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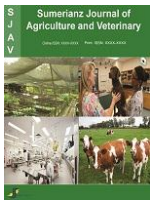


Original Article Open Access

Toxicity of Two Selected Plant Extracts on Termites, Macrotermes Spp. (Isoptera: Termitidae)

Okere C. I.*
Entomology Division, Nigerian Institute for Oil palm Research, Nigeria

Akunne C. E.
Zoology Department, Nnamdi Azikiwe University Awka, Nigeria

Adaigbe V. C.
Entomology Division, Nigerian Institute for Oil palm Research, Nigeria

Aneni T. I.
Entomology Division, Nigerian Institute for Oil palm Research, Nigeria

Ogbebor C. O.
Entomology Division, Nigerian Institute for Oil palm Research, Nigeria

Adeh S.
Statistics Division, Nigerian Institute for Oil palm Research, Nigeria

Abstract

Laboratory studies were conducted in the main station of the Nigerian Institute for Oil Palm Research to determine the toxicity of two selected plant extracts *(Jatropha. curcas and Ricinus. communis)* on adult soldier termites, *(Macrotermes spp)*. The seed of J. *curcas* and R. *communis* were extracted using crude aqueous extraction and applied separately at three concentration levels of 10, 20, and 35% (w/v) each on adult soldier termites. Water (2ml) served as negative control while Cypermethrin (1%) served as positive control. The treatment was replicated four times and mortality of adult soldier termites of *Macrotermes* spp. was recorded at 12 and 24 hours intervals. Phytochemical analysis of the plant extracts was carried out showing the presence of tannins, alkaloids, flavonoids, saponins and phenol. The result showed 100% mortality of *Macrotermes* spp. on exposure to 1% Cypermethrin and 35% of J. *curcas* seed extract at 12hrs while exposure to 10% and 20% of J.*curcas* at 24hrs recorded 100% with water having 0.00% at both 12hrs and 24hrs. There was significant difference between the treatments and the control at 12 hrs. and 24 hrs. (P=0.00). The result also showed that the percentage mortality of *Macrotermes* spp. (100%) was recorded higher on exposure to Cypermethrin followed by 35% of R. *communis* seed extract (97.5%) but lowest in the water control (0.00%) at 12 hrs. Also exposure to 10% and 20% extracts of R. *communis* at 24hrs showed 100% mortality of *Macrotermes* spp. However, the effect of R. *communis* seed extract on the adult mortality of *Macrotermes* spp was significantly different between the treatments and the control at 12 hrs and 24 hrs (P=0.00). The log-probit regression analysis showed that the LC50 of J. *curcas* and R. *communi* seed extract after 12 hrs was found to be 9.568% and 8.451% respectively. The study showed that J. *curcas* and R. *communi* seed extract have the ability to control adult termites of *Macrotermes* spp. and can serve as bio-control agents.

Keywords: Termites; *Jatropha curcas; Ricinus communis*; Cypermethrin; *Macrotermes* spp. Bio-control.

1. Introduction

Termites (*Macrotermes* spp.) are one of the most devastating insects that severely damage agricultural crops, forest trees, range land, furniture and building structures made of wood in the urban regions [1]. In Africa, the most important termite genera are: *Macrotermes*, *Odontotermes*, *Pseudocanthotermes*, *Ancistrotermes* and *Microtermes* [2]. Termites have the competence to infest plant at various stages of their growth [3] causing significant losses to annual and perennial crops especially in the semi-arid and sub humid tropics making agricultural production very difficult in termite infested areas [4].

In Nigeria, it causes considerable damage to buildings and wooden structures, as well as to food crops, ornamental shade-providing trees and to forestry [5]. Therefore it is pertinent to search for effective methods to control termites and reduce their negative impacts [1].

Chemical treatments are widely used to reduce the infestation of termites but its excessive use has become a serious environmental concern [6]. Chemical insecticides are not only costly [7] but their abuse and misuse are associated with several side effects such as acute and chronic poisoning in man, sudden deaths, blindness, skin irritation [8]

*Corresponding Author

The use of plants, plant material or crude plant extracts for the protection of crops and stored products from insect pests is probably as old as crop protection itself [9].

