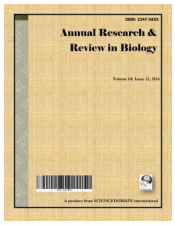

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Efficacy of Cashew Nutshell Extract against Termite Attack on *Triplochiton scleroxylon* Wood

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study investigated the efficacy of cashew nutshell extract against termite attack on *Triplochiton scleroxylon* wood in other to add to the quest for readily available and cost-effective pest control materials, specifically on termite attack on wood. The study was carried out at Entomology Laboratory, Federal College of Forestry Jos in Jos North Local Government Area of Plateau state, Nigeria, between April and May 2015. Some prepared wood billets were used as control/untreated (A), while others were treated with cashew nutshell extract in concentrations of 10% (B), 20% (C), 30% (D) and 40% (E) giving all together five (5) treatments which were replicated five (5) times to give a total of twenty five (25) billets. Both treated and untreated wood billets were taken to a selected area that is prone to termite attack by digging holes and placing billets in a Completely Randomized Design (CRD) for eight (8) weeks. After the duration of exposure, wood billets were removed and data was taken for number of termite present at point of removal on each billet, degree of attack, number of furrows and length of furrows and all the data were subjected to the Analysis of Variance (ANOVA) using the SPSS 16.0 package. Latin Square Design (LSD) was further conducted to examine the condition that was responsible for the difference. The result showed that the effects of number of termite present on billets are not significantly different between means. The effect of means percentage on degree of attack showed no significant

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difference among the treatments 20%, 30% and 40% but showed significant difference with the control and 10%, so also in number of furrows. Observations on the length of furrows showed that control (untreated) was significantly difference from other treatment means. This result led to the conclusion that cashew nutshell extract has pesticidal effects against termite attack on *Triplochiton scleroxylon* wood with treatment E (40%) having the highest effects.

Keywords: Efficacy; cashew; Triplochiton scleroxylon; wood; termite.

1. INTRODUCTION

Preservation of agricultural produce is of paramount importance and as such the continuous search for effective methods of preservation of plants and their produce [1]. Wood is an agricultural produce and as such a need to preserve, more so, because of its importance to man. The hard fibrous material (secondary xylem) that forms the main substances of the trunk or branches of a tree can be used in the building construction, furniture, railway sleepers, transmission poles, pulp and paper, plywood, veneers, composite boards, matches, fuel (coal industry) and fuel wood [2,3]. The earth contains about one trillion tonnes of wood, which grows at a rate of 10 billion tonnes per year. As an abundant carbon neutral renewable resource, woody materials have been of intense interest as a source of renewable energy. In 1991, approximately 3.5 cubic kilometer of wood was harvested. Dominant uses were for furniture and building construction [4].

In Nigeria, more than 80% of timber products are used for constructional purposes, and this is limited to strong and durable species of wood [5,6]. Wood preservation has become an important cause of concern in different parts of the world. Ligno-celullolytic materials are liable to degradation due to microbial agents and termites as well as other insect agents [7]. It has been noted that termites have by far the greatest economic importance. The food of termite is essentially cellulosic materials including wood paneling, paper products, art canvases, and the paper covering the sheetrock and carpeting and others [8]. Termites pose a chronic problem in many tropical regions, particularly in the sub-Sahara Africa, destroying wood by feeding on its components, thereby reducing its structural ability and appearance; hence a constant effort is directed towards their control [9,10].

Wood can be effectively protected from termite attack by treating with effective chemicals. Chemical pesticides including those used against fungal decays, soft rot, and some insect groups such as termites and borers [11]. Impregnating wood by applying suitable chemicals is the most preferred preservation method and presents a lot of economic gain [12], but there are problems created as a result of these which have resulted in phytotoxicity, mammalian toxicity, pesticide residues, insect resistance, insect outbreak and increased cost of production; coupled with environmental risks posed by some of these chemicals. The relatively high cost of procurement and low availability often contributes to the low levels of adoption in developing countries like Nigeria [13].

Over the past few decades, there has been substantial global awareness to develop eco-friendly wood preservatives and those which do not cause much effect on the health of mammals [14]. Efficacious botanical derivatives can provide an alternative to synthetic pesticides and agrochemical companies have started to focus on these alternatives [15]. Recently too, herbal extracts that are not harmful to the environment have been shown to be effective natural preservatives [16]. Findings from this study (using cashew nut extracts) are therefore aimed at adding to the quest for readily available and cost-effective pest control, specifically on termite attack on wood.

