



# Laboratory evaluation of different eco-friendly insecticides against the Egyptian fluted scale, *Icerya aegyptiaca*

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## Summary

Lac cultivation is generally carried out on a limited number of indigenous tree species found scattered in forests and cultivable land. Recent studies show that *Flemingia semialata* Roxb. (Leguminosae) is an excellent bushy host plant for the cultivation of the kusmi strain of lac insects. The present investigation was carried out with the objective of getting acquainted with the different eco-friendly insecticides under laboratory evaluation against the Egyptian fluted scale, *Icerya aegyptiaca*. Maximum nymphal mortality of 81.67 per cent and 78.34 per cent was observed at 0.2 per cent Pestoguard and Neemazal after 12 days of treatment, which is statistically at par with each other. 51.67 per cent mortality was achieved after 12 days of treatment at 1 per cent Uro-insecticide and Green mealkil, which is a microbial pesticide that is also effective against the Egyptian fluted scale, *Icerya aegyptiaca*. The mortality percentage was low after 1, 3 days and seven days, but it gradually increased after 12 days of treatment, obtaining 48.34% mortality, which is statistically at par with Uro-insecticide. All the eco-friendly insecticides used in the present experiment (Uroinsecticides, Pestoguard, green mealkil and neemazal) are effective in controlling the population of *Icerya aegyptiaca*. Unlike Malathion and Imidacloprid, they don't have a quick knockdown effect; however, the mortality due to exposure significantly increases as there is an increase in days or duration of application, and they are safe for the lac insect.

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**Keywords:** *Icerya aegyptiaca*, lac, *Flemingia semialata*, eco-friendly insecticides

## Introduction

Lac is a valuable gift to mankind. Lac is a natural resin produced by female lac insects, mainly *Kerria lacca* (Kerr), belonging to the family Tachardiidae (Homoptera). Lac, popularly known as shellac, in its refined flake form, is the resinous substance secreted as a protective covering by a minute lac insect, which is found as a parasite on a number of both wild and cultivated plants. The lac insect being parasitic in nature, its survival is also dependant on the health of the plant as it remains permanently attached to host plants from which it derives its nutrition, which in turn can be affected by various insect pests. Lac cultivation is generally carried out on a limited number of indigenous tree species found scattered in forests and cultivable land. Though the lac insect *Kerria lacca* (Kerr) exploits different host plants for its nutrition but, only a few lac hosts are of commercial importance, viz., *Butea monosperma* (palas), *Schleichera oleosa* (kusum) and *Ziziphus mauritiana* (ber). Recent studies show that *Flemingia semialata* Roxb. (Leguminosae) is an excellent bushy host plant for the cultivation of the kusmi strain of lac insect. It is a tall, bushy host with dense foliage and has a tillering habit. After harvesting, it can be ratooned at an interval of six months, which can be further used for lac cultivation

after another six months. However, during the last few years, lac production has shown a declining trend due to varied factors. Among these, the most serious is mortality due to parasitization. However, the growth and development of the host plants are adversely affected by several biotic and abiotic factors. Among the biotic factors, insect pests are the major factors that adversely affect the growth and development of plants in various stages of plant growth that indirectly or directly affect the cultivation of lac insects. Egyptian fluted scale (*Icerya aegyptiaca*)- a new record as a pest of *F. semialata* (Meena et al. 2012; Singh et al. 2022). Combinations of Ro, cineole and camphor with matriline have sound insecticidal effects on *I. aegyptiaca* while remaining safe to the environment and these combinations of biological insecticides have excellent development prospects and provide a new reference for the pest management of scale insects (Singh et al. 2021 a&b; Zhou et al. 2022). The economic impact on cultivated hosts, including citrus, grapes, maize, peppers, sunflowers, tomatoes, and ornamental crops, is anticipated if establishment occurs (EFSA panel, Bragard et al. 2023). Immature, as well as adults, suck the cell sap from leaves and an upper soft portion of the semialata plant, resulting in leaf drop and stunted growth. As with most sap-sucking insects, the production of honeydew was also observed, leading to the development of sooty mould on the affected plant parts. Keeping in view of the above constraints, the present investigation was carried out with the objective of getting acquainted with the different eco-friendly insecticides under laboratory

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evaluation against the Egyptian fluted scale, *Icerya aegyptica*.