Products from the Physic tree (*Jatropha curcas*) have proved to have promising properties on mortality and tunneling of Subterranean Termites [10]. Also, Castor tree (*Ricinus communis*) seeds were used to check the biocide potential of the oil against termite and cockroach [11]. However, in Nigeria, information about the effects of the application of the extracts of *J. curcas* and *R. communis* against adult termite is limited. The aim of this research is to determine the toxicity effect of two selected plant extracts on termites, *Macrotermes* spp. (Isoptera: termitidae).

2. Materials and Method

2.1. Description of Study Site

This study was carried out at the Entomology laboratory of Nigerian Institute for Oil palm Research, NIFOR, Ovia North East, Benin City, in Edo State. Nigeria. The study area is located at geographical coordinate of 06^0 33 N Latitude and 05^0 37E Longitude and an Altitude of 149.4M. The maximum and minimum temperature of the area is 29^0C and 23^0C respectively with maximum relative humidity of 89% and mean rainfall of 2000mm per annum.

2.2. Collection of Termites

Adult soldier termites of *Macrotermes* spp. were collected from termite mounds in Oil palm plantation at Nigerian Institute for Oil palm Research NIFOR according to the methods of Acda [12]. Mounds were excavated using axe and shovel and soil containing termites were placed into a plastic bucket and taken to the laboratory. The buckets were kept in a cool dark place until when needed for the experiment. The termites were identified using the morphological characteristics of the Soldiers.

2.3. Collection of Plant Materials

The plant materials used for this research were collected within the Institute environment. The plant materials were *Jatropha curcas* (Physic seed) and *Ricinus communis* (Castor seed). The seed of these plant materials were air dried in shade for three weeks.

2.4. Extraction of the Plant Materials

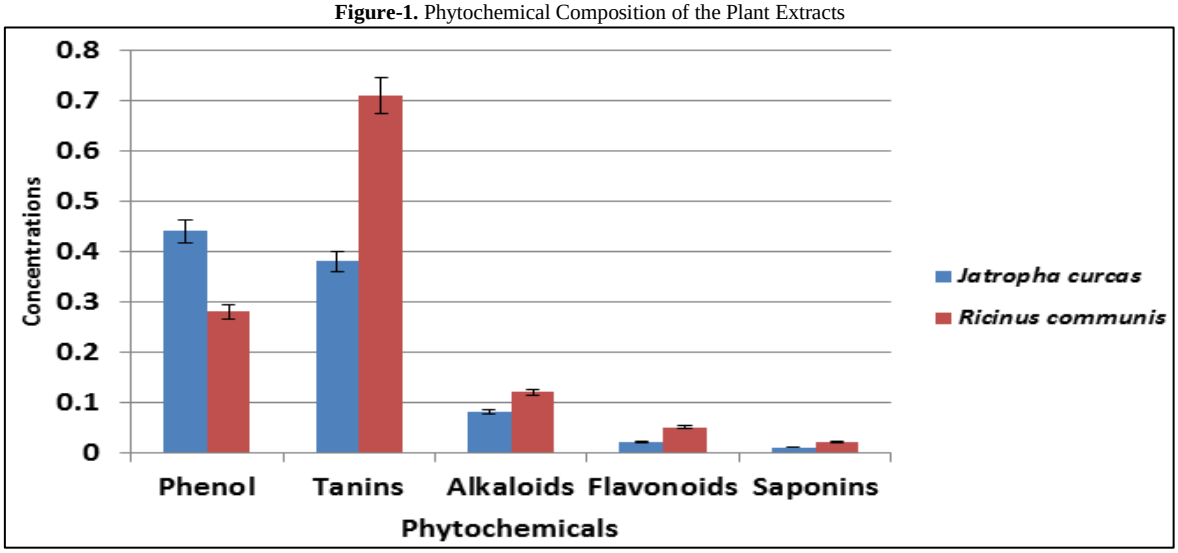
The seed of *Jatropha curcas* and *Ricinus communis* were respectively de pulped by hitting them with stone and grinded using mortar and pestle until they became powdered, then sieved using a 0. 25mm pore size mesh sieve to obtain uniform fine particles. The powders were kept separately in air tight plastic buckets in a cool dry place until when needed. A weight of 100g powder from each plant sample was weighed using a digital weighing balance (Model: Adventure Pro AV212, Ohaus Corporation, Switzerland) then mixed with 200ml of water in a conical flask, shaken thoroughly, and left to stand overnight. Filtration was done the next day, after 24hrs using a fine white cotton cloth. Concentrations of 10%, 20%, and 35% (w/v) were prepared and kept till when needed for the work. Addisu, *et al.* [13]. 1% of Cypermethrin 25% EC and water served as positive and negative control respectively.

