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**A Prescreen of Termicidal Potentials of Aerial Parts of Castor,
Ricinus communis, (Euphorbiaceae)**

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Abstract: Preliminary investigations were carried out on the termicidal potentials of aqueous extract of the leaf, fruit and bark of castor, *Ricinus communis* (Euphorbiaceae), on mortality and repellency of *Macrotermes natalensis* in the laboratory towards the development of alternative to synthetic termicides. Ability of *Nasutitermes* species to rebuild broken termatarium treated with leaf and fruit extract was also investigated on the field. Results obtained show that the extracts had significant ($p < 0.05$) effect on the test parameters. Symptomological response of *M. natalensis* to the extract included back lying of the insects prior to their death with overall reduced excitability. Highest response was observed in fruit extract. At 3 h after treatment (HAT), leave extract caused significant mortality. Between 6-12 HAT, mortality due to different extracts was not significant. However, at 24 HAT, mortality (82.00%) due to fruit extract was significantly higher than mortality due to other extracts. Also, fruit extract exerted highest repellency (90%) to *M. natalensis*, which was followed by 87.27% repellency due to leaf extract, both being class V repellency. The repellency due to bark (40%, class II) was significantly the lowest. On the field, both leaf and fruit extracts inactivated *Nasutitermes* species from rebuilding broken termatarium, whereas untreated control was rebuilt within 24 h.

Key words: Castor (*Ricinus communis*), *Macrotermes natalensis*, *Nasutitermes*, repellency, termatarium, toxicity

INTRODUCTION

Termites (Isoptera:Termitidae) are agricultural pests in the tropical and subtropical regions of the world. Their affinity for cellulose materials make them deleterious to many plant species including timber, arable crops, stored products and structural materials (Logan and El-Bakri, 1990; Stoll, 2000; Umeh, 2003). In Nigeria, different species have been reported on various crops with *Macrotermes* on maize stem, cassava cuttings and yam tuber sets (Umeh and Ivbijaro, 2003) and *Nasutitermes* on citrus (Umeh, 2003). The first researcher of this study also encountered *Nasutitermes* on susceptible yam (*Dioscorea*) species at harvesting on termite-prone plots in Southwestern Nigeria.

Due to the economic importance of termites, several control strategies have been employed all over the world. Control measures in Florida include removal of remnant wood from the orchard soil and protection of vulnerable crown by soil removal and application of insecticide to the base of citrus tree (Stansly *et al.*, 1992) and use of insecticidal baits (Stansly *et al.*, 2001). In Nigeria and certain West African countries, indigenous methods of burning goat viscera, spreading of dry cell battery powdered material, introduction of ants and use of wood ash were reported to be non-effective. The most popular

method has been use of synthetic insecticides with organochlorines being the commonest product used in Mali, Burkina Faso, Niger and Nigeria (Umeh, 2003). If the necessary precautions are taken, the method is practically effective when the pest status approaches economic damage level. Their disadvantages however include residual toxicity and health hazard to humans and non-target species (Bouguerra, 1990).

Castor, *Ricinus communis*, is commonly found on refuse dumps near house steads in many rural settlements in Southwestern Nigeria. Although its insecticidal properties have been documented against stored product pests (Okonkwo and Okoye, 1992) much has not been done on termiticidal potentials of its aerial parts. In certain part of India, farmers usually cultivate castor on plots to reduce termite infestation during the next cropping season. The control effect has particularly been attributed to root exudates (Stoll, 2000). The objective of this study was therefore to carry out a preliminary investigation of termiticidal properties of aerial parts of *R. communis*; thereby elucidate the necessity of further studies towards incorporating it into Integrated Pest Management (IPM) of termites in the cropping system of resource-poor farmers in developing countries.

MATERIALS AND METHODS

Experimental Insects

M. natalensis used for laboratory bioassay was collected from termateria within the campus of Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Nigeria. The *Nasutitermes* termateria used for field evaluation were also found within the campus. The experiment was conducted in September 2006. Identification of the two species was done at the Insect Collection Museum of the Department of Crop Protection and Environment Biology, University of Ibadan, Ibadan, Nigeria.

