JBiopest 16(1):33-37 (2023)

Repellent and growth regulatory effects of *Lantana camara* extracts on *Odontotermes wallonensis* (Isoptera: Termitidae)

Adlin Pricilla Vasanthi, E[1*]., Jeyarajan Nelson, S.[2] and Sangeetha, B[3]

ABSTRACT

Odontotermes wallonensis is a fungus growing termite species that are abundant in South India. *Lantana camara* leaves extracted with methanol have been found to have repellent and IGR activities against termites. The extract was also tested on *O. wallonensis* nymphs and showed significant IGR activity at a concentration of 1 %.

Keywords Termite, *Odontotermes wallonensis, Lantana camara,* Antifeedant, IGR, Repellent

MS History: 13.03.2023(Received)-21.05.2023(Revised)- 27.05.2023 (Accepted)

Citation: Adlin Pricilla Vasanthi, E., Jeyarajan Nelson, S. and Sangeetha, B. 2023. Repellent and growth regulator effects of *Lantana camara* extracts on *Odontotermes wallonensis* (Isoptera: Termitidae). *Journal of Biopesticides*, **16**(1): 33-37. **DOI:10.57182/jbiopestic.16.1.33-37**

INTRODUCTION

Among the 337 termite species reported from India, approximately 35 have been known to damage agricultural and horticultural crops as well as buildings and wooden structures. *Odontotermes wallonensis* is the most abundant termite species in South India, which attacks cereals, pulses, sugarcane, oilseeds, fruit trees, and cashews. Soil application of chemical insecticides is still considered the preferred termite management strategy among farmers, and the application of biopesticides against termites has not been well demonstrated (Ahmad *et al.,* 2018). The development of potential biopesticides to control termites will decrease the application of synthetic chemical insecticides, reduce soil pollution, and improve fertility. Botanical extracts of locally available plants may have antitermitic effects and can be used for termite management. However, in India, the pesticidal properties of many local plants have not yet been studied or documented. In this view, our earlier research started with the screening of the termiticidal properties of 50 locally available plants and found that *L. camara* was the most effective botanical extract among them on termites. *L. camara* shows insecticidal activity against many pests, including *Spodoptera litura* (Rathi and Gopalakrishnan, 2010; Bhatt *et al.,* 2014) and Dysdercus koenigii (Kayesth and Gupta, 2018; Kayesth *et al.,* 2020). However, no information is available on termites. So, the present study was undertaken with the following objectives: to explore the repellent activity of *L. camara* plant extracts on *O. wallonensis* and to find out the IGR activity of *L. camara* plant extracts on *O. wallonensis* nymphs.

MATERIALS AND METHODS

Extraction of L. camara leaves

L. camara plants were collected from Ooty and the leaves were separated. After thorough washing with water, the leaves were shade dried and pulverized. Leaf powder was extracted with methanol in the Soxhlet apparatus for a period of 72hrs at 40~60°C. Excess solvent was removed by keeping in water bath at 40ºC for 2hrs. Stock solution was prepared from crude extracts by dissolving 2.5mg of solvent extract in 25mL of methanol to get a solution of 10 per cent concentration. From this stock solution, various concentrations *viz.*, 0.05, 0.10, 0.25, 0.50 0.75 and 1.00 per cent were prepared by serial dilutions and used for the experiments.

Field collection of termites

Termites were collected by using 9.5 × 8cm sized mud pots filled with paddy straw. This set up was used as bait and kept in termite abundant areas around TNAU campus, Coimbatore. Nymphs were

collected for IGR experiment by cut opening the *O. wallonensis* mound.

