other qualities. (Muruganm *et al*., 1998) [12]. Majority of insects have particular semiochemicals.

According to Sundarajan (2002) [13], the methanol extract of *Vitex negundo* caused the greatest mortality in *H. armigera*, measuring 82.5% at a 2% concentration. In comparison to *Catharanthus roseus* (Sadaphuli) and *Nerium oleander* (Kaner), *Annona squamosa* (Sitaphal) seed extract at 1.5% concentration showed the highest mortality (43.33%) in *H. armigera* (Sonkamble *et al*., 2000) [14].

In the laboratory trial (Kulkarni, 2002; Yankanchi, 2003) [15, 16], the extracts of *V. negundo*, *C. inerme*, *L. camara*, and *E. odoratum* exhibited substantial mortality against *A. janata*, *P. xylostella*, and *S. litura larvae*. Plant-synthesized secondary organic compounds play a crucial function in shielding plants against insect pests. These substances can function as antifeedants and are poisonous, delaying the growth of larvae in insects (Isman, 2006) [17].

The protection of the environment against pesticides is now a top priority. It is not necessary for an insecticide to kill a lot of the target species in order for it to be considered safe. Thus, growth-inhibiting and antifeedant properties can be added to other insect control methods as part of the integrated pest management (IPM) strategy. Clarifying a chemical's method of action is crucial for insect control because it may provide important guidance on the proper varieties of formulations.

Table 1: Efficacy of *Nerium oleander* leaf extract in chloroform and methanol solvents against the developing stages of *Heliothis armigera.*

Solvent	Dose (ml/Kg)	Mortality of larvae %	Average	Average Pupal Period in days	Emergence of adults %	Activity
Chloroform	Control	-	19.87±1.12	15.12±0.83	100	Actively Feeding
	2.0	60	16.66±1.15	14.33±0.57	30	Antifeedant
	4.0	70	17.33±1.52	15.50±0.70	20	Antifeedant
	6.0	100				Antifeedant
	8.0	100				Antifeedant
Methanol	Control	-	19.87±1.12	15.12±0.83	100	Actively Feeding
	2.0	20	18.37±1.30	15.20±0.83	50	Repellent
	4.0	40	19.50±1.22	16.75±0.95	40	Repellent
	6.0	40	20.40±1.51	17.20±0.81	40	Repellent
	8.0	70	21.25±1.73	18.50±0.70	20	Antifeedant

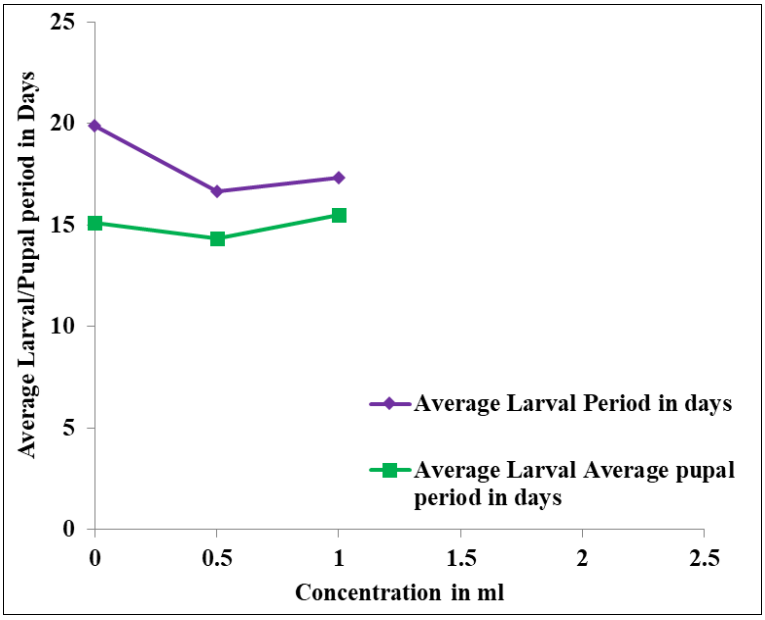

Fig 1: Efficacy of leaf extract of *Nerium oleander* in chloroform against larval and pupal period of *Heliothis armigera*

