Efficacy of Two Selected Botanical Extracts to Protect Wood from Damage When Exposed to Termite Attack

Okere C. I. Adaigbe V. C., Aneni T. I. Ogbebor C. O. & Aghayedo C. O.
Entomology Division,
Nigerian Institute for Oil palm Research,
Edo, Nigeria

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

Abstract
Termite's natural activities help to improve soil ph, organic carbon content, water content and porosity. However, termites also have negative economic impacts; devaluing property, damaging crops and necessitating household repairs. This study is aimed at determining the effectiveness of Jatropha curcas and Ricinus. communis to protect wood from damage when exposed to termite attack. The seed of Jatropha. curcas and Ricinus. communis were extracted using crude aqueous extraction and applied separately at three concentration levels of 10%, 20%, and 35% (w/v) on 128 wood pieces which were introduced into four selected termitaria. Each termitarium has 32 wood pieces. Water served as negative control, Cypermethrin (1%) served as positive control and the treatment was replicated 4 times. The initial weight of wood was taken before treatment and weight loss of the treated woods were taken after 15days interval, the highest percentage weight loss (64.44%) of the wood samples was recorded in wood samples treated with water followed by those of 10% of J. curcas (41.5%) while least in those of Cypermethrin (9.52%). There was significant difference between the percentage weight loss of wood samples exposed to J. curcas and the controls (p=0.00). The highest percentage weight loss (64.44%) of the wood samples was recorded in wood samples treated with water followed by those of 10% of R. communis (56 .94%) while least in those of Cypermethrin (9.52%). There was significant difference between the percentage weight loss of wood samples exposed to R. communis and the controls (p=0.00).

Keywords: *Termites; Jatropha curcas; Ricinus Communis; Cypermethrin Botanicals*

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 (Verma *et al.*, 2016; Crowe *et al.*, 1977). In Africa, the most important termite genera are: *Macrotermes*, *Odontotermes*, *Pseudocanthotermes*, *Ancistrotermes* and *Microtermes* (Crowe *et al.*, 1977). Termite damage to buildings in tropical countries is a serious concern. This is in part due to the diversity of termites in these areas. Africa alone has 660 distinct termite species (Uys, 2002). There has been an increased appreciation of the importance of termite damage to buildings due to the rising costs of repairs and maintenance (Ghaly and Edward, 2011). In Nigeria, it causes considerable damage to buildings and wooden structures, as well as to food crops, ornamental shade-providing trees and to forestry (Omo-malaka and Leuthold 1986). Many houses are attacked by termites within few years of construction despite use of chemically treated wood that rapidly deteriorate under the tropical

conditions of high humidity (Cassens *et al.*, 1995). Chemical treatments are widely used to reduce the infestation of termites but its excessive use has become a serious environmental concern (Mahmoud *et al.*, 2014). Chemical insecticides are not only costly (Mohamed, 2006) but their abuse and misuse are associated with several side effects such as acute and chronic poisoning in man, sudden deaths, blindness, skin irritation (Akunne and Okonkwo, 2006) and pest resurgence in the ecosystem (Lowenberg-DeBoer and Ibro, 2008; Omoloye, 2008). Furthermore, the development of resistant strains, killing of non-target species, pollution of part of the ecosystem, toxic residue, worker's un safety and increasing costs are recorded as environmental repercussion of abuse and misuse of chemicals (Akunne and Okonkwo, 2006; Ofuya *et al.*, 2008).

As a result of the limitations of chemicals in preventing termite attack and deterioration of wooden structures, alternative method that is environmental friendly, inexpensive and effective must be sought (Magaji *et al.*, 2011; Yeap *et al.*, 2010). A broad range of plants are toxic, repellent, or have some anti-feeding properties against termite attack several of which were regarded as insecticides (Bläske and Hertel, 2001; Ganapaty *et al.*, 2004; Boulogne *et al.* 2012; Raina *et al.* 2012; Addisu *et al.* 2014).

MATERIALS AND METHOD

Description of study site

This study was carried out at 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.

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.