Plant Materials

Three parts (fresh leaves, bark and immature fruits) of red coloured variety of *R. communis* used for the experiment were obtained from LAUTECH Farms and the premises of Soun Stadium, Ogbomoso. Two kilograms leaf, bark and fruit were separately pounded using mortal and pestle with 3 L of water and allowed to stand for 35 h for chemical reaction to take place. The extract was thereafter decanted and was sieved to obtain a stock solution. The stock solution was stored in plastic jars until when needed for laboratory and field evaluation within 5 days post preparation of the extracts.

Toxicity of *R. communis* to *M. natalensis*

Ten milliliters of each extract was pipetted on 1.5 g tissue paper inside a 9 cm diameter Petri dish. The tissue paper (Product of John Browns Nigeria Ltd., Apake, Ogbomoso) was folded to perfectly fit into the Petri dish bottom. The stock solution was thoroughly stirred to ensure proper mixture of the extract before it was pipetted. Ten *M. natalensis* were introduced into Petri dish and was quickly covered to prevent insect's escape. There were three replicates. Mortality data were taken at 3, 6, 12 and 24 h after treatment (HAT).

Repellency of *R. communis* against *M. natalensis*

The method used for repellency bioassay was based on the area preference test (McDonald *et al.*, 1970) with some modifications. Test arena consisted of 10×10×5 cm rectangular plastic bowls. Tissue paper (0.5 g) was treated with 2 mL extract with the aid of a syringe. The control was a tissue paper of similar weight treated with water. The two tissue papers (treated and control) were put on opposite

ends of a diagonal of the rectangular plastic bowl. Ten *M. natalensis* were introduced into the center of each repellency chamber. There were three replicates. The numbers of insect present in the treated and untreated corners were recorded after 20 min (Obeng-Ofori and Reichmuth, 1997). Percentage repellency was calculated for each replicates according to the method of Sighamony *et al.* (1986) as the difference between the numbers of insect on treated corner and the control expressed as a percentage of the number of insects introduced.

Effect of *R. communis* on *Nasutitermes* Ability to Rebuild Broken Termitarium

Bark extract was not used in this bioassay, based on the previous laboratory bioassays that indicated its lowest potency. Six active termite mounds (species of *Nasutitermes* were used, making three replicates each of leaf and fruit extract. A portion (4 cm radius) of the termite mound soil was removed and treated with 24 mL extract. Similar portion of soil was broken as the control at the opposite side of the termite mound to give 50 cm distance to the treated spot. The control was not treated with extract. A broomstick was used to mark the treated arena. At 24 h post treatment the setup was checked for possible remoulding of the broken termite mound.

Statistical Analysis

Mortality data were expressed as percentage of the total number of insects introduced and corrected with Abbott’s formula (Abbott, 1925). Data were arcsine transformed before analysis. It was later subjected to two-way Analysis of Variance (ANOVA) and standard error of means were calculated to show variations between replicates. Repellency data were subjected to one-way ANOVA. For both sets of data, significant difference between means were determined using Fischer’s Least Significant Differences (LSD) at 5% level of probability, where differences existed. Repellency was later classified according to McGovern *et al.* (1977); class 0 = Negative repellency; class I = 0- 20%, class II = 20. 1-40%, Class III = 40.1- 60%, class IV = 60.1-80%, class V = 80.1-100%.

RESULTS

Aqueous extracts of the aerial parts of *R. communis* were effective against *M. natalensis* in the laboratory, although at varying degrees. The symptomological response of the species to the three extracts included back laying of the insect prior to their death with overall weakness in excitability. The response was, however, more pronounced in fruit extracts than in other two extracts. The result of analysis of variance indicated that the efficacy of the extracts was affected by time after treatments. Between 6-12 HAT, the efficacy of the three extracts was not significant (p<0.05). However, at 24-HAT mortality due to fruit was significantly (p<0.05) higher than mortality due to other treatments (Table 1).