Evaluation of repellent effect on termites

To test the repellent effect of plant extracts, filter paper of diameter 9cm divided into two equal halves were kept in Petri plates. The first half was treated with various concentrations (0.05, 0.10, 0.25, 0.50, 0.75, and 1.00%) of *L. camara* extracts. The second half was left untreated. Control was similarly prepared in which one half of filter paper received distilled water and another half was left untreated. Petri plates were left uncovered for 4hrs at ambient condition for solvent evaporation. Then 250µL of distilled water was added to each filter paper. Forty-five workers and five soldiers were released into Petri plates and covered with lids. This set up was kept in BOD (25±1º C and 70±5% RH) and covered with an opaque black sheet to eliminate the effect of light. The per cent repellency was recorded in 2, 4, 6, 8, 10, 12, 24, 36 and 48 HAT depending on number of existing insects on the treated half of filter paper.

Evaluation of IGR effect on termites

To find the IGR effects of botanical extracts, pseudergates (P3 or P4) of *O. wallonensis* were used for the experiment. The different concentrations of *L. camara* extracts (0.05, 0.10, 0.25, 0.50, 0.75, and 1.00 %) were prepared and applied with a syringe @ 5mL on the filter papers arranged in the round Petri plates. The control was similarly prepared in which filter papers had received only distilled water and check used was Diaflubenzuron 25% WP @ 1 per cent concentration. Pseudergates numbering fifty per replication were released. Three replications were maintained for each treatment. The experimental set up was kept for three weeks in BOD incubator at 25±1°C. Once in a week the following observations viz., deformed nymphs and intermediate underdeveloped workers were observed.

Statistical analysis

The data on percentage values and numbers were transformed into arcsine and square root values, respectively, before subjecting them to statistical analysis (Gomez and Gomez, 1994). Analysis of variance was performed using the AGRESS and AGDATA software packages. Duncan's Multiple Range Test (Duncan, 1951) was used to compare treatment means.

RESULT

Repellent effect of *L. camara* on *O. wallonensis*

All the concentrations of methanolic extract of *L. camara* leaves showed repellent activity on termites (Table 1) and cent per cent repellency at higher concentration (1.00%) was observed as that of Chlorpyrifos 20 EC @ 0.1 per cent concentration (Fig.1).

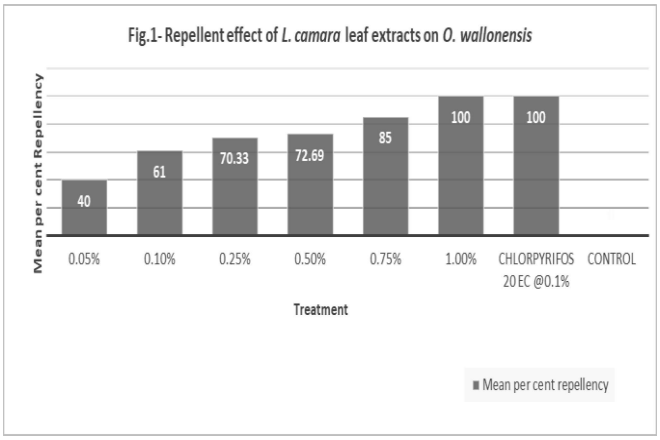

Fig. 1. **Repellent effect of *L. camara* on *O. wallonensis***

IGR activity of *L. camara* on *O. wallonesnis*

The present study demonstrated the IGR activity (development of intermediate adults and deformed nymphs) of L. camara methanolic extract on O. wallonensis nymphs (Table 2). Significant IGR activity was observed at 1.00 per a concentration (Fig. 2), which resulted in a high mean percentage of intermediate adult development (58.78%) and deformed nymphs (39.63%).

