

Efficacy of Botanical extracts for the Management of termites, *Odontotermes obesus* (Rambur, 1842) under Laboratory conditions.

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Abstract— Termites are the agroeconomic and polyphagous pests. In this study, the effect of five botanicals, *Datura metel*, *Catharanthus roseus*, *Lantana camara*, *Calotropis gigantea* and *Azadirachta indica* against the workers of *Odontotermes obesus* was evaluated. Among these rapid mortality rate is recorded with *Catharanthus roseus* (3.89 at 1st hour) followed by *Datura metel* (2.89 at 1st hour). Both *Catharanthus roseus* and *Datura metel* showed the mortality within 4 hours. Which is followed by *Azadirachta indica*, *Lantana camara*.

Keywords- Termites; *Datura metel*; *Catharanthus roseus*; *Lantana camara*; *Calotropis gigantea* and *Azadirachta indica*.

I. INTRODUCTION

Termites are social insects living in colonies usually comprising a king, queen, sterile workers and soldiers. They are cosmopolitan in distribution and are mostly found in the tropics, sub-tropics, and temperate regions of the world [1]. Termites play a major ecological role in enhancing the soil fertility by degrading the cellulose based materials and by their tunneling behaviour and thorough mixing of soil organic matter increases the aeration of soil and nutrient availability and modifies the soil structure [2, 3]. Despite of its beneficial effects, it is a devastating insect pests and it is becoming threat to major field crops such as sugarcane, cereals, tobacco, vegetables, fruits, legumes, oil seeds, many ornamental plants and forest resources [4-8]. The termites bring forth primary damage by directly feeding on plant parts and secondary damage includes the susceptibility of pathogenic fungal infections in the infected site [9]. Few species build termite mounds in fields lead to complete eradication of soil vegetations, thus desolate the soil surfaces which in turn exposed to erosion thus reduces farm productivity and finally result in land degradation [10].

For controlling termites, synthetic termiticides have been used for a long time. As it provides prolonged control, it was considered as a boon. But now it was realized that, continuous and over usage of synthetic pesticides posed a health hazard to environment, due to their residual effect. More over the use of synthetic insecticides in the control of termites is known to cause aquatic and environmental pollution, lethal effect on non-target organism, pest resurgence and resistance development by the termites [11]. Some of the termiticides like DDT, aldrin, dieldrin, heptachlor and BHC were banned in many countries. Hence, there was an urgent need to find alternative, ecofriendly and easily available termite control strategies to tackle these problems.

Use of some cultural control methods such as mounds distraction, removal of the queen, flooding water into the mound is also not completely effective as they are always hidden in tunnels and it is difficult to reach their living places.

Thus, botanicals with insecticidal properties could be regarded as potential alternatives. A broad range of plants are reported to have toxic, repellent and anti- feeding properties [12]. The botanical pesticides have less harmful effects to non-target beneficial insects and other organisms. The plant based products are easily biodegradable and leaves no residual effects in environment. In this study, the efficacy of leaf extracts of *Datura metel*, *Catharanthus roseus*, *Lantana camara*, *Calotropis gigantea* and *Azadirachta indica* against the *Odontotermes obesus* workers were evaluated under laboratory conditions.

II. MATERIALS AND METHODS

Collection and identification of termites

The termites were collected from Scott Christian College campus, Nagercoil, Kanyakumari District, Tamil nadu, South India. The worker termites were carefully selected using brush in plastic boxes and taken to the laboratory. The termites were identified using the keys [13]. They were fed with powdered wood and the humidity was maintained by keeping wet cotton in the plastic boxes.

Collection of botanical plants

The leaves of five locally available plants namely, *Datura metel*, *Catharanthus roseus*, *Lantana camara*, *Calotropis gigantea* and *Azadirachta indica* were collected and it was washed with tap water and shade dried. The leaves were powdered separately and stored in air tight containers.

Preparation of crude extracts

The shade dried leaves were powdered separately in an electric blender and sieved through 0.25 mm pore size mesh. The powders were stored individually in air tight labelled glass containers in room temperature. For experimental analysis, four concentrations 10, 20, 30, and 40 % (w/v) was prepared by soaking 10, 20, 30 and 40g of each powdered leaves in 100 ml of distilled water in a conical flask. The flasks were shaken overnight in the automatic shaker. After 24 hours, the mixture was filtered in Whatman No. 3 filter paper and the crude extracts were prepared.

