Bio - efficacy of plant powders on the mortality and adult emergence of Cigarette beetle, Lasioderma serricorne (Fab.) (Anobiidae: Coleoptera) infesting stored turmeric, Curcuma longa L

K Naveena, R Philip Sridhar and S Sheeba Joyce Roseleen

DOI: https://doi.org/10.22271/j.ento.2021.v9.i2d.8483

Abstract

The leaves of neem (Azadirachta indica), notchi (Vitex negundo), pungam (Pongamia pinnata) and eucalyptus (Eucalyptus globulus) were shade dried, powdered and admixedtured at the dosage of 250 and 500 mg along with the standard checks viz., malathion 25% WP (5 mg) and deltamethrin 2.5% EC (2 µl) per 50 g of cured turmeric rhizomes. The highest percent mortality was observed in notchi leaf powder 500 mg (68.15%) followed by neem leaf powder 500 mg (66.16%), notchi leaf powder 250 mg (60.65%), eucalyptus leaf powder 500 mg (60.19%), eucalyptus leaf powder 250 mg (55.22%), neem leaf powder 250 mg (53.72%), pungam leaf powder 500 mg (47.26%) and pungam leaf powder 250 mg (43.77%). The minimum number of 4.60 adults were emerged in notchi leaf powder 500 mg followed by neem leaf powder 500 mg (4.94 adults), eucalyptus leaf powder 500 mg (6.05 adults), neem leaf powder 250 mg (6.10 adults), notchi leaf powder 250 mg (6.16 adults), pungam leaf powder 500 mg (8.77 adults), pungam leaf powder 250 mg (10.27 adults) and eucalyptus leaf powder 500 mg (10.44 adults). It was evident that, notchi leaf powder 500 mg was found to be best among the plant products tested, since it caused maximum mortality and adult emergence.

Keywords: cigarette beetle, Lasioderma serricorne, plant products, Azadirachta indica, Vitex negundo, Pongamia pinnata, Eucalyptus globulus and turmeric rhizomes

Introduction

Turmeric (Curcuma longa L.) belongs to the family Zingiberaceae is also known as Indian saffron, golden spice and sacred spice. In India, it is being exported in a large scale accounting 51,500 tonnes [1]. India is the largest producer and consumer of turmeric in the world. The major states cultivating turmeric in India are Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Orissa, West Bengal and Gujarat. Andhra Pradesh is the leading state in area and production whereas the productivity of turmeric is high in Gujarat. In Tamil Nadu, Erode is one of the major turmeric growing district contributing 30 percent of India’s total production [1] and also a major trading centre for turmeric in Tamil Nadu.

The cigarette beetle (Lasioderma serricorne Fab.) belongs to the family Anobiidae of Coleoptera is a cosmopolitan stored product pest causing considerable economic damage to stored turmeric and tobacco, hence called as cigarette beetle or tobacco beetle [3]. The larva make holes and feeds on its internal contents. Adult feeding is limited, but it make holes in packaged commodities to escape. Excreta, dead beetles and other waste products causes quality loss [5]. The economic damage caused by cigarette beetle infestation are estimated to be about 0.7–1% of the total warehoused tobacco commodity [7]. The weight loss caused by the cigarette beetle after three and six months of storage was reported to be 7.15 and 22.75 percent in turmeric [7].

To manage this devastating pest, at present aluminum phosphide is the recommended fumigant in warehouses. However, lack of practical alternatives and repetitive use led beetles to evolve phosphine resistance which further complicates the management. The residue-free disinestation practices namely ionizing irradiation, IGR’s, low temperature, low oxygen and high pressure CO2 treatments are quite expensive and its implementation by farmers are
difficult. Since, the turmeric is one of the widely used spices for consumption, there is a need to search bio-pesticides for management. The plant products are eco-friendly, easily available, cheaper, less hazardous, easier application, delayed development of resistance and safer to consumers.

Materials and Methods
The experiment was conducted in Post Graduate Laboratory at the Department of Plant Protection, Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli, Tamil Nadu during 2017 - 2018. For experiments, 500 g of cured turmeric rhizomes were obtained from M/S Ulavan Producers Company Ltd., Erode. The plant products viz., neem (Azadirachta indica A.), notchi (Vitex negundo L.), pongam (Pongamia pinnata L.) and eucalyptus (Eucalyptus globulus L.) leaves were collected from Horticulture Farm, HC and RI (W), Tiruchirappalli besides local procurement of malathion 25% WP and deltamethrin 2.5% EC.

