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Effectiveness of aqueous extracts of teak seeds on the growth and insect pests population of amaranth.

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Abstracts

Field experiment was conducted to evaluate the insecticidal activity of *Tectona grandis* seed extracts on the growth and insect pest population in amaranthus. The design of the experiment was randomized complete block design with five treatments replicated four times. The treatments were: 0%, 5%, 10%, 15% and lamdacyhalothrin. The effectiveness of the three extracts was compared to the control and insecticide. The aqueous extracts caused significant ($p<0.05$) reduction in the population of three insect pests of *Nezara viridula, Zonocerus varieagatus and Clavigralla tomentosicollis*) of amaranthus. The results showed that the seed extracts were very effective in causing reduction in population 24 h after application. However, none of the seed extracts could be compared with the chemical insecticide in percentage reduction caused to the insect pests. The results also indicated that among the teak seed extracts, 15% application rate was found to be most effective in controlling the above mentioned insect pests. Further work is recommended to determine how the extracts could be combined with chemical pesticicdes for sustainable production of vegetables in the agroecological zone.

Key words: *Tectonia grandis, amaranths, phytotoxicity, lambdacyhalothrin, agroecological.*

I. Introduction

Amaranth [*Amaranthus hypochondriacus, A. cruentus* (Grain type) & *A. tricolor* (Vegetable type)] is an herbaceous annual with upright growth habit, cultivated for both its seeds which are used as grain and its leaves which are used as a vegetable or green. Both leaves and seeds contain protein of an unusually high quality. The grain is milled for flour or popped like popcorn. The leaves of both the grain and vegetable types may be eaten raw or cooked. Amaranths grown principally for vegetable use have better tasting leaves

then the grain types [1]. Vegetables are major constituents of human diet, but are more prone to pest attack mainly due to their tenderness and softness than other crops [2]. The cultivation and production of amaranth is limited by biological factors of insect pests and diseases. According to [3] a wide range of insect pests have been recorded to be attacking amaranth worldwide with some described as major pests while others as minor depending on the magnitude of the damage they cause. Both wild and cultivated varieties of amaranths spp were also remarked to be infested by the general crop pests like grasshoppers, bugs and beetles. One of these beetles, which can be said to have assumed a serious pest status, because of its attacks on the cultivated varieties of African spinach, is *Gasteroclisus rhomboidalis*. [4] identified insect pest infestations as perhaps the most important constraint to production of vegetables in Nigeria and one of the primary causes of low quality and yields. According to the authors a wide range of foliar insect pests and diseases such as aphids (*Aphis* spp.), leaf worms (*Spodoptera* spp.), leaf rollers (*Sylepta derogota*), leaf miners (*Liriomyza* spp.), spider mites (*Tetranychus* spp.), stem boring weevils (*Hypolixus haereus*), bugs (*Asparia armigera*) to cause damage to amaranths.

Over-reliance on organochlorides and organophosphates or their derivatives as a control strategy for pest is facing resistance due to rising impact on the environment and health of human beings and their animals [5] and [6]. The need to develop non-toxic and safe and effective biodegradable alternatives to synthetic insecticides led to global efforts at screening various plants for bioactivity against insect pests infestation. A number of tropical pests species have been observed to have medicinal properties, which suggest that natural insecticides can be derived from them [7].

Teak leaves and seeds, *Tectonia grandis*, has been reported to possess insecticidal properties. In an experiment on phytotoxicity of leaf extracts of multipurpose trees against insect pests in bitter gourd (*Momordica charantia*) and brinjal (*Solanum melongena*) spraying with casuarina, portia, tamarind and teak resulted in reduced number of leaves and was on par with the absolute control. Tamarind and teak were effective in reducing *Epilachna* beetle infestation but ineffective against fruit fly on brinjal [2]. Leaf teak extract at 5.0 per cent and NSKE 5.0 per cent were found to be effective in reducing leafhopper with the

mean population 3.80 /3 leaves and 4.51 /3 leaves, respectively [8]. This present study was carried out to investigate the insecticidal activity of teak seed extracts on growth and insect pests in amaranth.