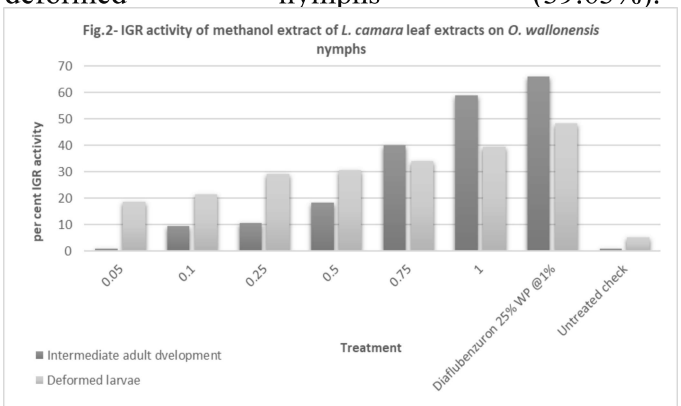

Fig.2. **IGR activity of *L. camara* on *O. wallonesnis***

Table 1. Repellent activity of methanol extract *L. camara* leaves on *O. wallonensis*

Methanol extract of *L. camara* leaves	Mean per cent repellency at HAT**								
	2	**4**	**6**	**8**	**10**	**12**	**24**	**36**	**48**
0.05%	0.00 ^{c}	0.25^{g}	1.33 ^{g}	5.08 ^{g}	30.00 ^{d}	35.33^{f}	37.28^{e}	40.00^{b}	40.00^{e}
0.10%	0.00 ^{c}	0.29^{f}	2.78^{e}	7.33^{f}	28.52^{e}	45.00^{e}	48.67^{d}	53.33^{b}	61.00^{d}
0.25%	0.00^{c}	0.59^{e}	1.76^{f}	8.09^{e}	19.00^{g}	47.38^{d}	55.66^{d}	69.50^{b}	70.33^{c}
0.50%	0.06^{b}	1.98^{d}	5.25^{d}	12.33^{d}	25.50^{f}	58.99^{c}	69.33^{c}	72.66^{b}	72.69^{c}
0.75%	0.18 ^{b}	3.00^{c}	8.66^{c}	20.93^{c}	35.00^{c}	59.13^{c}	73.00^{bc}	82.12^{b}	85.00^{b}
1.0%	0.50^{a}	6.33^{b}	18.00^{b}	25.33^{b}	43.00^{b}	60.33^{b}	78.98^{b}	100.00^{a}	100.00^{a}
Chlorpyrifos 20 EC @0.1%	0.00^{c}	11.56^{a}	37.27^{a}	49.00^{a}	60.33^{a}	75.99^{a}	100.00^{a}	100.00^{a}	100.00^{a}
Control	0.00	0.00 ^{h}	0.00^{h}	0.00^{h}	0.00^{h}	0.00^{g}	0.00^{f}	0.00^{c}	0.00^{f}
Sed	**0.670**	**0.090**	**0.158**	**0.382**	**0.414**	**0.288**	**1.524**	**5.511**	**1.790**
CD (P=0.05)	**1.421**	**0.191**	**0.335**	**0.809**	**0.877**	**0.611**	**3.232**	**11.684**	**3.795**

*Mean of 3 replications; **HAT-Hours After Treatment
Means followed by same letter(s) are not significantly different at 5% level by LSD

DISCUSSION

Various viable options in termite management are termite baits (novaluron, hexaflumuron), the use of synthetic pesticides/insecticides/termiticides (bifenthrin, chlorpyrifos, cypermethrin, fenvalerate, imidachloprid, permethrin, dexamethasone, ibuprofen, aldrin, dieldrin), chemicals (boric acid, ibuprofen sodium salt), or botanicals (*Withania somnifera, Croton tiglium*, *Hygrophila auriculata, Trachyspermum ammi, Pimenta dioica, Carum carvi, Anethum graveolens, Pelargonium graveolens, Litsea cubeba, Croton urucurana, Melia azedarach, Crotalaria burhia,* and *Anacardium occidentale*) (Sahayraj, 2018). Studies on the repellent effect of *L. camara* showed that all the concentrations of its extracts had significant repellency against termites when compared to the control. Ding and Hu (2010) demonstrated the repellent activity of *L. camara* against subterranean termites, Reticulitermes flavipes and *C. formosanus* and concluded that leaves, stems and flowers were more repellent than roots. The repellent properties of different fractions obtained from *L. camara* flowers have been evaluated against mosquito species (Dua et al., 2010), and the results showed that one application of the chloroform fraction provided 100 per cent protection for 7 h against Aedes mosquito bites. Adlin *et al.* (2016) studied the termiticidal and antifeedant effects of aqueous extracts of *L. camara* and reported it to be the most effective termiticide, with cent/cent mortality and low food consumption.

