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Comparative Study on the Extraction and application of aqueous Crude Stem Bark Extracts from *Jatropha curcas* and *Azadirachta indica* as Pesticides.

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Abstract

A comparative study was carried on the extraction and application of aqueous crude stem bark extracts from *Jatropha curcas* and *Azadirachta indica* as Pesticides. The study was based on the use of natural plants crude extracts from the bark as an alternative to synthetic pesticides. The treatment were laid out in a completely randomized design (CRD) with four replicates using sixteen (16) billets of *Bambusa vulgaris* schrad which was cross cut into 1.25 inches thickness and 12 inches in length. 50ml, 100ml, 150ml and 200ml separate stem bark extracts of *Jatropha curcas* and *Azadirachta indica* were applied to the billets using a brush. T_1 was treated with aqueous stem bark extract of *Jatropha curcas*; T_2 was treated with aqueous stem bark extract of *Azadirachta indica*, T_3 was treated with combine aqueous stem bark extract of *Jatropha curcas* and *Azadirachta indica*, while T_4 serve as the control. The study revealed that T_3 (combine aqueous stem bark extract of *Jatropha curcas* and *Azadirachta indica*) was more effective in causing significant reduction in termite attack than other applications used, probably due to the toxicity/anti-feedant properties to termite. The analysis of variance showed no significant difference on the incidence of termite attack and severity of damage, while there was significant difference on the number of furrows and weight loss of billets at 0.05% significant level.

Keywords: Wood Preservation, Extraction Processes, Pest infestation.

Introduction

Natural resistance is the inherent ability of some wood species to resist the attack of bio-deteriorating agents without treatment with chemical preservatives. The term 'natural durability' refers to the degree of resistance of wood to bio-deteriorating agents. The natural resistance exhibited by some species is the resultant effect of the presence of extractives in the heart region. Pesticides are chemical substances that are

used to decimate, repulse, prevent, and control the pests creating nuisances and help to increase the yield in agricultural sector (Kumar *et al*., 2012). Milton (1995) stated that the sapwood of all known tree species is very susceptible to decay, regardless of any natural resistance of the heartwood. Unless sapwood is entirely removed or impregnated with preservatives, decay is likely to occur even in durable species. Trees with more toxic natural chemicals deposited during the transformation have very durable heartwood that is highly resistant while some may be moderately resistant and other have no resistance to insect attack (Adam *et al*., 2002). More than 200 compounds can be extracted from neem (Koul & Wahab, 2004), where azadirachtin (Az) is the most active compound of neem (Khan *et al*., 2015). It is the component of neem oil, leaves, flowers, and fruits with insecticidal properties (Akhtar *et al*., 2008).

Susceptible wooden material may be protected from termites by the use of toxic or repellent chemicals. However, many wood chemicals will be unacceptable in the future because of their potentially adverse environmental effects. The plantation of forest species and the use of wood having natural resistance to termites offer an alternative for the use of chemicals products (Peralta *et al*.; 2004). Traditional medicine using plant extracts continues to provide health coverage for over 80% of the world's population, especially in the developing world (WHO, 2002).

Finding safe alternative to synthetic pesticides/insecticides to protect/preserve wood from pest infestation are highly desirable. The essential minimum requirements for pesticides to be a more sustainable alternatives for insects pests control is that they should be produced from renewable raw materials and that their uses could have lower negative environmental impacts (Henning, 2006).