3. Results

3.1. Phytochemical Composition of the Plant Extracts

The phytochemical composition of *J. curcas* and *R. communis* is presented in Figure 1. The result revealed that *R. communis* had higher tannins (0.71), alkaloids (0.12), flavonoids (0.05) and saponins (0.02) than *J. curcas* which had, lesser tannins (0.38), alkaloids (0.08), flavonoids (0.02) and saponins (0.01). However, *J. curcas* had higher phenol (0.44) than *R. communis* (0.28). There was no significant difference between the phenols, tannins, alkaloids, flavonoids and saponins (P>0.05).

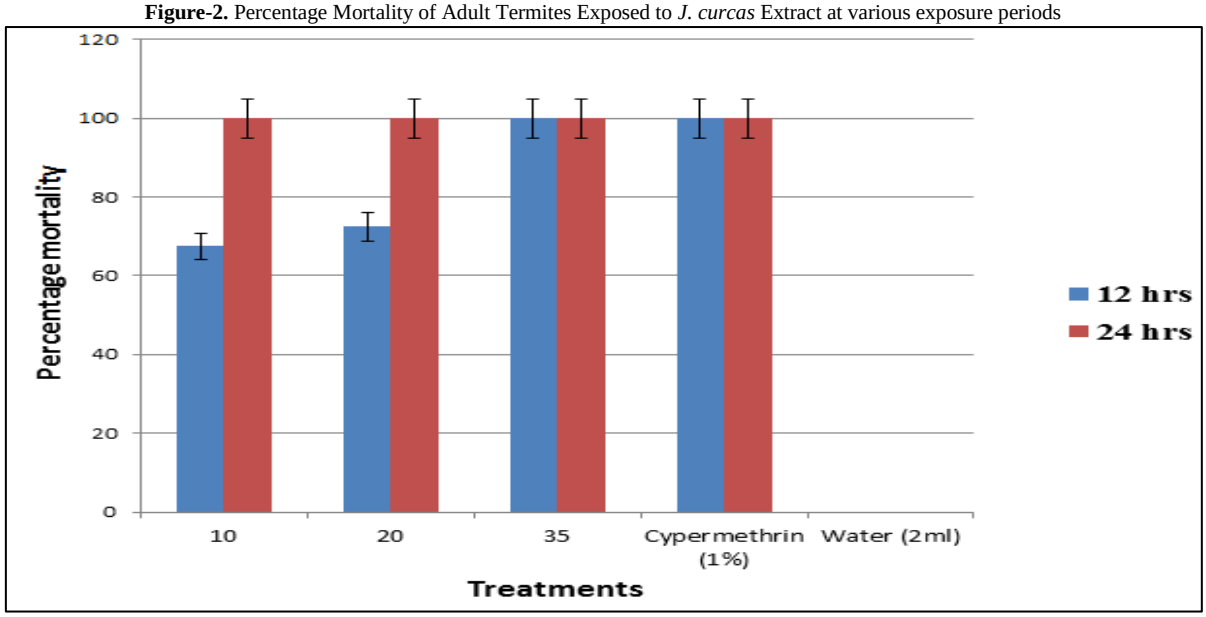
Figure-1. Phytochemical Composition of the Plant Extracts



3.2. Percentage Mortality of Adult Macrotermes Spp Exposed To J. Curcas Extract at Various Exposure Periods

The result in figure 2 indicated that the percentage adult mortality of *Macrotermes* spp. (100%) was recorded higher on exposure to 35% of *J. curcas* seed extract and 1% of Cypermethrin 25% EC (100%) followed by 20% (72.5%), 10% (67.5%) but lowest in the control (0.00%) after 12 hrs. Meanwhile, 100% mortality of adult termites was observed after 24 hrs. in all the treatments except water (2ml) (0.00%). The log-probit regression analysis showed that the LC_{50} of *J. curcas* after 12 hrs was found to be 9.568%. However, the effect of *J. curcas* seed extract on the adult mortality of *Macrotermes* spp. was significantly different between the treatments and the control after 12 hrs (P=0.00).