2. MATERIALS AND METHODS

2.1 Study Area

The experiment was carried out within the premises of the Federal College of Forestry Jos, Plateau State, Nigeria. Jos is located in Northern Guinea Savanna, between latitudes 8º 30´ and 10º 10´ N and longitude 8º 20´ and 9º 30´ E.

2.2 Sample Collection

2.2.1 Wood

The wood plank of *Triplochiton scheroxylon*, was obtained from the Katako market in Jos. This wood was cut into billet sizes of 25 mm x 25 mm x 300 mm (breadth x thickness x length). Each billet was labeled accordingly and the weights were taken.

2.2.2 Cashew nut shells/extraction

Fresh cashew nuts were obtained within the Federal College of Forestry Jos premises. They were air dried for three weeks in the laboratory after which the shells were broken locally to separate nuts and shells. The shells were further dried, and then pounded using mortar and pestle before taking for extraction. 800 g of pounded cashew nut shell was weighed and extracted by soaking in methanol at a concentration of 800 g in 4000 ml (i.e.200 g/l) for 72 hours the supernatant was thereafter separated by filtration using Whatman #1 filter paper. The extract was concentrated using a rotary evaporator and dried over a water bath. Extract was then refrigerated until when needed for use [17,18].

2.2.3 Treatment

Required concentration of the extract (i.e. concentration of 10, 20, 30 and 40%) was prepared in separate containers by mixing up with petroleum ether. Wood billets were treated by applying the extract preparations using a brush to rub on the surfaces. The treatment on wood was allowed to dry for about two hours, while control billets were left untreated. Wood billets were then taken to the selected field and exposed to Formosan subterranean termite attack by digging the ground and placing about ⅔ (two-thirds) of the billet lengths into the hole for eight weeks.

2.2.4 Parameters assessed

Number of termites on each billet at point of removal, Degree of attack (by grading), Number of furrows and Length of furrows were all taken.

2.3 Statistical Analysis

Data collected was presented using tables and graphs, thereafter subjected to analysis of variance (ANOVA) and SPSS version 16.0 software was used to analyze the data.

3. RESULTS

The number of termites and the furrows present on each billet at point of removal shows a progressive decrease in mean number as the concentration of the treatment increases (Figs. 1 and 3). The degree of attack by the termite also showed the same trend as that of the number of termite present on the billet. However, billet C and D showed the same mean as shown in Fig. 2.

The summary of all these parameters were presented in Table 1. This reveals that cashew nutshell extract has significant effects on termite control, which is in agreement with the findings of Mathew et al. [19]. However, as the concentrations increases, the mean percentage parameters of treatments decrease.