Materials and Method

Study Area

The experiment was carried out in Federal Polytechnic Bauchi. Bauchi state has a land area of 49,259.01 km^2 with a population of 4.6 million people and located between latitude 9^o 30^1 North of the equator and longitude 8^o 50^1 and 11^o East of the Greenwich Meridian. The state has a typical tropical climate clearly marked by the dry and rain seasons. The average annual rain fall is 700mm in the Northern parts and 1300mm in the Southern parts. The wettest months are July, August and September. Dry season starts in November and ends in April; this is a period of harmmatan, when the dust loaded North East trade wind from Sahara desert has a marked drying effect on the vegetation and the general climate of the state. Bauchi state is one of the states in Northern part of Nigeria that span three distinct vegetation zones, namely; Northern Guinea Savannah, Sudan Savannah and

Sahel Savannah with Sudan Savannah dominating. Northern Guinea Savannah become manifest as one moves along a belt that stretches from extreme western part of the state to the extreme southern part covering Local Government Areas of Toro, Tafawa Balewa, Dass and Bogoro. The Sudan Savannah type of vegetation covers Local Government Areas of Ningi, Warji, Darazo, Ganjuwa, Kirfi, Alkaleri and Bauchi. The Sahel zone also known as Semi – desert type becomes manifest on the middle of the state as one moves from south to the north. (Bauchi State Official Diary, 2014).

Plant material

Fresh stem bark of *Jatropha curcas* and *Azadirachta indica* were collected from Bauchi State Agricultural Development Program (BADP) and Forestry Department in Bauchi State, Nigeria in the month of August, 2021 and was identified by the Forestry Department of Federal Polytechnic Bauchi, Nigeria. Voucher sample was prepared and deposited in the Herbarium for reference. The collected stem barks were spread to dry under shade at normal room temperature for seven (7) days in the shade. Upon drying, the plant materials were pounded using mortar and pestle into smaller particles and then blended to powder using Kenwood electric blender (Kenwood Ltd, Harvant, United Kingdom) and the powder stored in airtight containers and kept under normal room temperature (28 ± 2°C) until required.

Extraction Procedure/Preparation of the bark extracts

Exactly 250g of powdered each (*Jatropha curcas* and *Azadirachta indica)* sample was soaked in 800ml solvent contained in a 1000ml sterile conical flask. The flask was covered with cotton plug and then wrapped with aluminium foil and shaken vigorously at 3 hours intervals for 48 hours at room temperature. The crude extract was then filtered using muslin cloth and then Whatman no.1 filter paper. The filtrate was evaporated to dryness using rotary evaporator (Model 349/2, Corning Limited) maintained at 40°C and the dried substance was stored in airtight bottles until required.

Preparation of the Billets

Bambusa vulgaris schrad of 2 x 2 inches thickness were cross – cut into billets, 18 inches in length. The initial weight of the billets was determined using an electronic balance and was recorded.

Experimental Design

The experiment was set up in a completely randomized design (CRD). This comprised of four treatments including the control (T_1, T_2, T_3, and T_4) which were replicated four times to have (4 X 4) samples (16 billets) and the aqueous crude extracts of *Jatropha* curcas and *Azadirachta indica* at a dose of 50ml, 100ml, 150ml and 200ml respectively.

T_1 - Treated with *Jatropha curcas* aqueous crude stem bark extracts

T_2 - Treated with *Azadirachta indica* aqueous crude stem bark extracts

T_3 - Treated with combine aqueous crude stem bark extracts of T_1 and T_2

T_4 - No treatment (control)

The result obtained was subjected to analysis of variance and the significance was determined.

Treatment of samples billets with the aqueous crude stem bark extracts

50ml, 100ml, 150ml and 200ml of separate aqueous crude stem bark extracts from *Jatropha curcas* and *Azadirachta indica* representing four levels of treatment A, B C and D. Each sample billet was polished with the aqueous crude stem bark extracts using a brush thoroughly which ensures maximum penetration of the aqueous crude extracts into the sample billets.

Installation of billets into the termite mound.

The sample billets where installed into the termites mound (termiterium) located within the Polytechnic premises near Forestry Department Plantation. The sample billets where inserted at a depth of 10 – 15cm down the ground level with the help of an Indian hoe.

Data Collection Procedures.

