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Comparative effects of *Azadirachta indica* and *Ocimum tenuiflorum* extracts on *Haritalodes derogata* (Fabricius, 1775) (Lepidoptera: Crambidae)

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Abstract— *Hibiscus is an important plant cultivated in large numbers in Indian systems of medicine and perfumery. Haritalodes derogata is a common pest of Hibiscus species, feeding on their leaves in large numbers and causing considerable loss in harvest. In the present study, last instar larvae of H. derogata were fed with leaf extracts of Azadirachta indica and Ocimum tenuiflorum. Mortality, pupation success, and adult emergence were monitored over 14 days. A. indica extract caused significantly higher and faster mortality compared to O. tenuiflorum, resulting in 100% mortality by Day 5. It also induced larval body shrinkage, production of orange-coloured fluid fecal matter, and complete inhibition of pupation. In contrast, O. tenuiflorum caused only 12.5% mortality by Day 5, with most larvae proceeding to pupation and adult emergence, though adults died subsequently. The findings demonstrate the superior efficacy of A. indica extract as a potent botanical insecticide for managing H. derogata infestations.*

Keywords— Hibiscus, Pupation, Mortality, Larvae, shrinkage, botanical extracts, IPM.

I. INTRODUCTION

Haritalodes derogata (Fabricius, 1775) (Lepidoptera: Crambidae: Spilomelinae) is a common pest of plants belonging to the Malvaceae family and is found to severely infest many *Hibiscus* species. The larvae feed on the leaves in high numbers, causing defoliation, premature ripening of bolls, and thereby impairing bud formation (Tabesh et al., 2015). The larvae habitually roll the leaves of their host plant and consume the leaf margins, causing the leaves to curl and droop. *H. derogata* was first recorded as a serious pest of cotton in India (Sidhu & Dhawan, 1979). *Hibiscus* is considered an important medicinal plant with bioactive properties and is recommended as an herbal alternative to cure many diseases (Obi et al., 1998). It also possesses antibacterial and antioxidant properties (Mak et al., 2012). The quality and quantity of raw materials obtained from medicinal plants are adversely affected by attacks from numerous insect pests in cultivated areas.

The use of synthetic and chemical pesticides creates many environmental hazards and affects non-target beneficial organisms. Botanical extracts offer a sustainable alternative. *Azadirachta indica* (Neem) contains potent bioactive compounds like azadirachtin, known for their antifeedant, growth regulatory, and insecticidal properties. *Ocimum tenuiflorum* (Tulsi) contains various essential oils and compounds such as eugenol and ursolic acid, which exhibit insecticidal and repellent activities. While the potential of natural products like Neem and Tulsi has been evaluated against many insects, no studies have been conducted on *H. derogata*. In the present investigation, the comparative effects of *A. indica* and *O. tenuiflorum* leaf extracts on the larvae of *Haritalodes derogata* have been studied.

II. MATERIALS AND METHODS

2.1 Insect Collection and Rearing:

Approximately 72 *Haritalodes derogata* larvae were collected from infested *Hibiscus rosa-sinensis* plants on the Little Flower College campus. They were maintained as a stock culture in a glass bottle containing fresh *H. rosa-sinensis* leaves, covered

with muslin cloth. The larvae were examined under a Magnus Binocular Stereo Zoom dissection microscope, and their morphological features were studied. Length and width were measured by placing each larva on a glass slide over graph paper.

2.2 Plant Extract Preparation:

Leaves of *Azadirachta indica* and *Ocimum tenuiflorum* were collected from a home garden and shade-dried. Ten grams of each dried leaf sample were weighed using a digital scale. Each sample was ground into a fine paste using a mortar and pestle with 100 ml of bicarbonate buffer (pH 9.0, adjusted using 1M sodium carbonate and 1M sodium bicarbonate). The homogenate was centrifuged at 10,000g for 10 minutes. The supernatant was used as the stock extract for treatments. The concentration of the applied extract is expressed as deriving from the original 10g/100ml preparation.

2.3 Bioassay:

Thirty developmentally synchronous last instar larvae were isolated and divided into three sets of 10 larvae each (experiment performed in duplicate, total n=20 per treatment). Each set was reared in a separate culture bottle.

- **Group 1 (Neem):** Fed with 1.62g of *H. rosa-sinensis* leaf pieces dipped uniformly in 0.5 ml of *A. indica* extract.
- **Group 2 (Tulsi):** Fed with 1.62g of leaf pieces dipped in 0.5 ml of *O. tenuiflorum* extract.
- **Group 3 (Control):** Fed with 1.62g of leaf pieces dipped in 0.5 ml of bicarbonate buffer (pH 9.0). Fresh, treated leaf pieces were provided daily. The experiment was conducted at ambient room temperature (approx. 27±2°C). The day of initial treatment was designated Day 0. Larvae were observed daily for 14 days for mortality, morphological changes, pupation, and adult emergence. Mortality percentages were calculated.

III. Results and Discussion

3.1 Larval Mortality and Symptoms:

Larvae fed neem-treated leaves showed pronounced symptoms by Day 2. The rear end of the larvae appeared dark, their bodies showed overall shrinkage, and their fecal matter turned into an orange fluid (Plate 2). They became sluggish by Day 3 and reached 100% mortality by Day 5 (Table 1, Table 4).