## Material and Methods

### Laboratory culture of the insects

The culture of the Egyptian mealy bug, *Icerya aegyptiaca*, was maintained in the laboratory of the Department of Entomology, Central Agricultural University, Imphal, in 2021 by collecting mealy bug adults from the untreated leaves of *Flemingia semialata*. Enough

numbers of adults were transferred to fresh excised leaves of *F. semialata* in Petri dishes to get a sufficient number of newly laid nymphs, and the leaves were replaced with fresh untreated leaves every day.

### Experimental design

The experiment was laid out in Completely Randomized Design with seven treatments and replicated three times (Table 1).

**Table 1. Treatment details**

| Treatment      | Insecticide               | Concentration |
|----------------|---------------------------|---------------|
| T <sub>1</sub> | Uro-insecticide           | 1%            |
| T <sub>2</sub> | Green mealkil (Microbial) | 0.5%          |
| T <sub>3</sub> | Pestoguard                | 0.2%          |
| T <sub>4</sub> | Neemazal                  | 0.5%          |
| T <sub>5</sub> | Imidacloprid              | 0.1%          |
| T <sub>6</sub> | Malathion 50 E.C.         | 0.1%          |
| T <sub>7</sub> | Control                   | -             |

### Laboratory bioassay procedure

Excised fresh *F. semialata* leaves were dipped in each insecticidal solution for 10 min. 50 µl wetting agents were added to the solutions. After 10 minutes, the leaves were taken out and kept in petri dishes for 15-30 minutes at room temperature to dry up the excess moisture. The two days old immature nymphs were released at the rate of 20 nymphs/ replication of the leaf disc. The leaf disc dipped in 0.1% Malathion 50 E.C. and 0.1% Imidacloprid were recorded as a standard check,

and the leaf disc dipped in water and wetting agent was used as control treatments. The data on mortality (nymphs not moving when touched with a fine brush were considered as dead) was recorded after 1, 3, 7 and 12 days after treatment. Such individuals were also exposed to sunlight to confirm their death if they did not respond to the heat exposure. The obtained data was analysed by using Analysis of Variance (ANOVA), and means were compared by using the Least Significant Difference (LSD) Test.



**Plate1.** Photograph showing the laboratory bioassay procedures of different eco-friendly insecticides against *Icerya aegyptiaca*

## Results and Discussion

It is a tall, bushy host with dense foliage and has a tillering habit. After harvesting, it can be ratooned at an interval of six months, which can be further used for lac cultivation after another six months. However, during the last few years, lac production has shown a declining trend due to varied factors. Though the lac insect *Kerria lacca* (Kerr) exploits different host plants for its nutrition only a few lac hosts are of commercial importance, viz., *Butea monosperma* (palas), *Schleichera oleosa* (kusum) and *Ziziphus mauritiana* (ber). Among these, the most serious is mortality due to parasitization. Egyptian fluted scale (*Icerya aegyptiaca*)- a new record as a pest of *F. semialata*. Immature, as well as adults, suck the cell sap from leaves and an upper soft portion of the semialata plant, resulting in leaf drop and stunted growth. As with most sap-sucking insects, the production of honeydew was also observed, leading to the development of sooty mould on the affected plant parts. The effect of different eco-friendly insecticides (Table 2) on the mortality of nymphs of Egyptian Fluted Scale, *Icerya aegyptiaca* after 1, 3, 7 and 12 days after treatment are presented in Table 2 given above. The nymphal mortality was low when recorded after one day of treatment and gradually increased when recorded after 3, 7 and 12 days. The nymphal mortality recorded after one day of treatment was 5 % mortality at 1% Uroinsecticide, 6.67% at 0.5% Green mealikil which is statistically at par with the untreated control with 5% mortality. The mortality percentage recorded in 0.2% Pestoguard and neemazal were 16.67% and 11.67%. In contrast, the maximum mortality was recorded in Standard check 53.34% at 0.1% Imidacloprid and 41.67% mortality at 0.1% Malathion 50 E.C. The nymphal mortality increased when recorded after three days of treatment the minimum mortality was recorded on 0.5% Green mealikil with 11.68% mortality which is statistically at par with untreated control, 18.34% at 1% uro-insecticide, 25% at 0.2% Neemazal and 26.68% at 0.2% pestoguard. The highest nymphal mortality after three days of treatment was recorded in Standard check, i.e. 0.1% Imidacloprid and 0.1% Malathion 50 E.C., which were 93.34% and 91.67%, respectively. The present studies reveal that the nymphal mortality after seven days of treatment gradually increases, which were, 28.34% at 0.5% Green mealikil followed by 41.67% at 1% Uro-insecticide, 51.68% at 0.2% Neemazal, 58.34% at 0.2% pestoguard and as against 15% mortality in untreated control whereas 100% mortality was observed in 0.1% Imidacloprid and 0.1% Malathion 50 E.C. After 12 days of treatment the highest mortality of 81.67% were recorded in 0.2% pestoguard followed by 78.34% in 0.2% Neemazal, 51.67% in 1 % uro-insecticide and 48.34% in 0.5% Green mealikil. In contrast, the mortality percentage in untreated control was 20%.