The collected leaves were shade dried for a week and ground to a coarse powder with an electric blender. The powders were sieved through 60 mesh sieve and stored in an airtight plastic containers (8cm × 7cm) at 30 ± 2° C room temperature and 60 ± 5 percent relative humidity before use. They were admixed at the concentrations of 250, 500 mg per 50 g while malathion 25% WP was used at a concentration of 5 mg per 50 g and deltamethrin 2.5% EC at 2 μl per 50 g of well dried cured turmeric rhizomes. The powders were mixed thoroughly with rhizomes by shaking the plastic containers (11cm × 7cm). An untreated check (control) was also maintained simultaneously. The performance of the plant powders as protectants against L. serricorne was assessed based on the adult mortality and adult emergence due to the infestation in each treatment.

Tropical rhizomes (50 g) and test materials at respective doses were treated and kept in plastic containers (11cm × 7cm). Five pairs of 2 to 3 days old adults of L. serricorne were released in each container at an interval of 6, 10, 15, 30, 45, 60 and 75 days of treatment. The plastic containers were covered with two-fold muslin cloth and tied with a rubber band to ensure ventilation. Three repetitions were used in each case. The mortality counts were recorded after 4 days of release of adults at each interval in turn to assess the efficacy of plant powders till 75 days. Insects showing movement of legs and antennae were considered as alive. The percent adult mortality was calculated on the basis of the number of dead insects as given below.

\[
\text{Per cent adult mortality} = \frac{\text{Number of dead insects}}{\text{Total number of insects released}} \times 100
\]

The corrected percentage mortality was calculated using the following Abbott’s (1925) formula.

\[
\text{Corrected per cent mortality} = \frac{p' - c}{100 - c} \times 100
\]

Where, \(P'\) = Percent mortality in treatment.
\(C\) = Percent mortality in control.

For the observations on adult emergence, the number of adults emerged were recorded after 30 days of treatment till the complete emergence of adults at an interval of 10 days upto 90 days.

| Treatments | Mortality (%) | Grand Mean | Corrected Mean Mortality (%) |
|------------|---------------|------------|-------------------------------|
| **T1** - Neem Powder 250 mg | 66.66 (54.695) | 55.71 | 53.72 |
| | 60.00 (50.768) | | |
| | 56.66 (48.792) | | |
| **T2** - Neem Powder 500 mg | 76.66 (51.070) | 67.61 | 66.16 |
| | 73.33 (58.887) | | |
| | 66.66 (54.695) | | |
| **T3** - Notchi Powder 250 mg | 73.33 (58.887) | 62.85 | 60.65 |
| | 70.00 (56.789) | | |
| | 66.66 (54.695) | | |
| **T4** - Notchi Powder 500 mg | 80.00 (63.434) | 69.52 | 68.15 |
| | 73.33 (58.887) | | |
| | 70.00 (56.789) | | |
| **T5** - Pungam Powder 250 mg | 56.66 (48.792) | 46.18 | 43.77 |
| | 53.33 (46.892) | | |
| | 50.00 (41.149) | | |
| **T6** - Pungam Powder 500 mg | 66.66 (54.695) | 49.52 | 47.26 |
| | 56.66 (48.792) | | |
| | 53.33 (46.892) | | |
| **T7** - Eucalyptus Powder 250 mg | 73.33 (58.887) | 57.14 | 55.22 |
| | 66.66 (54.695) | | |
| | 63.33 (52.713) | | |
| **T8** - Eucalyptus Powder 500 mg | 73.33 (58.887) | 61.90 | 60.19 |
| | 66.66 (54.695) | | |
| | 66.66 (54.695) | | |
| **T9** - Malathion 25% WP | 100.00 (89.670) | 100.00 | 100.00 |
| | 100.00 (89.670) | | |
| | 100.00 (89.670) | | |
| **T10** - Deltamethrin 2.5% EC | 100.00 (89.670) | 100.00 | 100.00 |
| | 100.00 (89.670) | | |
| | 100.00 (89.670) | | |
| **T11** - Control | 0.00 (0.330) | 4.28 | 0.00 |
| | 10.00 (18.434) | | |
| | 0.00 (0.330) | | |
| | 10.00 (18.434) | | |

Mean values followed by the same alphabet in a column are not significantly different (\(F = 0.01, 0.05\)).

*Numeric data represents the mean value of three replications.

Figures in the parentheses are arcsine transformed values. 

\(\sin^{-1}\sqrt{P}\) - DAT - Days After Treatment
### Results and Discussion

The data on adult mortality (Table 1) showed that the treatments differed significantly. The overall corrected percent mortality of adults ranged from 43.77 to 100 percent. The highest mortality percentage was observed in notchi leaf powder 500 mg (86.66%) followed by neem leaf powder 500 mg (70.00%), eucalyptus leaf powder 250 mg (65.15%), and pungam leaf powder 250 mg (55.22%), which were sufficient for managing *P. serricorne* adults. The efficacy of the botanical sources was also statistically different (P = 0.01, 0.05).

