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Research Article

Impact of pongam oil and neem gold on the larvae of *Spodoptera litura* (Fab.) (Lepidoptera : Noctuidae)

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Abstract

The efficacy of the pongam oil and neem gold (commercial product) against the *Spodoptera litura* (Fab.) was carried out under the laboratory condition. Based on the present study the pongam oil was more effective which promoted larval mortality from 49.79% to 79.79% with median lethal concentrations (LC_{50}) ranging from 38.74% to 31.83% followed by neem gold (44.59% to 69.79). Data also indicated that the median lethal concentrations were ranging from (LC_{50}) 40.65% to 35.92% on 1st instar to 6th instar larvae of *Spodoptera litura.* The present investigation reported that the long treatment period (36h) influenced higher level of larval mortality on all larval stages of *Spodoptera litura.*

Keywords: Pongam oil, Neem gold, *Spodoptera litura* and larval mortality

Introduction

Spodoptera litura (Fab.) is a dangerous polyphagous pest of many economically important crops. It is distributed throughout the tropical and subtropical parts of the world including India, China and South East Asia causes damage to more than 120 species of host plants (Murugesan and Dhingra, 1995). Among these host plants, more than 40 species are reported from India alone (Chari and Patel, 1983). Essential oils are volatile, natural and complex compounds characterized by a strong odour and are formed by aromatic plants as secondary metabolites. The interest in essential oils has regained momentum during the last decade, primarily due to their fumigant and contact insecticidal properties. It is primarily because of essential oils are easily extractable, ecofriendly being biodegradable and easily catabolised in the environment and play an important role in plant production against insect pests (Isman, 2006 and Roman Pavela, 2012).

Many essential oils are documented to exhibit acute toxic effects against insects. The compounds present in the neem oil are reported as strong antifeedants and growth inhibitors against lepidopteran larvae (Koul *et al*., 2004). Deota and Upadhyay (2005) reported that Azardiractin, the active compound and antifeedant against *S. litura.* Sighamony *et al*. (1984) reported that karanj oil (Pongam oil) possessed repellent property against insect pest when treated at the concentration of 2.5 mg/cm^3.

Materials and Methods

Test insect culture

The experiment was carried out in the Zoology laboratory, Government Arts College, Coimbatore, Tamil Nadu in India. The eggs and larvae were collected from the cauliflower field of Thondamuthur, Located at Coimbatore. The collected eggs and larvae of *S. litura* were reared and maintained in laboratory conditions (30^o ±2^{o}C) and 72rh. The larvae were reared in plastic

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containers, and provided with known quantity of castor leaves. The hatched larvae were fed with fresh castor leaves and it was changed daily till pupation. The pupa was collected and kept in the moth emergence cage. They emerged adults were fed with 10% honey solution applied with a cotton swab. The newly emerged I – VI instar larvae were used in the present investigation.

The experimental materials Neem Gold (Commercial product) and Pongam oil were brought from market in Coimbatore. The ten different concentrations (22%, 24%, 26%, 28% 30%, 32%, 34%, 36%, 38%, and 40%) were prepared by using distilled water mixed with an emulsifier (tween-20) stirred at 120rpm for 10 minutes to remove the dust and allowed to evaporate. The desirable concentrations of plant products were prepared by using distilled water and emulsifier. A leaf disc assay method was followed to assess the larval mortality of *S. litura*. The control was maintained with the leaves dipped in distilled water having 0.01% Tween-20. All the treated and untreated leaves were weighed before introducing the pre weighed I –VI instar larvae starved for 4 hours. Twenty larvae for each concentration with provision for alteration labelled according to the formulations and its dilution was allowed to feed for a period of 12, 24, 36 hours. These are kept at 30°C in an incubator. The experiment was replicated at 5 times.

The percentage mortality was calculated by using the following formula:

$$\text{Percentage Mortality} = \frac{\text{Number of dead larvae}}{\text{Number of larvae Introduced}} \times 100$$

The results were corrected for control mortality by using the Abbot's (1925) formula:

$$n_t = \frac{n_0 - n_c}{100 - n_c} \times 100$$

n_t = corrected percentage mortality

n_o= observed mortality in treatment

n_c= observed mortality

The data were analysed using Software 16.0 version and the LC_{50} and LC_{90} values at all instar of larvae of *S. litura* were calculated after 12, 24 and 36 hours of treatment.