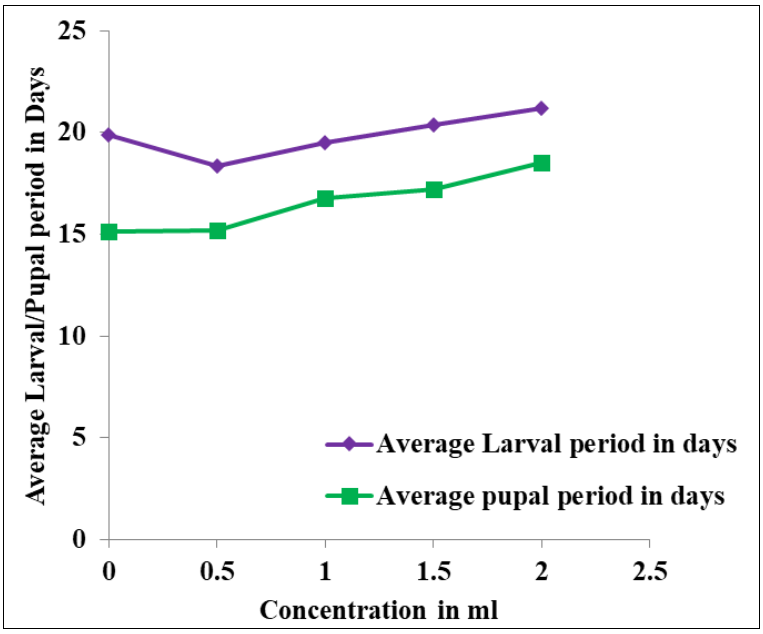

Fig 2: Efficacy of leaf extract of *Nerium oleander* in methanol against larval and pupal period of *Heliothis armigera*

Plate 1A: Rearing of *Heliothis armigera* larvae on artificial diet in laboratory

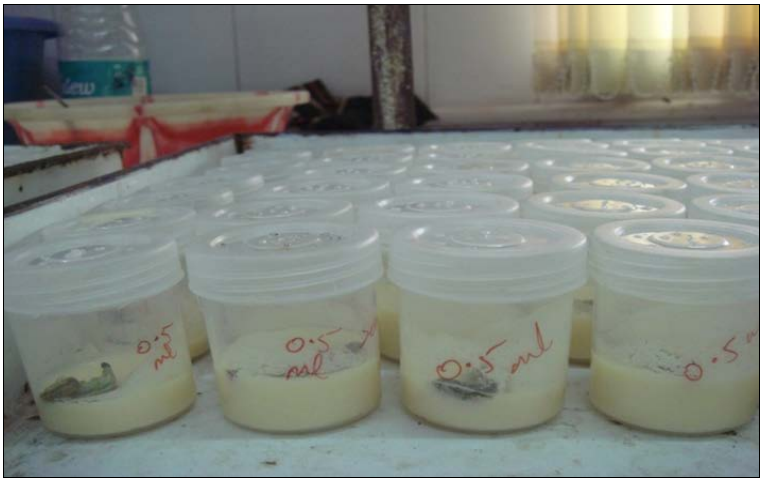

Plate 1B: Experimental Setup

Conclusion

As a consequence of this assay, leaf extracts of *N. oleander* in methanol and chloroform solvents showed different degrees of insecticidal activity, prolonged larval and pupal duration, caused abnormalities mortality and reduced % emergence of adults from pupae of *H. armigera.* The growth disruption affects the inability of some of the larvae to successfully moult into the pupal stage or some of the pupae into the adult stage. Thus, *N. oleander* can therefore be utilized as a substitute for the chemical treatments.

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