Figure-2. Percentage Mortality of Adult Termites Exposed to *J. curcas* Extract at various exposure periods



3.3. Median Lethal Concentration (LC_{50}) for J. curcas

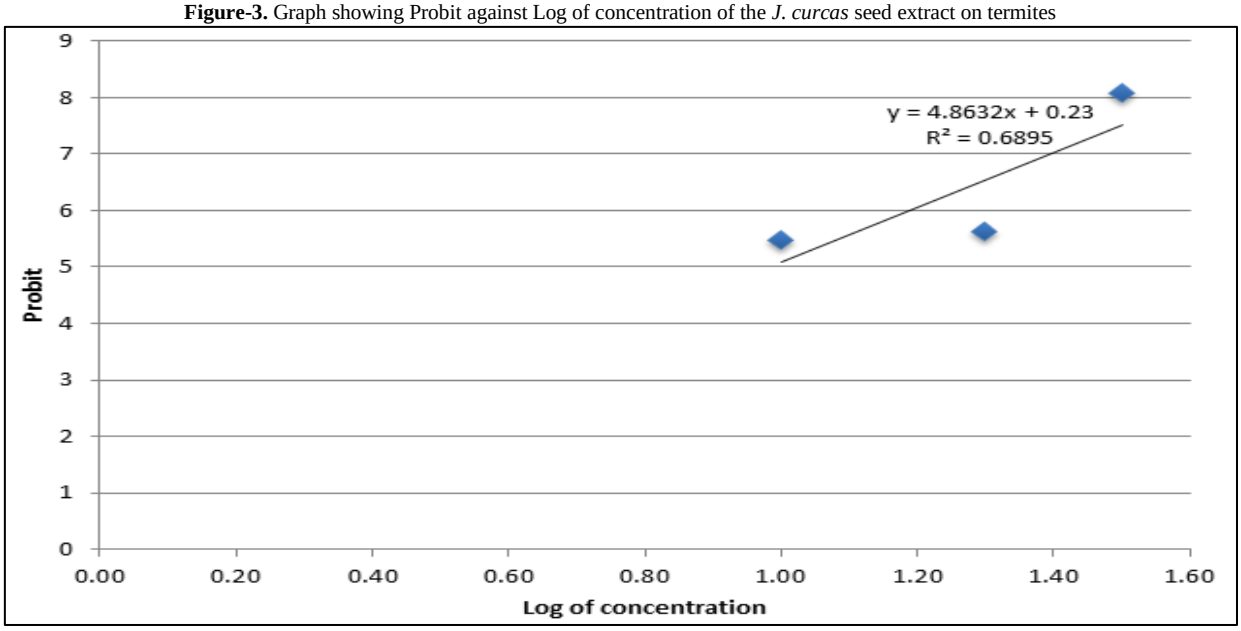
Table-1. Percentage Mortality and Probit values of adult termites exposed for 12 hours to the toxicity of *J. curcas* extract

Concentrations	Log conc.	Percentage mortality	Probit
10%	1.0	67.50^{b}	5.47
20%	1.3	72.50^{b}	5.61
35%	1.5	100^{c}	8.09
Cypermethrin (1%)		100^{c}	-
Control (2 ml of Water)		0.00^{a}	-

Columns sharing similar superscripts (a,b,c) are significantly different using Duncan's Multiple range test

The log-probit regression analysis showed that the LC_{50} of *J. curcas* after 12 hrs.was found to be 9.568% (Figure 3).

Figure-3. Graph showing Probit against Log of concentration of the *J. curcas* seed extract on termites