Generally, all treatments of *L. camara* showed higher development of intermediate adults and deformed nymphs in the tested populations of *O. wallonensis* nymphs. The methanolic extract of *L. camara* was tested for larval weight, pupation, and adult emergence of cabbage butterflies (Sharma and Mehta, 2009). *L. camara* exhibited significantly lower effect on reduction in weight (1.25%) and pupal formation increased significantly (0.0-43.1%) with a decrease in concentration from 5.0 to 1.25 per cent. A similar trend was observed with respect to the adult emergence of *Plasmodiophora brassicae*. Similar results for larval deformities and intermediate adult development in *Chrysomya megacephala* treated with *L. camara* essential oil were also reported by Maddheshiya *et al*. (2021).

Table 2. Insect Growth Regulatory activities of methanol extract of *L. camara* on *O. wallonensis*

Dose (%)	Mean per cent Intermediate adult development*			Mean	Mean per cent deformed nymphs*			Mean
	I week	II week	III week		2 DAT	4 DAT	6 DAT	
0.05	0.00 ^{f}	0.60 ^{g}	3.33 ^{f}	1.11^{g}	10.00^{g}	18.33^{g}	28.00 ^{f}	18.78 ^{f}
0.10	0.00^{f}	13.00^{f}	15.33^{e}	9.44^{f}	13.07^{f}	20.66^{f}	30.65^{e}	21.46^{e}
0.25	2.33^{e}	13.97^{e}	15.67^{e}	10.66^{e}	20.58^{e}	32.00^{d}	35.00^{d}	29.19^{d}
0.50	5.00^{d}	20.33^{d}	30.00^{d}	18.44^{d}	25.33^{d}	30.00^{e}	36.27^{d}	30.53^{d}
0.75	20.33^{c}	42.00^{c}	58.00^{c}	40.11^{c}	26.80^{c}	33.58^{c}	42.00^{c}	34.13^{c}
1.00	43.00^{b}	60.00^{b}	73.33^{b}	58.78^{b}	30.00^{b}	40.33^{b}	48.57^{ab}	39.63^{b}
Diaflubenzuron 25% WP @1%	52.30^{a}	68.00^{a}	78.00^{a}	66.10^{a}	33.66^{a}	48.66^{a}	63.00^{a}	48.44^{a}
Untreated check	0.00^{f}	0.00 ^{h}	2.33^{g}	0.98^{g}	0.00^{h}	3.00^{h}	12.63^{g}	5.21^{g}
SED	0.227	0.304	0.317	0.293	0.359	0.445	0.480	0.486
CD(P=0.05)	0.481	0.644	0.672	0.621	0.761	0.943	1.019	1.031

*Mean of 3 replications; **DAT-Days After Treatment; means followed by same letter(s) are not significantly different at 5% level by LSD

In this study, the tested botanical extracts showed significant repellent and IGR activity against *O. wallonensis*, which can be further studied on different insect pests, and the active ingredient fractions of *L. camara* can be separated for the development of commercial botanical insecticides.

CONTRIBUTION OF AUTHORS

E. A.P.V. - Corresponding author and investigator conducted the laboratory experiments; **S. J. N.-** Chairman of advisory committee who guided the research' **B. S.-** Assisted in field collection of termites and laboratory experiments

REFERENCES

Adlin Pricilla Vasanthi, E., Jeyarajan Nelson, S., Muthukrishnan, N., Ramanathan, A. and Uma, D. 2016. Antitermitic effect of invasive plants on subterranean termite, Odontotermes *wallonensis Wasmann*. (Termitidae: Isoptera). *J. ent*. Res., **40** (3): 207-212.