Results and Discussion

The results clearly indicated that pongam oil and neem gold was the most effective plant products which treated at all the concentrations. Many biological activities of *Pongamia pinnata* seed extracts can be attributed Karanjin, the major flavonoid of the seed oil. Pongam oil is shown to possess insecticidal, repellent and anti oviposition properties (Parmar and Gulati 1969; Pavela and Herda, 2007b). The data of table -1 represented that the percentage larval mortality of pongam oil and neem gold treated with *S. litura* after 12h exposure. The mortality of I instar larvae of *S. litura* treated with 22% of pongam oil and neem gold oil were 29.59%, 24.79% and it was elevated to 89.79% when treated with 40% of these oils. Similarly, the third instar pongam oil and neem gold treated larva exhibited 19.59% and 19.69 % larval mortality when treated with 22% pongam and neem gold oil after 12h. The plant derivative showed that the decreased level of mortality on the last stage larva (VI Instar). The obtained values of 40% of pongam and neem gold treated 6th instar larvae were 49.79% and 44.59% after 12h. The value of the present study indicated that the larval mortality of *S. litura* was dose and age dependent. When the age of the larva increased the percentage larval mortality significantly reduced from 29.59% to 4.79% in pongam oil and 24.79% to 4.9% in neem gold oil in the case of I instar to VI instar larva when treated with minimum concentration (22%). LC_{50} value of I- instar larvae treated with pongam oil was 28.62% and it was raised to 38.74% on the VI instar larvae. Similarly LC_{50} value of I instar in neem gold was 29.72% it

was raised to 40.65% in VI instar larvae. The obtained values of pongam and neem gold oil treated on *S. litura* after 24h presented on the table - 2. The date showed that the larval mortality of 22% in treated (Pongam oil) larvae was 34.79% it was elevated to 39.59, 49.79, 59.59, 64.79, 69.79, 74.79, 79.79, and 94.59% with the respective concentrations of 22%, 24%, 26%, 28%, 30%, 32%, 34%, 36% 38% and 40% of plant product. LC_{50} value of 1st to 6th instar larvae after 24h were 26.21%, 28.18%, 30.69%, 32.84%, 34.44% and 35.94% respectively. The 40% of neem gold oil increased the percentage larval mortality of the maximum of 94.79% on the I instar larvae and it was gradually declined when the age of the larvae increased. Amount of larval mortality generally occurred at initial instar compared to late instar. Death response differed on the level of detoxification. According to Syaputra *et al*. (2006), the initial instar larva more sensitive to the toxic compound and would easily to die compared to late instar larva because of the late instar has a strong defence reaction compared to initial instar.

The mortality of I instar larva on *S. litura* was 44.59% and it was decreased to 34.59% of III instar larvae, declined to 24.50% of VI instar larvae when treated with 22% pongam oil after 36h (table - 3). The percentage mortality was 59.59% to 99.79% of the I instar larvae with respective concentrations of 26% and 40% over the period of 36h. The LC_{50} value was ranging from 23.61 to 31.83 (I – VI instars) over the treated period at 36h in pongam oil. The efficacy of neem gold was lower (14.50%) in neem gold is in VI instar when treated 22%. The highest LC_{50} values were estimated for neem gold oil which is significantly high concentration (40%). The median lethal concentrations increased with the age of the tested larvae.