Extraction of the Plant Materials

The seed of *Jatropha curcas* and *Ricinus communis* were respectively de pulped by hitting them with stone and ground 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 according to the method of Addisu *et al.*, (2013). 1% of Cypermethrin 25% EC and water served as positive and negative control respectively.

Determining the efficacy of *J. curcas* and *R. communis* extracts to protect wood from damage when exposed to termite attack.

The test was carried out according to the method of Mohammed (2006). 128 pieces of chemically untreated woods were cut into equal sizes and sun dried for three weeks and weighed constantly until a constant weight was obtained to ensure absence of moisture. The initial weight of the wood after drying was noted before treatment. 10%, 20% and 35% concentrations of each of the two plant extracts were then applied on different pieces of wood

by soaking and leaving the soaked woods to air dry for 24hrs. 1% Cypermethrin served as positive control while water served as negative control. The 128 treated wood pieces were attached with plastic strings and nails, properly labeled using masking tape according to their treatments and replicates. Four termitaria were randomly selected from termite mounds in the Oil palm plantation and opened using digger and shovel. A hole was dug inside each of the four termitaria and the 128 wood pieces were treated with the three concentrations of the two plant extracts including water (negative control) and Cypermethrin (positive control). 32 treated woods was selected and placed close together inside each of the four termitaria (treatments replicated four times) with their strings dangling out of the termitarium. Initial weight of wood before treatment and weight of treated wood after 15 days interval was used as the parameter for determining the stated objective. The wood pieces were weighed at 15days intervals for the duration of 2 months and weight loss of the wood due to termite damage were noted and visible signs of termite attack on the wood were also noted.

Statistical Analysis

Data was generated and recorded from phytochemical composition, percentage weight loss of wood samples. The data collected were used to determine the most efficient of the plant extracts. Data generated were subjected to analysis of variance (ANOVA) using SPSS computer Software package (version 20) at 0.05 significant levels

RESULT

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).

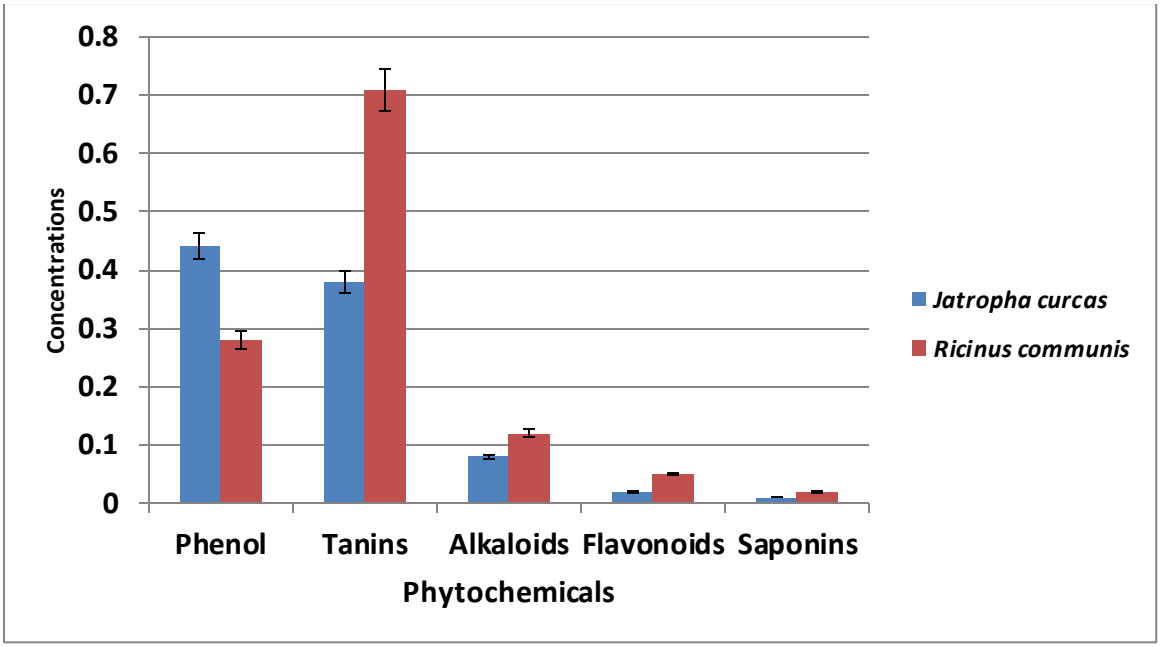

Figure 1: Phytochemical Composition of the Plant Extracts

Percentage weight loss of the wood treated with various concentrations of *J. curcas* at 15 days interval.