The data also showed that all the treatments of plant products gave complete protection up to 40 DAT except control, while some adult emergence was noticed from 60 DAT to 90 DAT in all the plant products (Table 2). The chemical treatment did not record any emergence of beetles up to 60 DAT which was statistically on par with pungam leaf powder 500 mg (0.00 no.), eucalyptus leaf powder 500 mg (0.00 no.) and eucalyptus leaf powder 250 mg (0.33 no.). At 90 DAT, a minimum number of 15 adults were observed in 500 mg of notchi powder. No adults emerged from the two insecticidal treatments. The maximum number of adults was observed in untreated control (55.00) which was statistically on par with pungam leaf powder 250 mg (4.66%).

### Table 2: Effect of plant powders on the adult emergence of *P. serricorne* in turmeric rhizomes

| Treatments           | 30 DAT | 40 DAT | 50 DAT | 60 DAT | 70 DAT | 80 DAT | 90 DAT | Grand Mean |
|----------------------|--------|--------|--------|--------|--------|--------|--------|-----------|
|                      |        |        |        |        |        |        |        |           |
| T1 - Neem Powder 250 mg | 0.00   | 0.00   | 0.33   | 1.66   | 2.00   | 8.33   | 24.33  | 6.10      |
|                      | (0.707)| (0.707)| (0.912)| (1.471)| (1.581)| (2.972)| (4.983)|           |
| T2 - Neem Powder 500 mg | 0.00   | 0.00   | 0.33   | 0.66   | 1.66   | 5.00   | 22.00  | 4.94      |
|                      | (0.707)| (0.707)| (0.912)| (1.080)| (1.471)| (2.345)| (4.743)|           |
| T3 - Notchi Powder 250 mg | 0.00  | 0.00   | 0.33   | 1.00   | 5.66   | 10.00  | 20.00  | 6.16      |
|                      | (0.707)| (0.707)| (0.912)| (1.224)| (2.483)| (2.340)| (4.527)|           |
| T4 - Notchi Powder 500 mg | 0.00  | 0.00   | 0.33   | 0.66   | 3.64   | 8.00   | 15.00  | 4.60      |
|                      | (0.707)| (0.707)| (0.912)| (1.080)| (2.041)| (2.915)| (3.937)|           |
| T5 - Pungam Powder 250 mg | 0.00  | 0.00   | 0.66   | 1.00   | 6.66   | 14.33  | 39.00  | 10.27     |
|                      | (0.707)| (0.707)| (1.080)| (1.224)| (2.677)| (3.851)| (6.284)|           |
| T6 - Pungam Powder 500 mg | 0.00  | 0.00   | 0.00   | 0.00   | 2.66   | 12.00  | 38.00  | 8.77      |
|                      | (0.707)| (0.707)| (0.707)| (0.707)| (1.779)| (3.535)| (6.204)|           |
| T7 - Eucalyptus Powder 250 mg | 0.00   | 0.00   | 0.33   | 0.66   | 2.33   | 8.00   | 52.00  | 10.44     |
|                      | (0.707)| (0.707)| (0.912)| (1.080)| (1.683)| (2.915)| (5.522)|           |
| T8 - Eucalyptus Powder 500 mg | 0.00  | 0.00   | 0.00   | 0.00   | 1.00   | 5.00   | 30.00  | 6.05      |
|                      | (0.707)| (0.707)| (0.707)| (0.707)| (1.224)| (2.345)| (5.295)|           |
| T9 - Malathion 25% WP | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00      |
|                      | (0.707)| (0.707)| (0.707)| (0.707)| (0.707)| (0.707)| (0.707)|           |
| T10 - Deltamethrin 2.5% EC | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00      |
|                      | (0.707)| (0.707)| (0.707)| (0.707)| (0.707)| (0.707)| (0.707)|           |
| T11 - Control        | 0.00   | 2.00   | 4.00   | 5.00   | 8.66   | 20.00  | 55.00  | 15.77     |
|                      | (0.707)| (1.581)| (2.121)| (2.345)| (3.027)| (4.527)| (7.449)|           |
| SEd                  | NS     | 0.07   | 0.16   | 0.16   | 0.17   | 0.19   | 0.14   |           |
| CD (0.05)            | NS     | 0.16   | 0.34   | 0.34   | 0.36   | 0.39   | 0.29   |           |
| CD (0.01)            | NS     | 0.22   | 0.46   | 0.46   | 0.49   | 0.53   | 0.39   |           |
| CV%                  | NS     | 12.44  | 21.67  | 18.09  | 12.27  | 8.57   | 3.66   |           |