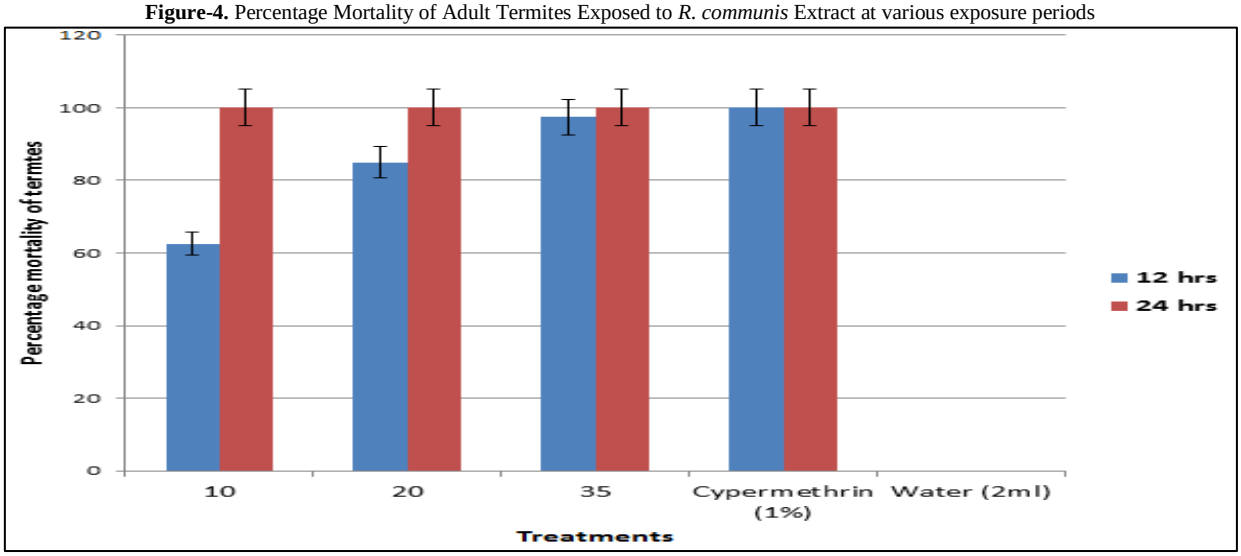


y = 4.8632x + 0.23
R^2 = 0.6895
5= 4.8632x + 0.23
5- 0.23= 4.8632x
X= 10^0.9808
LC_{50} = 9.568%

3.4. Percentage Mortality of Adult Macrotermes Spp. Exposed To R. Communis Extract at Various Exposure Periods

The result in Figure 4 indicated that the percentage adult mortality of *Macrotermes* spp (100%) was recorded higher on exposure to 1% of Cypermethrin 25% EC followed by 35% of *R. communis* seed extract (97.50%), 20% extract (85%) and 10% extract (62.5%) but lowest in the water control (0.00%) after 12 hrs. There was 100% mortality of *Macrotermes* spp. on exposure to *R. communis* seed extract at the different concentration at 24hrs, The log-probit regression analysis showed that the LC_{50} of *R. communis* after 12 hrs. was found to be 8.451%. However, the effect of *R. communis* seed extract on the adult mortality of *Macrotermes* spp was significantly different between the treatments and the control after 12 hrs (P=0.00).

Figure-4. Percentage Mortality of Adult Termites Exposed to *R. communis* Extract at various exposure periods



3.5. Median Lethal Concentration (LC_{50}) for R. communis

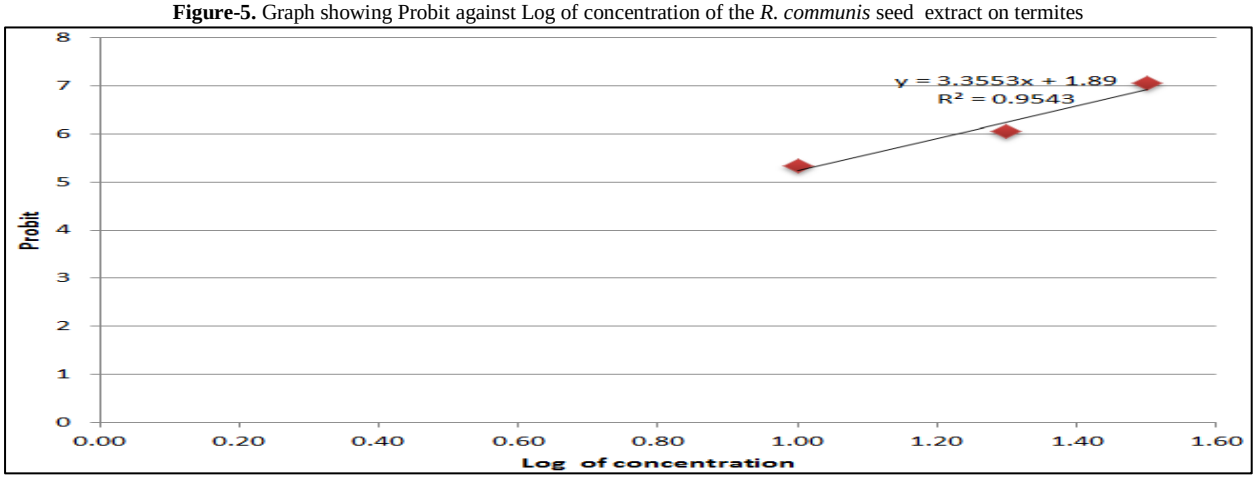
Table-2. Percentage Mortality and Probit values of adult termites exposed for 12 hours to the toxicity of *R. communis* extract