Table 1 show that the highest weight loss (64.44%) of the wood was recorded in wood samples treated with water followed by those of 10% of *J. curcas* (41.50%) while least in those of Cypermethrin (9.52%). There was significant difference between the weight loss of wood exposed to *J. curcas* and the controls (p=0.00)

Table 1: Weights of Wood samples treated with various concentrations of *J. curcas* at 15 days interval

	Weights of wood species at 15 days interval ± SD						
Concentrations	**Initial**	**15days**	**30 days**	**45 days**	**60 days**	**Weight loss (g)**	**Percentage weight loss (%)**
10%	97.36±1.44^{c}	84.54±9.46^{bc}	78.17±12.26^{b}	66.77±12.43^{b}	56.94±8.74^{b}	40.41±8.94^{c}	41.50
20%	86.77±7.54^{ab}	75.47±6.50^{b}	71.71±4.47^{b}	62.33±6.57^{b}	56.62±8.19^{b}	30.16±5.99^{b}	34.75
35%	90.48±6.04^{bc}	85.44±5.09^{c}	82.27±4.62^{bc}	76.90±4.94^{c}	73.15±4.87^{c}	17.33±1.21^{a}	19.15
1% of Cypermethrin	94.69±2.90^{c}	92.80±2.05^{c}	89.93±2.34^{c}	88.76±1.64^{d}	85.68±1.47^{d}	9.02±1.78^{a}	9.52
Water	82.23±1.74^{a}	64.32±5.92^{a}	57.50±6.91^{a}	46.50±8.57^{a}	29.24±6.89^{a}	52.99±7.86^{d}	64.44

Columns sharing similar superscripts (a,b, c) are not significantly different at P>0.05

The percentage weight loss of the wood samples treated with various concentrations of *R. communis* at 15 days interval

Table 2 shows that the highest percentage weight loss (64.44%) of wood was recorded in wood samples treated with water followed by those of 10% of *R. communis* (56.94%) while least in those of Cypermethrin (9.52%). There was significant difference between the weight loss of wood exposed to *R. communis* and the controls (p=0.00).

Table 2: Weights of Wood samples treated with various concentrations of *R. communis* at 15 days interval

	Weights of wood species at 15 days interval ± SD						
Concentrations	**Initial**	**15days**	**30 days**	**45 days**	**60 days**	**Weight loss (g)**	**Percentage weight loss (%)**
10%	79.03±17.53^{a}	69.21±16.42^{ab}	52.29±11.88^{a}	39.78±8.29^{a}	34.03±10.99^{a}	45.00±8.80^{c}	56.94
20%	89.02±4.88^{ab}	83.57±6.08^{cd}	77.32±7.73^{b}	69.91±4.41^{b}	61.38±9.55^{b}	27.64±10.86^{b}	31.04
35%	84.91±5.34^{ab}	78.62±4.86^{bc}	74.71±4.43^{b}	70.64±4.94^{b}	70.47±5.16^{b}	14.44±6.25^{a}	17.00
Cypermethrin (1%)	94.69±2.90^{b}	92.80±2.05^{d}	89.93±2.34^{c}	88.76±1.64^{c}	85.68±1.47^{c}	9.02±1.78^{a}	9.52
Water	82.23±1.74^{ab}	64.32±5.92^{a}	57.50±6.91^{a}	46.50±8.57^{a}	29.24±6.89^{a}	52.99±7.86^{c}	64.44

Columns sharing similar superscripts (a,b,c,d,) are not significantly different at P>0.05

DISCUSSION

This study shows that 35% concentration of *J. curcas* and 35% of *R. communis* protected the wood by reducing the weight loss of wood due to termite attack at 60days exposure period., this is related to the high concentration of the extracts. Singh and Sushilkumar (2008) and Acda, (2009) stated that *J. curcas* leaf and seed extracts have been found toxic against the Philippine milk termite *Coptotermes vastator* and *Microcerotermes beesoni.* Okonkwo and Okoye (1992) reported the insecticidal activity of dried ground leaves of *R. communis* against *C. maculatus* (Coleoptera: Bruchidae). Castor oil also has insecticidal activity against *Zabrotes subfasciatus* (Coleoptera: Bruchidae) (Fernandes and Alves, 1991).