The larval mortality recorded in the lowest concentration (22%) tested in the insecticidal bioassay was 4.79% against the respective VI instar larvae when they were treated Pongam oil and neem gold after 12 hour exposure. The larval mortality was gradually decreased from sixth to first instar larvae. In the present study, highest mortality was observed (99.79%) in pongam oil and (94.79%) in neem gold when treated with the highest concentration of 36h exposure. Amount of larval mortality generally occurred more at an early stage when compared to late instar. The difference in level of defense in detoxification of poison compound in insect body, causing death response will differ among the larval stages. According to Syahbutra *et al.* (2006), if the larva consumes active plant compound, initial instar larvae were more sensitive to the toxic compound and would easily kill the insects compared to late instar of larvae because of the late instar has a stronger defence reaction compared to initial instar. Behera and Satapathy (1996) observed that fifty percent larval mortality in fourth instar larvae of *S. litura* was observed when they used 10% concentration of aqueous extract of *P. pinnata*. A similar observation was reported by Garcia and Rembold (1984), such dose dependent anti insect activity is a common phenomenon in botanical such as azardirachtin and they found that 600 times less concentration of azardirachtin was required to disturb the development of *Rhinidnius prolixus*. Schmuterer (1990), Mordue and Blackwell (1993) suggested that azardirachtin treatment resulted in various morphogenetic defects as well as mortality depending on concentration applied. Nisbet *et al.* (1992) made a similar report that 100 to 1000 ppm azardirachtin induced significant primary antifeedant effect. Whereas, Mordue and Blackwell (1993) and Ramachandran *et al.* (1989) reported that 50ppm was enough to impact significant antifeedant action in Lepidopteran insects.

Conclusion

The present investigation provides the information of biological efficacy of botanical

Table - 1. Efficacy of Pongam Oil (*Pongamia Pinnata*) and Neem Gold (*Azardiracta indica*) on the treated larvae of *Spodoptera litura* after 12 h.

Name of the Samples	Concentrations (%)	Larval Stages (Instars)					
		I	II	III	IV	V	VI
Pongam Oil	22	29.59	24.79	19.59	14.79	9.59	4.79
	24	34.79	29.79	24.59	19.79	14.59	9.79
	26	39.59	34.59	29.59	24.79	19.59	14.79
	28	44.79	39.79	34.59	29.59	24.59	19.79
	30	49.59	44.59	39.59	34.59	29.59	24.79
	32	59.59	49.79	44.79	39.59	34.59	29.79
	34	69.59	54.79	49.59	44.59	39.59	34.79
	36	79.79	64.59	59.79	49.79	44.79	39.79
	38	84.59	79.59	69.59	54.59	49.59	44.59
	40	89.79	84.79	74.79	64.79	54.79	49.79
	LC_{50}	28.62	31.00	32.97	35.96	37.52	38.74
	Chi^2	4.14	5.13	1.66	0.32	0.87	2.24
Neem Gold	22	24.79	19.79	19.69	14.59	9.79	4.79
	24	34.59	29.59	24.79	19.59	14.79	9.59
	26	39.79	34.79	29.79	24.59	19.79	9.59
	28	44.59	39.59	34.59	29.59	24.79	14.59
	30	49.79	44.59	39.79	34.79	29.79	19.59
	32	54.79	49.59	44.79	39.59	34.59	24.59
	34	59.59	54.79	49.79	44.59	39.79	29.59
	36	69.79	59.79	54.59	49.59	44.79	34.79
	38	79.59	64.59	59.59	54.79	49.79	39.59
	40	89.79	69.79	64.79	59.79	54.59	44.59
	LC_{50}	29.72	32.24	34.12	35.93	37.49	40.65
	Chi^2	2.70	1.22	0.15	0.36	0.83	0.97

Mean values of FIVE replications Computed as C-T/Cx100; Where T = Percent damage in treatment, C= Percent damage in control, LCL – Lower Concentration Limit, UCL – Upper Concentration Limit

Table - 2. Efficacy of Pongam Oil (*Pongamia Pinnata*) and Neem Gold (*Azardiracta indica*) on the treated larvae of *Spodoptera litura* after 24h

Name of the Samples	Concentrations (%)	Larval Stages (Instars)					
		I	II	III	IV	V	VI
Pongam Oil	22	34.79	29.59	24.79	19.59	14.79	9.59
	24	39.59	34.59	29.79	24.59	19.79	14.59
	26	49.79	39.79	34.79	29.59	24.79	19.59
	28	59.59	49.59	44.79	34.59	29.79	24.59
	30	64.79	59.79	49.79	39.59	34.79	29.59
	32	69.79	64.59	54.79	49.59	44.79	39.79
	34	74.79	69.79	59.59	54.59	49.79	44.59