Experimental procedure

Whatman No.5 filter paper of size 5 X 5 cm was taken. It was dipped in 2 ml of 10% concentration crude extract of *Datura metel*. The filter paper was then air dried.

Exactly 10 worker termites were selected and taken in a glass petriplates. To that the pretreated filter paper was given to the termites. The termites were allowed to eat that paper. The mortality was recorded at regular time intervals. The same procedure was followed for all the plant extracts (*Catharanthus roseus*, *Lantana camara*, *Calotropis gigantea* and *Azadirachta indica*) in all the concentrations separately. About 3 replicates were maintained and the control was maintained by giving the air dried filter paper after dipping in 2ml distilled water.

Statistical Analysis

The data collected were subjected to analysis of variance by completely Randomized block design and Agress statistical software package was employed.

III. RESULT AND DISCUSSION

In the present study, five botanicals such as *Datura metel*, *Catharanthus roseus*, *Lantana camara*, *Calotropis gigantea* and *Azadirachta indica* were tested against the worker termites under laboratory conditions. From the Analysis of Variance, it was found that, the mortality rate of termite was significantly varied with the different leaf extracts treated paper at different concentration. Among the leaf extracts the rapid mortality rate is recorded with *Catharanthus roseus* treated paper (3.89 at 1st hour) followed by *Datura metel* (2.89 at 1st hour) performance was good. Both *Catharanthus roseus* and *Datura metel* showed the mortality of all 10 termites within 4 hours. Comparatively, the mortality performance of *Lantana camara* treated paper was slower (Table 1).

Among the different concentrations, the higher concentration (30%) recorded faster mortality rate than the lower concentrations (10% and 20%). The paper treated with leaf extracts at 30% concentration recorded rapid mortality rate (3.67 at 1st hour) followed by 20% concentration (2.40 at 1st hour). The slower performance was recorded with low concentration 10% (0.67 at 1st hour).

The interaction and effect of different leaf extracts with various concentrations significantly influenced on the performance of mortality rate of termite. The rapid mortality rate of termite was recorded with the paper treated with *Catharanthus roseus* at 30% (5.67 at 1st hour and 4.33 at 2nd hour). Within 2 hours all the 10 termites have been died. And it was on par with *Azadirachta indica* at 30% (4.67 at 1st hour, 4.33 at 2nd hour and 1.00 at 3rd hour). The slower performance was recorded with *Lantana camara* at 10% (0.00 at 1st and 2nd hour, 1.33 at 4th hour, 4.33 at 6th hour and 5.00 at 12th hour) (Table 2).

The result of this study coincides with the reports of other authors. Oladipo-nee Ajayi, Oyeniyi, and Elijah (2020) reported that extracts of *A. indica* plus *Nicotiana tabacum* achieved 100% mortality of worker termites, *Macrotermes subhyalinus* (Rambur, 1842) within 4 h of exposure [14]. Akbar, Sajjad, Afzal, Luqman, Riaz and Majeed (2021) evaluated the efficacy of some botanicals (*Dodonaea viscosa*, *Gardenia jasminoides* and *Nerium indicum*) and plant essential oils (*Allium sativum*, *Citrus aurantium* and *Cymbopogon citratus*) against *O. obesus* and observed that all the treatment plots showed reduced termite infestations than the control sets

[15]. Addisu, Mohamed, and Waktole (2014) reported that, the percent mortality of *Macrotermes* spp. against *Jatropha curcas* at 20 to 50 % concentrations and *A. indica* at 35% concentration caused 100% mortality in 72 hrs [16]. Shiberu, Ashagra, and Nageri (2013) showed that *Milletia ferruginea* and *Nicotiana tabacum* extracts after 24 hours showed 100% mortality on both soldier and worker *Macrotermes* termites [17].