The data also showed that all the treatments of plant products gave complete protection up to 40 DAT except control, while some adult emergence was noticed from 60 DAT to 90 DAT in all the plant products (Table 2). The chemical treatment did not record any emergence of beetles up to 60 DAT which was statistically on par with pungam leaf powder 500 mg (0.00 no.), eucalyptus leaf powder 500 mg (0.33 no.) and eucalyptus leaf powder 250 mg (0.33 no.). At 90 DAT, a minimum number of 15 adults were observed in 500 mg of notchi powder. No adults emerged from the two insecticidal treatments. The maximum number of adults was observed in untreated control (55.00) which was statistically on par with eucalyptus leaf powder 250 mg by registering 52.00 adults. It is inferred that, a minimum number of 4.60 adults emerged in notchi leaf powder 250 mg which was followed by neem leaf powder 500 mg (4.94 adults), eucalyptus leaf powder 500 mg (6.05 adults), neem leaf powder 250 mg (6.10 adults), notchi leaf powder 250 mg (6.16 adults), pungam leaf powder 500 mg (8.77 adults), pungam leaf powder 250 mg (10.27 adults) and eucalyptus leaf powder 500 mg (10.44 adults) (Figure 1).
Fig 1: Effect of plant powders on the mortality and adult emergence of *L. serricorne* in turmeric rhizomes

Our present findings are in overall agreement with the findings of Ravi Kumar *et al.* (2017) [6] on the efficacy of different plant products causing lesser fecundity, adult emergence, weight loss in neem seed kernel powder after 9 months of treatment, followed by notchi leaf powder, pungam leaf powder, lantana leaf powder and annona leaf powder. Our results are also in accordance with the observations by Onu *et al.* (2015) [4] testing the plant products viz., neem and garlic powders against the storage pests of *S. oryzae*, *S. zeamais* and *C. maculatus* in cereals and found that mixture of both plant products were effective, besides being in conformity to the overall results reported by Khalequzzaman and Goni (2009) [2] in confirming the efficacy of notchi leaf powder against *Callosobruchus maculatus* and *C. chinensis* in cowpea.

**Conclusion** Accordingly, the present study has clarified the potential for notchi leaf powder as promising botanical bio-pesticide source against cigarette beetle in stored turmeric, whereas further studies are required to optimize the dosage regime, so as to compete with synthetic insecticides.

**References**

1. *Dsouza R, Murall N, Shah K. Turmeric Crop Survey and Analysis, Nirmal Bang Commodities Pvt. Ltd 2015.*
2. *Khalequzzaman M, Goni SHMO. Toxic potentials of some plant powders on survival and development of Callosobruchus maculatus (F.) and Callosobuchus chinensis L. Journal of Life and Earth Science 2009;3:1-6.*
3. *Naveen M, Jayaraj J, Chinniah C, Mini ML, Vellaikumar S, Shanthi M. Insecticidal property of methanolic leaf extract of Sweet Basil, Ocimum basilicum (L.) against cigarette beetle, Lasioderma serricorne (Fab.) (Coleoptera: Anobiidae). Journal of Entomology and Zoology Studies 2020;9(1):259-262.*
4. *Onu F, Ogu E, Ikehi M. Use of neem and garlic dried plant powders for controlling some stored grain pests. Egyptian Journal of Biological Pest Control 2015;25(2).*
5. *Powell TE. An ecological study of the tobacco beetle, Lasioderma serricorne (F.) with special reference to its life history and control. Ecological Monographs 1931;1:333-393.*
6. *Ravi Kumar K, Narendra Reddy C, Vijaya Lakshmi K, Rameash K, Keshavulu K, Rajeswari B. Efficacy of different grain protectants on the effect of fecundity, adult emergence and weight loss of cigarette beetle (Lasioderma serricorne Fabricius) infestation in cured turmeric rhizomes (Curcuma longa Linnaeus). International Journal of Current Microbiology and Applied Sciences 2017;6(4):963-971.*
7. *United States. Stored-Product Insect Research Branch. 1962. Stored-tobacco insects: biology and control, Agriculture handbook (United States. Department of Agriculture), Washington, DC: U.S. Dept. of Agriculture, Agricultural Marketing Service 233(1-39).*
8. *Vidya H, Awaknavar J. Host suitability of different spices to Cigarette beetle, Lasioderma serricorne Fab. (Anobiidae: Coleoptera). Insect Environment 2004;10(4):176-177.*