Name of the Samples	Concentrations (%)	Larval Stages (Instars)					
		I	II	III	IV	V	VI
	36	79.59	74.59	64.79	59.79	54.79	49.59
	38	84.79	79.79	69.59	64.59	59.59	54.59
	40	94.59	89.79	84.59	74.59	74.79	64.79
	LC_{50}	26.21	28.18	30.69	32.84	34.44	35.94
	Chi^2	0.99	0.97	0.76	0.41	0.59	1.08
Neem Gold	22	29.79	24.59	19.79	14.59	9.79	4.79
	24	34.79	29.59	24.79	19.59	14.79	9.59
	26	39.59	34.59	29.79	24.59	19.79	14.59
	28	44.79	39.79	34.79	29.59	24.79	19.59
	30	49.59	44.59	39.59	34.59	29.79	24.59
	32	54.59	49.79	44.79	39.79	34.79	29.59
	34	64.79	54.79	49.59	44.59	39.59	34.59
	36	74.79	64.59	59.79	49.79	44.79	39.79
	38	84.59	69.79	64.79	54.79	49.59	44.79
	40	94.79	84.59	79.59	74.59	69.59	59.79
	LC_{50}	29.02	31.53	33.31	35.91	37.52	37.57
	Chi^2	5.38	0.63	0.54	0.35	0.87	2.31

Mean values of FIVE replications. Computed as C-T/Cx100; Where T= Percent damage in treatment, C= Percent damage in control, LCL – Lower Concentration Limit, UCL – Upper Concentration Limit

Table - 3. Efficacy of Pongam Oil (*Pongamia Pinnata)* and Neem Gold (*Azardiracta indica*) on the treated larvae of *Spodoptera litura* after 36h

Name of the Samples	Concentrations (%)	Larval Stages (Instars)					
		I	II	III	IV	V	VI
Pongam Oil	22	44.59	39.79	34.59	34.59	24.59	24.59
	24	49.79	44.79	39.59	39.59	29.59	29.59
	26	59.59	49.59	44.59	44.59	34.59	34.59
	28	69.79	59.79	49.79	49.59	39.59	39.59
	30	74.59	64.79	54.59	54.79	44.59	44.59
	32	79.79	69.59	59.79	59.59	49.79	49.59
	34	84.59	74.79	64.59	64.79	54.59	59.69
	36	89.79	79.59	69.79	74.69	59.79	64.59
	38	94.59	84.79	79.79	79.59	69.59	69.79
	40	99.79	94.79	89.59	89.79	79.59	79.79
	LC_{50}	23.61	25.48	28.00	29.88	33.66	31.83
	Chi^2	0.94	0.41	1.24	0.86	0.51	0.61
Neem Gold	22	39.79	34.59	29.79	29.79	19.79	14.59
	24	44.59	39.59	34.79	34.79	24.79	19.59
	26	49.79	44.79	39.79	37.79	29.79	24.59
	28	64.59	49.59	44.59	44.79	34.79	29.59

Neem Gold	30	74.79	64.79	49.79	49.59	39.79	34.59
	32	79.59	74.59	59.79	59.59	44.59	39.59
	34	84.79	79.59	64.79	59.79	49.79	44.79
	36	89.59	79.79	69.79	64.79	54.59	49.59
	38	89.79	80.79	74.59	74.59	59.59	54.79
	40	94.79	89.59	84.79	84.59	74.79	69.79
	LC_{50}	24.84	26.66	29.30	29.88	34.12	35.93
	Chi^2	3.22	6.05	0.49	0.86	0.14	0.35

Mean values of FIVE replications. Computed as C-T/Cx100; Where T= Percent damage in treatment, C= Percent damage in control, LCL – Lower Concentration Limit, UCL – Upper Concentration Limit

insecticides, the Pongam and neem gold formulations against *S. litura*. The tested botanical insecticides showed good efficacy on the mortality of *S. litura* larvae. The present study conferred that the neem gold proved to be the most effective insecticide after Pongam oil. Many biological activities of *P. pinnata* seed extracts shown to possess pesticidal properties. Moreover, evidence of a significant synergistic effect with same pyrethrins was also provided for Pongam oil. Based on the results presented in this paper, formulations of plant products, Pongam oil and neem gold are essential oils can be recommended for protection of crops against *S. litura* larvae.

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