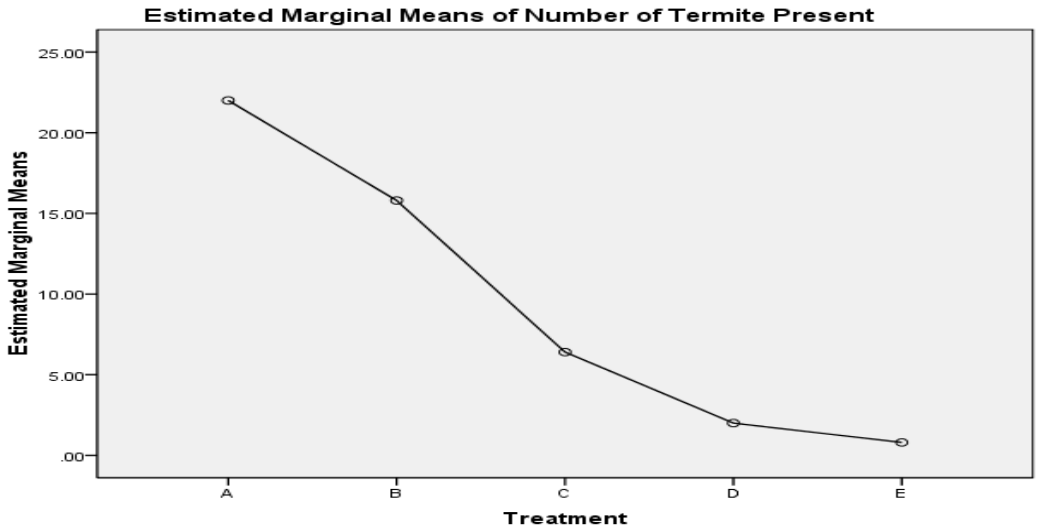

Fig. 1. Number of termites present on each billets at point of removal

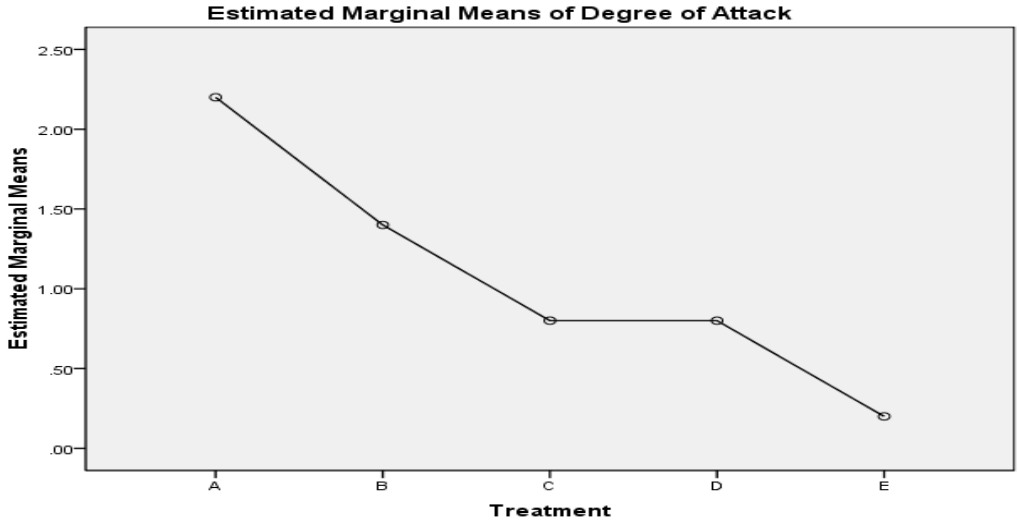

Fig. 2. Degree of attack (by Grading) by termite

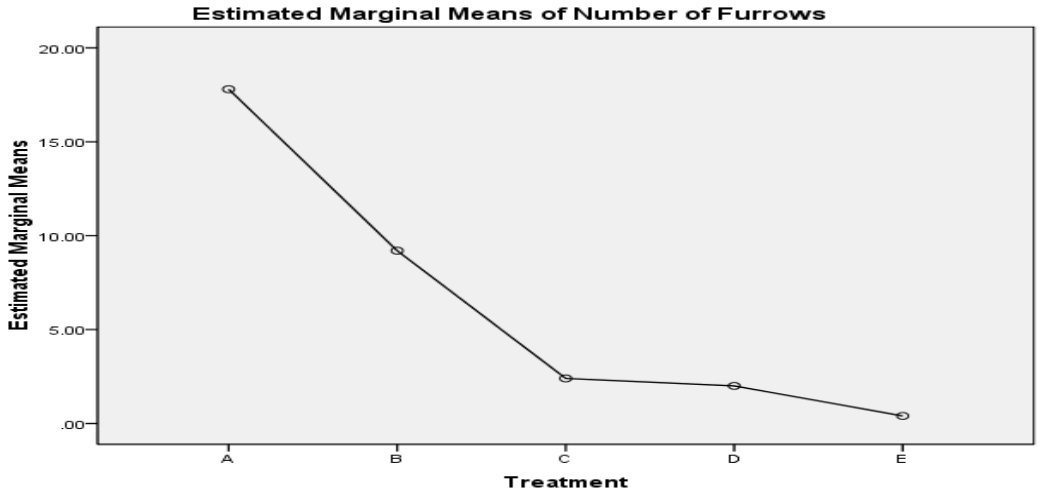

Fig. 3. Number of furrows made on the billets by termites

Furthermore, analysis of variance and LSD shows no significant difference among the number of termites present on billets: control (22.0), followed by 10% (15.8), 20% (6.4), 30% (2.0) and 40% (0.8) treatments respectively.

For the degree of attack, there is a decline in the mean of each treatment from 2.2 in A (control) to 0.2 in E (40% treatment) although, treatment C (20%) and D (30%) were equal with means of 0.8. Analysis of variance showed that there was significant difference among the treatments and LSD further reveled that no significant different between the control and treatment A (10% conc.), but there was significant difference between control and other concentrations. The number of furrows showed the same observation as the degree of attack (Table 1).