In contrast, larvae fed tulsi-treated leaves showed less severe symptoms, with many turning brown. Mortality was significantly delayed and lower, reaching only 12.5% by Day 5 (Table 1, Table 4). Control larvae showed a baseline mortality of 25% by Day 4 and 100% by Day 14, likely due to handling or natural factors (Table 1).

Table 1
Cumulative percentage mortality of *Haritalodes derogata* larvae fed hibiscus leaves treated with buffer (control), *O. tenuiflorum* (Tulsi) extract, or *A. indica* (Neem) extract

Day	Buffer	Tulsi	Neem
1	12.5	-	-
2	12.5	-	12.5
3	12.5	-	37.5
4	25	-	62.5
5	-	12.5	100
6	-	-	-
7	-	-	-
8	-	-	-
9	-	-	-
10	-	12.5	-
11	-	-	-
12	-	25	-
13	-	25	-
14	100	-	-

3.2 Effects on Development (Pupation and Adult Emergence):

Neem extract completely inhibited pupation (0%, Table 2). Tulsi extract allowed 87.5% of larvae to pupate, and the buffer control allowed 62.5% pupation (Table 2). Adult emergence was also affected. While 25% of tulsi-treated pupae emerged as adults by Day 7, these adults died soon after (Table 3). The control group showed delayed adult emergence (12.5% by Day 13), which also did not survive (Table 3).

TABLE 2
CUMULATIVE PERCENTAGE PUPATION OF *HARITALODES DEROGATA* LARVAE FROM THE DIFFERENT TREATMENT GROUPS

Day	Buffer	Tulsi	Neem
1	0	0	0
2	0	0	0
3	0	37.5	0
4	12.5	-	0
5	62.5	-	-
6	-	87.5	-

TABLE 3
CUMULATIVE PERCENTAGE ADULT EMERGENCE OF *HARITALODES DEROGATA* FROM PUPAE IN THE TULSI AND CONTROL GROUPS (NEEM GROUP HAD NO PUPATION)

Days	Buffer	Tulsi
7	0	25
8	0	-
9	0	-
10	0	-
11	0	-
12	0	-
13	12.5	-

TABLE 4
DIRECT COMPARISON OF CUMULATIVE PERCENTAGE MORTALITY IN LARVAE TREATED WITH NEEM VERSUS TULSI EXTRACT

Days	Neem	Tulsi
1	0	0
2	12.5	0
3	37.5	0
4	62.5	0
5	100	12.5
6	-	-
7	-	-
8	-	-
9	-	-
10	-	12.5
11	-	-
12	-	25

3.3 Discussion:

The results clearly demonstrate that *A. indica* extract is far more effective than *O. tenuiflorum* extract against *H. derogata* larvae, causing rapid, 100% mortality and complete disruption of development. This aligns with the established potency of neem's bioactive compounds. Azadirachtin and related limonoids are known to act as potent insect growth regulators (IGRs), interfering with ecdysone and juvenile hormone pathways, leading to lethal molting disruptions, feeding deterrence, and sterilization (Isman, 2006). The observed larval shrinkage is a classic symptom of IGR activity. The orange fluid fecal matter may indicate severe midgut disruption or excretion of unmetabolized plant compounds.

The lower efficacy of tulsi extract, despite known insecticidal compounds like eugenol, suggests that *H. derogata* may be less susceptible to its primary mode of action (often neurotoxicity) or that the concentration used was sub-lethal. The eventual death of adults emerging from tulsi-treated pupae indicates possible chronic or sublethal effects affecting metamorphosis and adult viability, as reported in *Spodoptera* species (Nadya et al., 2024; Samuel et al., 2021).

Notably, no strong feeding deterrence was observed in the neem group, as larvae consumed treated leaves before succumbing. This suggests mortality was primarily due to post-ingestion toxicity rather than antifeedancy at this concentration, contrary to some studies where salannin in neem makes plants unpalatable (Gisbert et al., 2006). The efficacy observed here is remarkable considering the potentially low concentration of the crude extract, highlighting its potency.

The findings corroborate previous research on neem's growth-inhibiting and lethal effects on various lepidopteran pests (Charleston et al., 2005b; Egwurube et al., 2010; Mondédji et al., 2015). The complete inhibition of pupation is a particularly valuable trait for pest management, as it breaks the reproductive cycle.

IV. CONCLUSION

Azadirachta indica leaf extract caused significant and rapid mortality (100% by Day 5), larval body shrinkage, fluid fecal matter, and complete inhibition of pupation in *Haritalodes derogata*. *Ocimum tenuiflorum* extract caused only marginal mortality (12.5% by Day 5) and did not prevent pupation or adult emergence, though emerged adults were non-viable. Therefore, *A. indica* extract is significantly more effective than *O. tenuiflorum* extract against this pest. The superior efficacy, coupled with its ability to halt development completely, demonstrates the strong potential of *A. indica* extract as a key component in integrated pest management (IPM) strategies for protecting *Hibiscus* cultivations from *H. derogata*.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

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