Singh and Sushilkumar, (2008) reported maximum wood protection against *Odontotermes obesus* and *Microcerotermes beesoni* termites by *J. curcas* oil and its toxic fraction were obtained at their highest concentration i.e., 20%. *R. communis* has also been reported to significantly reduce weight loss in wood exposed to termites (Sharma *et al.*, 1990).

Conclusion

J. curcas and *R. communis* seeds contain important phytochemical which gave the wood some level of protection against termite attack.

Concentrations of *J. curcas* at 35% and *R. communis* at 35% thou didn't prevent the wood from being attacked by termite but significantly reduced damage and weight loss of wood caused by termite attack.

References

Acda, M. N. (2009). Toxicity, tunneling and feeding behavior of the termite, *Coptotermes vastator,* in sand treated with oil of the physic nut, *Jatropha curcas*. *Journal of Insect Science*, ***9***: 1-8.

Acda,,

M .N. (2014). Repellent Effects of Annona Crude Seed Extract on the Asian Subterranean Termite *Coptotermes gestroi* Wasmann (Isoptera: Rhinotermitidae). *Sociobiology* ***61***(3)*:* 332-337.

Addisu, S., Mohamed, D. and Waktole, S. (2014). Efficacy of botanical extracts against termites, *Macrotermes spp* (Isoptera: Termitidae) under laboratory conditions. *International Journal of Agricultural Research* ***9***(2):60-73.

Akunne, C..E. and Okonkwo, N. J. (2006). Pesticides: Their Abuse and Misuse in our Environment. *Book of Proceedings of the 3rd Annual National Conference of the Society for Occupational Safety and Environmental Health (SOSEH) Awka 2006,* 130-132 pp.

Ashfaq, M., Talib Sahi, S., Shahid Nisar, M., and Ahmed.S., (2012). Effect of Leaf and Seed Extracts of *Jatropha curcas* Linn. on Mortality and Tunneling of Subterranean Termites , *Odontotermes obesus* in Pakistan (Ramb.) (Termitidae : Isoptera). *Pakistan Entomologist* ***10***: 33–38.

G.E., Demissie, G., (2013). Comparative Bio-activity Guided Characterization of Biocide from *Jatropha curcas* and *Ricinus communis* L. Seeds Oil. *Journal of Pharmacognosy and Phytochemistry*, ***2(***3): 176-181

Berger, M.M., (2005). *Can oxidative damage be treated nutritionally*? *Clinical Nutrition, 24*:172–183.

Bläske , V.U. and Hertel , H. (2001). Repellent and toxic effects of plant extracts on Subterranean Termites. *Journal of Economic Entomology,* ***94***(5):1200-1208.

Boulogne I., Petit P., Ozier-Lafontaine H, Desfontaines L., Loranger Merciris G. (2012). Insecticidal and antifungal chemicals produced by plants: a Review. *Environmental Chemistry*. ***10***(4):325-347.

Crowe, T.J., Tadesse, G.M. and Tsedeke, A. (1977). *An annotated list of insect pests of field crops in Ethiopia*. Institute of Agricultural Research, Addis Ababa Pp. 71.

Fernandes, P.M. And Alves, (1991). Control of *Cornitermes cumulanus* with *Beauveria bassiana* (Bals). *Annis da Sociedade Entonologia do Brasil,* ***20***: 45-49.

Ganapaty, S., Thomas, P.S., Fotso, S. and Laatsch, H. (2004). Antitermitic Quinone's from *Diospyros sylvatica*. *Phytochem*. ***65***(9):1265-1271.

Ijeh, I .I and Ejike, C.E. (2011). Current Perspectives on the Medicinal Potentials of *Vernonia amygdalina* Del. *Journal of Medicinal Plants Research,* ***5***(7):1051-1061.