The length of furrows also showed a graduated decrease from the control through treatment B, treatment C (3.1), D (1.9) and E (0.3) respectively. Therefore, increase in treatment concentration gave a decrease in length of furrow on the wood billets. Analysis of variance and LSD reveled that there was a significant difference between the control and all other treatments (Table 1).

Table 1. The mean percentage of the effect of cashew nutshell extract against termite attack on *Triplochiton scleroxylon* wood

Plant extract	Conc (%)	Mean % parameters on post treatment			
		No. of termite present	Degree of attack	No. of furrows	Length of furrows
Cashew nutshell	Ctrl (untreated)	22.0 [a]	2.2[a]	17.8[a]	22.0[a]
	10	15.8[a]	1.4[ab]	9.2[ab]	9.0[b]
	20	6.4 [a]	0.8[b]	2.4[b]	3.1[b]
	30	2.0 [a]	0.8[b]	2.0[b]	1.9[b]
	40	0.8[a]	0.2[b]	0.4[b]	0.3[b]
	SE±	7.1	0.4	4.0	4.1
	LSD	---	1.04	9.66	9.99

Each value is a mean of ± standard error of five replicates. Mean followed by the same superscripts in a column are not significantly different (p≤0.05) from each other

4. DISCUSSION

Based on the results obtained from this study, the number of termites present on the billets at the point of removal showed a decrease in number of termites as extracts treatment increases and finally the lowest was 0.8 in treatment E (40%). However, there was no significant difference observed among treatments. This is similar to results observed by Venmalar and Nageveni [7] who reported that neem oil having the main constituent of azadirachtin acted as repellent, feeding inhibitors, egg laying deterents, growth retardants and sterilant.

Degree of attack on wood billets showed a decrease in the degree of attack as concentration increased. Treatment A (control) has the highest mean percentage of 2.2. This is in agreement with the work of Cinhat et al. [20] in a study of termiticidal properties of plant bark extracts used as wood preservatives against termite. They collected the extract of *Acacia mollissima*, *Shinopsis lorentzii* and *Pinus brutia* and used them against *Reticulitermes grassei* and results obtained showed that *Acacia mollissima* (mimosa) and *Shinopsis lorentzii* (quebracho) extracts can be used as alternative wood preservatives against *Reticulitermes grassei* for indoors application. However, the termicidal effect of the extracts varies depending on many factors including concentrations, natural durability, density and extractive types and quantities.

Analysis of variance (ANOVA) and LSD showed degree of attack to be significantly different from the control, thus confirming the work reported by Boongaling et al. [21], that cashew nutshell liquid (CNSL) have anti-feedant and termiticidal properties. This could have been the factors in play to bring about a decrease in degree of attack on the wood billets as the treatment concentrations increases.

In the same vein, the mean percentage of number of furrows decreases with an increase in treatment concentration. Analysis of variance and LSD on the number of furrows indicates significant value of cashew nutshell extract as 0.032 at 5% probability value. This reveals that the effect of treatments was significantly different from control. This corresponds with a study by Lepage and Delelis [22] whose results showed that natural cashew nutshell liquid was toxic to termites and controls termites from turnelling into the soil and feeding on woods.

Length of furrows also decreases as concentration of treatment increase. This is in agreement with a study by Eliveri et al. [23] which reported that wood blocks were not or only slightly damaged because the preservatives used acted as repellents or made the blocks unpalatable to termite thus lesser length of furrows.

5. CONCLUSION

From the study it can be concluded that there is an average increase in shelf life of *Triplochiton scheroxylon* (obeche) wood noticed on treated wood with cashew nutshell extract compared to untreated wood. The highest protection was observed with treatment E (40% concentration) of the extract in all parameters assessed. A significant difference noticed in degree of attack, number of furrows and length of furrows between treated and untreated wood billets proves that cashew nutshell extract is an effective insecticide with both anti-feedant and repellant properties against termite.

Similar studies have been reported indicating some wood, plant seed plant and fruit extracts were utilized to increase durability of wood species such as bald cypress (*Taxodium distichum*), heartwood extract [24], wood extract [25], Cinnamon bark extract [26], water pepper leaf extract [27] and Birbira seed extract [28].

6. RECOMMENDATION

Further research should be conducted using higher concentrations of cashew nutshell extracts on this and other wood species in order to determine its efficacy against attack on wood by termites.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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