In order to get detail information that will satisfy the objectives of this research, Inspection and evaluation of the sample billets was made by visual assessment after every 21 days for sign of termite attack for a period of 2 months. The sample billets were removed from the mound and cleaned, and then the damage was assessed. The incidence of termite attack was recorded as follows: 1 representing attacked; and 0 representing not attacked. The severity of the damage was recorded as follows: 1 representing less than 1% of total wood volume eaten; 2 for 1 – 20% of total wood volume eaten; 3 for 21 – 40%; 4 for 41 – 60%; and 5 representing above 60% of the total wood volume eaten respectively.

Data Analysis.

The results obtained were subjected to analysis of variance (ANOVA) and the significance was determined at 0.05% significant level. Percentages of sample billets attacked by termites and counts of sample in each severity class for the different weeks were summarized.

Phytochemical Screening

Phytochemical screening was carried out using the methods of Trease and Evans, (1989) and Sofowara (1989), the phytochemicals tested were; Jatrophine, Azadirachtin, Nimbin, Nimbidol, Tannins, Alkaloids, Flavanoids, Resin, Saponins and Glycosides respectively in all the stem bark extracts. The solvent used were distilled water, ethanol and hexane.

Result and Discussion

Phytochemical Compounds in the stem bark extracts of *J. curcas and A. indica*

Results of the extraction with various solvents show that ethanol was the more efficient solvent with a yield of 19.6%, followed by water with 17.6% and then hexane 14.9%. The ethanol extract produced the highest yield amongst all the solvents. This is a clear indication that the solvent system plays a significant role in the solubility of the bioactive components and influences the antibacterial activity. Medicinal plants contain some pharmacologically active principles which over the years were exploited in herbal medicine for the treatment of a number of diseased conditions. Phytochemical screening of the stem barks of *J. curcas* and *A indica* showed the presence of Jatrophine, Azadirachtin, Nimbin, Nimbidol, Tannins, Alkaloids, Flavanoids, Resin, Saponins and Glycosides as detailed in Table 1. These compounds are known to be biologically active because they protect the plant against infection and predation by animals. Phytochemicals generally exert their antimicrobial activities through different mechanisms to that of synthetic drugs (Scalbert, 1991). Tannins for example, have been found to form irreversible complexes with proline- rich proteins resulting in the inhibition of the cell protein synthesis. This activity might have been exhibited against the test bacteria. Apart from antimicrobial activity, tannin also reacts with proteins to provide the typical tanning effect. Medicinally, this is important for the treatment of pneumonia, asthma and inflamed tissues. Tannins have important roles such as been stable and potent antioxidants. Herbs that have tannins as their main component are astringent in nature and are used for treating asthma, pneumonia, and dysentery (Levin *et al*., 1979), thus justifying the use of the plant in traditional medicine practice.

Table 1: The Phytochemical Compounds in the stem bark extracts of *J. curcas and A. indica*

SAMPLES	PHYTOCHEMICAL COMPOUNDS
Jatropha curcas stem bark extracts	Alkaloids (Jatrophine) Tannins, Saponins, ethereal oils, toxalbumins and cyanogenic
Azadirachta indica stem bark extracts	Azadirachtin, Salanin, Nimbidin, Tannins, Nimbin, Sadium Nimbinate, Nimbidol and Gidunin

Author: Field/Lab result, 2021

Incidence of Termite attack on the billets

The incidence of termite attack on the billets after the experiment (9 weeks) at 2 weeks interval as represented in Table 2 shows that, the highest incidence of attack is shown on T_4 (control) compared to the least of T_3

(Combine stem bark extracts of *J. curcas* and *A. indica*) which shows no incidence of termite attack on the billets due to the concentration as well as the repellant ability possess as shown on table 1 below:

Table 2: Incidence of Termite attack on the billets (*Bambusa vulgaris* schrad)