Table 1: Mean percentage mortality (±SE) of *Macrotermes natalensis* exposed to *Ricinus communis* extract

Extract	Duration of exposure (h)			
	3	6	12	24
Control (water)	0.00±0.0a	0.00±0.0a	0.00±0.0a	0.00±0.0a
Bark	15.00±7.9b	34.40±8.1b	47.40±11.9b	49.60±8.5b
Leaf	28.80±2.9c	31.00±2.19b	43.66±9.4b	53.07±8.1b
Fruit	17.20±9.6b	32.20±7.7b	50.13±6.9b	82.00±8.0c

LSD = 10.19, SED = 5.08, Values are arcsine transformation of original data, Means followed by the same letter(s) along the column are not significantly different at 5% probability

Table 2: Mean percentage repellency of *Ricinus communis* to *Macrotermes natalensis*

Extract	Repellency (%)	Repellency class
Bark	40.00a	II
Leaf	87.27b	V
Fruit	90.00b	V
LSD (0.05)	33.12	
SED	16.05	

Class II = 20.1-40%, class V = 80.1-100%, Means followed by the same letter(s) along the column are not significantly different at 5% probability

The result followed the same trend with what was obtained in toxicity bioassay; with fruit extract exerting highest repellency (90%) to *M. natalensis* (Table 2). This was directly followed by leaf extract (87.27%). The repellency due to leaf and fruit were not significantly different at 5% probability LSD, with the two values being class V repellency. Repellency due to bark extract (40%) was significantly the lowest and was of class II.

When the fruit and leaf extracts were experimented on their efficacy to inactivate the ability of *Nasutitermes* to rebuild broken termitarium, the two extracts had significant effects. It was discovered that the species rebuilt the untreated broken termitaria arena within 24 h post treatment, whereas the treated arena was not rebuilt. It was also observed that the termites were migrating from the treated arena to the untreated parts, while some even died at a short time post application of treatment.

DISCUSSION

In different part of the world particularly in India, China and Africa, plant materials especially roots, twigs and flowers were collected from the field or cultivated specially for the purpose of insect pest control (Dales, 1996). The findings in this research reveal that *R. communis* has termiticidal properties. Although, *M. natalensis* ingested the extracts which could have caused stomach poison, the symptomological response of the species to the extracts suggests that the mode of action of the bioactive components was via nerve poison, in addition to oral toxicity.

Fruit and leaf extracts were more effective than bark extract. This possibly implies that the bioactive components of higher quality were in the leaves and fruits than in the bark or that their form were more readily released in fruits and leaves than when bark was used. Treas and Evans (1978) indicated that different parts of the same plant species may have varying quantitative or qualitative bioactive components. Duration of experiment also has significant effects on mortality of *M. natalensis*. This confirms the finding of Umeh and Ivbijaro (1998), Adedire and Lajide (1999) and Zhu *et al.* (2003). The extended time of exposure killed higher percentage of the species since they had no escape route in the experimental set up. The result of repellency followed the same trend as that of mortality. Although fruit (90.0%) repelled higher percentage than leave (87.27%), there was no significant difference in their efficacy.

On the field, bark extract was not used because the two previous laboratory biassays revealed its comparative poor performance as protectant against *M. natalensis*. So, leaf and fruit extracts were screened to determine their ability to inhibit *Nasutitermes* species from rebuilding broken termitarium. The efficacy of the two extracts was established as some insects migrated from the treated spot or died few minutes after treatments. The finding on repellency test agrees with previous findings (Rahmon *et al.*, 1999; Lale and Alaga, 2001). With the present findings, the potential of aerial parts of *R. communis* as termiticide at farmers' level or around homestead is established. Fresh leaves and fruits displayed greater effects than the bark.

The press cake of castor seed, although poisonous, is used as fertilizer (Rehm and Espig, 1991; Stoll, 2000). Use of *R. communis* as termiticide, therefore, has added advantages of serving as soil amendment. Although, aspect of characterization and identification of active compounds were not

covered in this study, Treas and Evans (1978) listed alkaloid, ricinine, cyanogenic glucoside, flavononoids, steroidal sapogenin, gallic acid and potassium nitrate as bioactive component of castor leaf. Since fresh leaf and fruits displayed greater termiticidal potentials than bark, they may be exploited for local farmers' uses and further scientific studies.

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