From this study it was revealed that, all the botanicals selected showed effective results in the management of *O. obesus*. Among the plant products taken for this study, *A. indica* leaves can be easily procured as this tree is abundantly distributed. *D. metel* and *L. camara* are weed plants and hence the leaves can be easily collected. *C. roseus* in an ornamental plant and hence it can be easily grown even in limited space. Hence, all the plant products selected are locally available and it can be collected throughout the year irrespective of seasons. Thus, all the botanicals can be readily collected and the extracts can be easily prepared and used by the farmers with minimum effort.

As *O. obesus* is a subterranean termite, topical application or spraying of the botanical insecticides is difficult under field conditions as it makes tunnel and the location of the termites was a challenge. So by this method, the botanical products can be given through the materials that feed under natural conditions.

Table 1. Percent Mortality (%) of *Odontotermes obesus* workers against botanicals at different concentration over time.

Treatments	Mortality in Hour (n = 10)				
	1 st hr	2 nd hr	4 th hr	6 th hr	12 th hr
Leaf extracts					
A1- <i>Datura metel</i>	2.89	3.56	4.22	0.00	0.00
A2 – <i>Catharanthus roseus</i>	3.89	3.33	2.67	0.00	0.00
A3 – <i>Lantana camara</i>	0.00	1.33	2.67	4.11	2.44
A4 – <i>Calatropis gigantea</i>	2.22	2.00	3.78	2.67	0.00
A5 – <i>Azadirachta indica</i>	2.22	2.67	4.11	0.00	0.00
Mean	2.24	2.58	3.49	1.36	0.49
SeM	0.238	0.228	0.217	0.157	0.099
CD	0.688	0.658	0.626	0.454	0.287
Concentration					
B1 – 10%	0.67	1.33	4.47	2.07	1.00
B2 – 20%	2.40	2.47	4.27	1.00	0.47
B3 – 30%	3.67	3.93	1.73	1.00	0.00
Mean	2.24	2.58	3.49	1.36	0.49
SeM	0.184	0.176	0.167	0.121	0.076
CD	0.533	0.509	0.484	0.351	0.222

(SeM – Standard error of Mean; CD – Critical difference; hr – hour)

Table 2. Percent Mortality (%) of *Odontotermes obesus* workers due to the interaction effect of botanicals at different concentration over time.

Treatments	Mortality in Hour (n = 10)				
	1 st hour	2 nd hour	4 th hour	6 th hour	12 th hour

<i>Datura metal</i> at 10%	1.33	2.33	7.00	0.00	0.00
<i>Datura metal</i> at 20%	3.33	3.33	4.33	0.00	0.00
<i>Datura metal</i> at 30%	4.00	5.00	1.33	0.00	0.00
<i>Catharanthus roseus</i> at 10%	2.00	1.67	6.00	0.00	0.00
<i>Catharanthus roseus</i> at 20%	4.00	4.00	2.00	0.00	0.00
<i>Catharanthus roseus</i> at 30%	5.67	4.33	0.00	0.00	0.00
<i>Lantana camera</i> at 10%	0.00	0.00	1.33	4.33	5.00
<i>Lantana camera</i> at 20%	0.00	1.00	3.33	4.00	2.33
<i>Lantana camera</i> at 30%	0.00	3.00	3.33	4.00	0.00
<i>Calatropis gigantea</i> at 10%	0.00	1.00	3.00	6.00	0.00
<i>Calatropis gigantea</i> at 20%	2.67	2.00	5.33	1.00	0.00
<i>Calatropis gigantea</i> at 30%	4.00	3.00	3.00	1.00	0.00
<i>Azadirachta indica</i> at 10%	0.00	1.67	5.00	0.00	0.00
<i>Azadirachta indica</i> at 20%	2.00	2.00	6.33	0.00	0.00
<i>Azadirachta indica</i> at 30%	4.67	4.33	1.00	0.00	0.00
Mean	2.24	2.58	3.49	1.36	0.49
SeM	0.412	0.394	0.375	0.272	0.172
CD	1.192	1.139	1.083	0.786	0.497

(SeM – Standard error of Mean; CD – Critical difference; hr – hour)

ACKNOWLEDGMENT

Thanks to the Head, Department of Advanced Zoology and Biotechnology, Scott Christian College, Nagercoil, South India for providing laboratory facilities and guidance.

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