Lowenberg-DeBoer, J. and Ibro, G. (2008). A Study of the Cowpea Value Chain in Kano State, Nigeria, From A Pro-Poor and Gender Perspective. *A Paper Commissioned by the GATE Project* 11111`56.

Magaji, B.T., Bamaiyi L. J and Mani U., (2011). Bioassay of *Mundule sericea* Ethanol Leaves Extract and Leaf Powder against *C. maculatus* (F) on Stored Cowpea. In *book of Abstracts, Entomological Society of Nigeria. 42nd Annual Conference Ibadan* 28 p.

Mahmoud, A.K., Satti, A.A, Bedawi, S.M., and Mokhtar, M.M. (2014) Combined insecticidal effects of some botanical extracts against the Khapra, beetle *Trogoderma, granarium Everts, 3*, **6**: 388–393

Mitchell, J.D. (2002). Termites are pests of crops, forestry, rangeland and structures in Southern Africa and their control. *Sociobiology*, ***40***:47-69

Mohamed, A. (2006). Effect of Neem oil and Nerium leaf extracts on Termite, *Microtermes thoracalis* Infestation on Wood of pine (*Pinus* sp.). *M.Sc. Thesis submitted to the University of Khartoum*. pp.34

Ofuya, T. I., Idoko, J.E. and Akintewe, L.A. (2008). Ability of *Sitophilus zeamais* Motschulsky [Coleoptera: Curculonidae] from Four Locations in Nigeria to Infest and Damage Three Varieties of Maize, *Zea mays* L. *Nigerian Journal of Entomology* ***25***:34-39.

Omoloye, A.A. (2008). *Fundamentals of Insect Pest Management*. Corporate Publishers Lagos. Pp. 223

Omo –Malaka, S. L. and Leuthold, R. H.(1986). Mechanisms of recruitment for the retrieval Of food in *amitermes evuncifer* silvestri (isoptera: termitidae: termitinae). *Insect Science. Application.* ***7***: 707-721.

Okonkwo, E.U., Okoye W.I., (1992). The control of *Callosobruchus maculatus* (Fabr.) in stored cowpea with dried ground *Ricinus communis* (L.) leaves in Nigeria. *Tropical Pest Management*. ***38*** (3):237–238.

Raina, A., Bedoukian R., Florane C. and Lax A. (2012). Potential of natural products and their derivatives to control Formosan Subterranean Termites (Isoptera: Rhinotermitidae). *Journal of Economic Entomology*. ***105***:1746-1750.

Sharma, S, Vasudevan, P., Madan, M., (1990). Insecticidal Value of Castor (*Ricinus communis*) Against Termites. *International Biodeterioration and Biodegradation,* ***27***: 249-254.

Singh N. and Sushilkumar, (2008). Antitermite activity of *Jatropha curcas* Linn. biochemicals. *Journal of Applied Sciences and Environmental*

Management, ***12***(3): 67-69.

Tasisa, J., and Gobena,T., (2013). Evaluation of Chemical , Botanical and Cultural Managements of Termites Control, West Wollega Zone Agricultural Office, Ghimbi, Ethiopia. *Zoological Science* 22, ***4***: 583–588.

Ufele, A.N., Nnajidenma U.P., Ebenebe C.I., Mogbo T.C., Aziagba B.O. and Akunne C.E. (2013). The Effect of *Azadirachta Indica* (Neem) Leaf Extract on Longevity of Snails (*Achatina achatina*). *International Research Journal of Biological Sciences*, ***2***(1)**:**61-63.

Verma M., Satyawati, S. and Anushree, M. (2016). Termiticidal and repellency efficacy of botanicals against *Odontotermes obesus*, *International Journal of Research in Biosciences*, ***5***(2):52-59.

Yeap, S.K., Ho, W.Y., Beh, B.K., Liang, W.S., Ky, H., Yousr, A.H. and Alitheen, N.B. (2010). *Vernonia amygdalina*, an Ethnoveterinary and Ethnomedically Used Green Vegetable with Multiple Bioactivities. *Journal of Medicinal Plants Research*, ***4***(25):2787-2812