Ahmad, S. K., Dale-Skey, N. and Khan, M. A. 2018. Role of Botanicals in Termite Management. In: Sustainability in Plant and Crop Protection, Khan, M., Ahmad, W. (Eds.) Termites and Sustainable Management *Springer, Cham*. https://doi.org/10.1007/978-3-319-68726-1_8.

Bhatt, P., Thodsare, N., and Srivastava, R. P. 2014. Toxicity of some bioactive medicinal plant extracts to Asian army worm, Spodoptera litura. *Journal of Applied and Natural Science*, *6*(1), 139-143.

Ding, W. and Hu, X. P. 2010. Antitermitic effect of the Lantana camara plant on subterranean termites (Isoptera: Rhinotermitidae). *Insect Sci*., **17**: 427-433.

Dua, V. K., Pandey, A. C. and Dash, A. P. 2010. Adulticidal activity of essential oil of Lantana camara leaves against mosquitoes. *Indian Journal of Medical Research,* **131**: 434–439.

Duncan, D. B. 1951. A significance test for differences between ranked treatments in an analysis of variance. *Virginia* Journal *of* Science, **2**: 171-189.

Gomez, K. A and Gomez, A. A. 1984. Statistical procedures for agricultural research, 2nd Edn. John Wiley and Sons, New York.

Kayesth, S., and Gupta, K. K. 2018. Impact of Lantana camara hexane extract on survival, growth and development of *Dysdercus koenigii* Fabricius (Heteroptera: Pyrrhocoriedae). *Acta Ecologica Sinica*, *38*(3), 187-192.

Kayesth, S., Kumar, S., Shazad, M., and Gupta, K. K. 2020. Effects of hexane extract of *Lantana camara* leaves on reproductive bioactivities of *Dysdercus koenigii* Fabricius (Heteroptera:

Pyrrhocoreidae). *Acta Ecologica Sinica*, *40*(3), 247-253.

Maddheshiya, R., Sahu, D. M., and Singh, K. P. 2021. Analysis of the chemical composition (GC–MS) of *Lantana camara* (Verbenaceae) essential oil and its insecticidal effect on the post-embryonic development of *Chrysomya megacephala* (Fab.1794) (Dipteroridae). *Journal* of *Applied Biology* and *Biotechnology* , **9** (4): 47–55.

Nisar, M. S. 2012. Effects of plant extract on the behaviour and physiology of the *Odontotermes obesus* (Ramb.) (Isoptera: Termitidae). in Ph.D., Thesis, University of Agriculture, Faisalabad, Pakistan. 59p.

Rathi, J. M., and Gopalakrishnan, S. 2010. Insecticidal activity of methanolic pooled fractions of Lantana wightiana Wall. *Journal of Biopesticides*, *3*(Special Issue), 282-285.

Sharma, S. and Mehta, P. K. 2009. Bioefficacy of plant extracts against cabbage aphid. *Res. on Crops*, **10**: 98-100.

Sahayaraj, K. 2018. Bio-intensive Integrated Management of Termites. *Termites and Sustainable Management: Volume 2-Economic Losses and Management*, 165-180.

E. Adlin Pricilla Vasanthi*[1], S. Jeyarajan Nelson[2] and B. Sangeetha[3]

[1]Division of Entomology, School of Agricultural Sciences, Karunya Institute of Technology and Sciences, Coimbatore- 641 114.

[2]Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore- 641 003.

[3]Division of Plant Pathology, School of Agricultural Sciences, Karunya Institute of Technology and Sciences, Coimbatore- 641 114.

***Corresponding author**

E-mail: adlinpricilla.203@gmail.com