Mangoud & Abd El-Gawad (2003) tested two spraying methods (oriented and whole tree spraying) were carried out to control the Egyptian fluted mealybug, *Icerya aegyptiaca* (Douglas) (Homoptera: Margarodidae), in August 2002. Biofly and oil gave a poor average reduction in infestation against adult females (41.6% and 49.1%, respectively), while NeemAzal and Sulphur gave

moderate effects (64.1% and 60.7%, respectively). Malathion and Malathion + Oil gave sound reduction (85.1% and 91.4%, respectively). Biofly, NeemAzal, oil and Sulphur gave moderate average reduction against nymphs (67.5%, 69.3%, 71.5% and 71.0%, respectively), while Malathion and Malathion + oil gave sound average reduction (93.9% and 91.9%, respectively). Mohammad et al. (2010) found that the pink hibiscus mealybug *Maconellicoccus hirsutus* is a severe pest on the ornamental plant *Hibiscus rosa sinensis* at Ismailia governorate. So, the comparative effects of six commonly used insecticides [four nonconventional pesticides: Biofly, Biovar, Bioranza and Orange oil & two conventional pesticides, Admiral (pyriproxyfen) and Cidal (phenthoate)]. They applied under field conditions on the population(s) of the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green). Results showed that the most negligible reduction value was recorded by Biovar, Bioranza, Admiral and Orange oil on the mealybug population(s). The highest effect was occurred by cidial treatment. Mangoud et al. (2012) studied the relative toxicity of different compounds against the seychellarum mealybug, *Icerya seychellarum* (Westwood) (Homoptera: Margarodidae) and the vedalia beetle, *Rodalia cardinalis* (Mulsant) (Coleoptera: Coccinellidae) were studied on mango leaves under laboratory conditions. The obtained data indicated that different compounds (Biofly, NeemAzal and Super Mesrona oil) gave medium effects on nymphs, and adult females of *I. seychellarum* and immature and mature stages of their predator *R. cardinalis*, compared with Malathion which gave highly impact on the mealybug and its predator using direct exposure technique.

Mangoud (2008) found that the black parlatoria, *Parlatoria ziziphi* (Lucas) (Homoptera: Diaspididae) is a dangerous pest of citrus trees. Misrona oil and Buprofezin gave sound percent reduction against nymphs, adults and adults with eggs after one, two and three months. Oil and Buprofezin have a significant long-term effect. The natural control agents (M-pede, NeemAzal and Biofly) gave medium or low reduction against *P. ziziphi*. Fatima et al. (2016) evaluated different concentrations (0.06%, 0.1%, and 0.14%) of Telsta, Advantage, Talstar, Imidacloprid, and their mixtures against hibiscus mealybug in the laboratory of systematics and pest management at University of Gujrat, Pakistan. The toxic effect was evaluated in the laboratory bioassay after 24 and 48 hours of the application of insecticides. The highest mortality (95.83%) was shown by Talstar and Talstar + Imidacloprid at the concentration of 0.14% after 48 h, followed by Advantage + Talstar with 87.50% mortality at 0.14% concentration after 48 h of application. The study also showed that the least effective treatment observed was Advantage + Telsta, with no mortality after 24 h and 25% mortality after 48 h at 0.14% concentration. The study revealed that the concentration of 0.14% was highly influential in lowering the mealybug population, and insecticide mixtures were effective in reducing mealybug density.