Concentrations	Log conc.	Percentage mortality	Probit
10%	1.0	62.50^b	5.33
20%	1.3	85.00^c	6.04
35%	1.5	97.50^c	7.05
Cypermethrin (1%)		100^c	-
Control (2 ml of Water)		0.00^a	-

Columns sharing similar superscripts (a,b,c) are significantly different using Duncan's Multiple range test

The log-probit regression analysis showed that the LC_{50} of *R. comunis* after12 hrs.was found to be 8.451% (Figure 5).

Figure-5. Graph showing Probit against Log of concentration of the *R. communis* seed extract on termites



$y = 3.3553x + 1.89$
$R^2 = 0.9543$
$5 = 3.3553x + 1.89$
$5 - 1.89 = = 3.3553x$
$X = 10^{0.9808}$
$LC_{50} = 8.451\%$

4. Discussion

Toxicity of *J. curcas* plant and *R. communis* is attributed to several components, including saponins, lectin (curcin), phytates, protease inhibitors, and curcalonic acid and phorbol esters [14, 15], as well as secondary metabolites alkaloids, tannins, flavonoids, phenols and saponins [16]. The insecticidal activity of seed oil of *J. curcas* has been found due to the presence of several sterols and terpene alchohols [17].

The present study also showed that *J. curcas* seed extract at 10- 35% and *R. communis* seed extract at 10- 35% had potent bio-termicidal effect on *Macrotermes* spp. with the same efficacy as Cypermethrin inducing 100% mortality to the test insect over 24hrs exposure period. Jembere, *et al.* [18] and Yohannes [19] also reported that water extracts of *J. curcas* caused high toxicity to all the castes of alates of the termite, *Macrotermes* in which 93-100% mortality was recorded at different concentration levels. Also Addisu, *et al.* [13] reported that *J. curcas* at 20-35% concentration caused 100% mortality of *Macrotermes* spp. in the laboratory The water extract of plants has also been found effective as termtiticide in the residual bioassays and extract of *Milletia ferruginea* which caused higher toxicity to all the castes of alates of the *Macrotermes* termites in which 93 to 100% mortality was recorded at all concentration levels [20] Also, *R. communis* possess insecticidal properties which control insect pests such as *C. maculatus* and *Acanthoscelides obtectus* [21]**.** Babarinde, *et al.* [22] Babarinde, *et al.* [23] reported its insecticidal properties against *Nasutitermes* species and rust red flour beetle, *Tribolium castaneum*. Ashfaq, *et al.* [10] reported that at 10% concentration of *Jatropha* oil, all the termite workers were killed within 48 hrs. and at 10% concentration of *R. communis* all the worker termites were killed at 72 hrs. Also leaf extracts of *Jatropha integerrima*, *Neem oleander* and *Lucaena leucocephala* in acetone, methanol, petroleum ether and aqueous solvents showed activity in terms of mortality of termite workers at different concentrations when mixed in the soil in Petri dishes [24]

The result of the Probit analysis for the determination of the Median lethal concentration (LC_{50}) at 12hrs after treatment for the mortality of termites showed the minimum concentration required to kill 50% of the test soldier termites. The result shows that *R. communis* seed extract (8.451%) was the most toxic at minimum concentration than *J. curcas* (9.568%) seed extract. This indicates that though both botanicals were toxic against termite, the degree of toxicity depends on the concentration applied.

5. Conclusion

J. curcas and *R. communis* seeds contain important phytochemical which gives them a toxic effect on termites. The water extracts of *J. curcas* and *R. communis* seeds at 35% concentrations were able to cause 100% mortality of adult soldier *Macrotermes* in the laboratory.

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