Treatment/	A			B			C			D		
Replicate	I	II	III	I	II	III	I	II	III	I	II	III
T_1	0	0	1	0	0	1	0	0	1	0	0	0
T_2	0	0	1	0	1	0	0	0	1	0	0	1
T_3	0	0	0	0	0	0	0	0	0	0	0	0
T_4	0	1	1	1	1	1	0	1	1	0	1	1

Severity of Damage to the Billets by Termites

The severity of damage to the billets by termites is presented on Table 3 after 9 weeks at 2 weeks interval which shows that T_4 (control) having much severity of attack compared to the least of T_3 (Combine stem bark extracts of *J. curcas* and *A. indica*) and also indicates the effectiveness of the combine effects of the two extracts (stem bark extracts of *J. curcas* and *A. indica*) used during the experiment. It also indicate the effectiveness of the dosage used.

Table 3: Severity of Damage to the Billets by Termites

Treatment/	A			B			C			D		
Replicate	I	II	III	I	II	III	I	II	III	I	II	III
T_1	1	1	1	1	1	2	1	1	2	1	1	1
T_2	1	1	2	1	1	1	1	1	1	1	1	2
T_3	1	1	1	1	1	1	1	1	1	1	1	1
T_4	1	2	2	1	2	2	1	2	3	1	3	3

Number of Furrows on the Billets

The number of furrows on the billets made by the termites is presented on Table 4 which revealed that the highest number of furrow is on T_4 (control) compared to that of T_3 which shows a great effect in termite repellant ability and also due to the double action it possess.

Table 4: Number of Furrows on the Billets

Treatment/	A			B			C			D		
Replicate	I	II	III	I	II	III	I	II	III	I	II	III
T_1	0	0	0	0	1	2	0	1	3	0	1	1
T_2	0	0	0	0	0	0	0	0	1	0	1	5
T_3	0	0	0	0	0	0	0	0	0	0	0	0
T_4	0	3	4	0	3	6	0	2	9	1	5	4

Weight loss of billets

Table 5 shows the weight loss of billets at the end of 2 months treatment at 2 weeks interval, which indicates that T_4 (control) having the highest weight loss across the replicates compared to T_1, T_2 and T_3 respectively, and also due to the presence of insect repellant and anti-feedant properties both stem bark extracts contains.

Table 5: Weight loss of Billets

Treatment/	A		B		C		D	
Replicate	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL
T_1	30	28	35	34	32	30	30	28
T_2	25	24	30	29	28	27	35	33
T_3	35	34	35	34	30	30	25	24
T_4	30	20	35	29	35	28	30	23

Discussion

The study showed that *J. curcas* and *A. indica* stem bark used in this study possess pesticidal/insecticidal protection/preservation against termite some organisms associated with insect infestation. It therefore suggests that these plants could be a source of bio-pesticide to be used in the preservation of insect pest infestation and deterioration against wood.

In order for a preservative treatment to be effective three factors must be considered. The proper amount of preservative must be absorbed or force into the wood to provide adequate toxicity, the quality of preservative retained or present after treatment and deep penetration of the preservative in the wood. The hot treatment technique increased the penetration and absorption of the preservative chemicals into the bamboo wood samples.

The high vulnerability and termite action as revealed by the control T_4 (untreated) in this research study indicate that the bamboo wood is not durable and as such requires preservative treatment to prolong its serviceable life or longevity. The findings of this study showed that bamboo species differ in their susceptibility to agents of bio deterioration, and also shows that both stem bark extracts (*J. curcas* and *A.* indica) has potentials of being used to control insect pest as shown in Table 2, 3, 4, and 5 respectively.

Recommendation

- The effects of other forms of solvent can be studied to determine their effects on retention and performance of both the stem bark extract preservative used.
- Base on the potentials of these tree species (*J. curcas* and *A.* indica) Government and Non Governmental Organisation should established more plantation in the Forestry Sector.
- Pesticides makers (industries) should be encourage to sponsor more research on other part of these tree species (*J. curcas* and *A.* indica) to utilized their potentials

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