Our results differ from the results of Karar et al. (2010), who evaluated Talstar against 1st instar nymphs of mango mealybugs after 24 h of spray, resulting in a low mortality of 66%. In our study, after 24 h of

insecticide exposure, Talstar caused the highest mortality, but after 48 h of insecticide exposure, both Talstar + Imidacloprid and Talstar caused the highest mortality.

**Table 2.** Effect of different eco-friendly insecticides on the nymphal mortality of Egyptian fluted scale, *Icerya aegyptiaca*

| Treatment      | Insecticide                | Concentration | One day after treatment       | Three days after treatment     | Seven days after treatment     | 12 days after treatment       |
|----------------|----------------------------|---------------|-------------------------------|--------------------------------|--------------------------------|-------------------------------|
| T <sub>1</sub> | Uro-insecticide            | 1%            | 5.00<br>(12.93) <sup>d</sup>  | 18.34<br>(25.31) <sup>c</sup>  | 41.67<br>(40.20) <sup>d</sup>  | 51.67<br>(45.96) <sup>c</sup> |
| T <sub>2</sub> | Green mealikil (Microbial) | 0.5%          | 6.67 (14.76) <sup>d</sup>     | 11.68<br>(19.89) <sup>d</sup>  | 28.34<br>(32.15) <sup>e</sup>  | 48.34<br>(44.05) <sup>c</sup> |
| T <sub>3</sub> | Pestoguard                 | 0.2%          | 16.67<br>(24.05) <sup>c</sup> | 26.68<br>(31.08) <sup>b</sup>  | 58.34<br>(49.84) <sup>bc</sup> | 81.67<br>(64.70) <sup>b</sup> |
| T <sub>4</sub> | Neemazal                   | 0.2%          | 11.67<br>(19.89) <sup>c</sup> | 25.00<br>(29.92) <sup>bc</sup> | 51.68<br>(45.96) <sup>c</sup>  | 78.34<br>(62.41) <sup>b</sup> |
| T <sub>5</sub> | Imidacloprid               | 0.1%          | 53.34<br>(46.93) <sup>a</sup> | 93.34<br>(75.25) <sup>a</sup>  | 100<br>(90.00) <sup>a</sup>    | 100<br>(90.00) <sup>a</sup>   |
| T <sub>6</sub> | Malathion 50 E.C.          | 0.1%          | 41.67<br>(40.17) <sup>b</sup> | 91.67<br>(73.41) <sup>a</sup>  | 100<br>(90.00) <sup>a</sup>    | 100<br>(90.00) <sup>a</sup>   |
| T <sub>7</sub> | Control                    | -             | 5.00<br>(12.93) <sup>d</sup>  | 11.68<br>(19.89) <sup>d</sup>  | 15.00<br>(22.79) <sup>f</sup>  | 20.00<br>(26.57) <sup>d</sup> |
| SE(d)          |                            |               | 2.39                          | 2.23                           | 1.65                           | 1.62                          |
| C.D (p=0.05)   |                            |               | 5.13                          | 4.78                           | 3.54                           | 3.47                          |

Figures in parenthesis are in arc sine angular transformation

Data are the mean of three replications

Number of nymphs released 20 nymphs/ replication

#### Conclusion

From the present studies, it can be concluded that all the eco-friendly insecticides used in the present experiment (Uroinsecticides, Pestoguard, green mealikil and neemazal) are effective in controlling the population of *Icerya aegyptiaca*. Unlike Malathion and Imidacloprid, they don't have a quick knockdown effect; however, the mortality due to exposure significantly increases as there is an increase in days or duration of application, and they are safe for the lac insect.

#### Declaration of Interests

The authors have no conflict of interest to declare.

#### Data Sharing

All relevant data are within the manuscript.

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