2. Materials and Methods.

The experiment was carried out at the Teaching and Research Farm, Adeyemi College of Education, Ondo, Ondo State, Nigeria, during the rainy season of 2014 between May and July. The planting material, *Amaranthus cruentus* used in the field experiment was procured from the Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife, Nigeria. The experiment was designed in a randomised complete block (RCBD) with five treatments and three replicates. The treatments were, 0%, 10% and 15% of the teak seed extract. The effectiveness of the different concentrations of teak seed extracts was compared with that of a conventional insecticide, lambdacyhalothrin, applied at the rate of 10g a.i./ha. The crop was planted in 3- x 3 m plots with 1-m pathway between each plot while maintaining 40 cm by 30cm inter plant and inter row distances. Fertilizer was applied at the recommended dose and other standard agronomic practices including thinning and weeding were carried out as required.

2.1. Collection of plant material and processing.

Matured seeds of teak, *Tectona grandis,* were collected from the teak plantation in Adeyemi College of Education, Ondo. The seeds were thoroughly washed with clean water to avoid dusts, sands and decayed plant materials. The seeds were later removed and spread on a clean wooden surface in the crop and soil laboratory of the Department of Agricultural Science, Adeyemi College of Education, Ondo, for 14 days. An electric blender was later used to powder the dried seeds and fine powder of the seeds collected using a 2 mm sieve.

2.2.Preparation of aqueous teak extracts

Aqueous extracts of teak were prepared into four different concentrations: 0%, 5%, 10% and 15%. At 0% no treatment was applied (control) while at 5%, 250g/0.25kg of teak seed powder was mixed with 400ml of hot water (70^{c}). The solution was separately filtered with the aid of muslin cloth for spraying. A surfactant was prepared by mixing 10g each of soap and starch in 50ml of water.

At 10%, 500g/0.5kg of teak seed powder was mixed with 400ml of hot water (70°c). The procedure of filtration and addition of surfactant was similar to that of 5% above. The treatment concentration of 15% was also prepared by adding 750g/0.75 kg seed powder to 400 ml of the solution. The solution was filtered and surfactant added appropriately as previously mentioned.

2.3 Application of plant extracts and data collection:

Plant extracts of teak at different concentrations were applied with the aid of a 15- l knapsack sprayer at an interval of 7 days starting from 2 weeks after planting (WAP). Data on insects and predators were collected as pre-treatment data 24 hours before application of treatment and 24 hrs, 48 hrs and 72 hrs after application of treatments (post-treatment) to evaluate the effectiveness of the teak extracts. Visual counting method was used to collect data on arthropod species. Five samples comprising of five stands per sample were taken per treatment per replicate in a zig-zag pattern. Data were collected on three insect pests' species: grasshoppers, green shield bug, *Nezara viridula* and coreid-pod bugs, *Clavigralla tomentosicollis*. Assessment of insect pests' population was done during the cool hours of the day-early in the morning and late in the evening.

On the growth of the plant, data were collected on two parameters: plant height and number of leaves. These growth parameters were determined by taken five samples comprising of five stands per sample starting from 3WAP. The data collected were subjected to analysis of variance (ANOVA) to determine the level of significance of treatments and significant treatment means were separated by using Duncan Multiple Range Test (DMRT) at 5% level of significance. Statistical analyses were all conducted by using statistical package for social sciences SPSS version 17.

3. Results and Discussion

3.1. Effect of teak seed extracts treatments and insecticide on number of leaves of amaranth.

The effects of teak seed extracts and synthetic pyrethroid insecticide on number of leaves of amaranthus are as shown in figure 1. The results revealed there was no significant difference in mean seed extracts of teak and the conventional

insecticide application, lamdacyhalothrin, The treatments did not significantly increase number of leaves of amaranthus ($p > 0.05$). Figure 2 shows the effect of teak seed extracts and a synthetic pyrethroid on plant height of amaranthus. The results indicated there was no significant difference in mean seed extracts of teak and the conventional insecticide on plant height of amaranthus ($p > 0.05$). The phytotoxic effects of teak seed extracts on amaranthus plants manifested in leaves and branches turning yellow immediately after application are as shown in figure 3

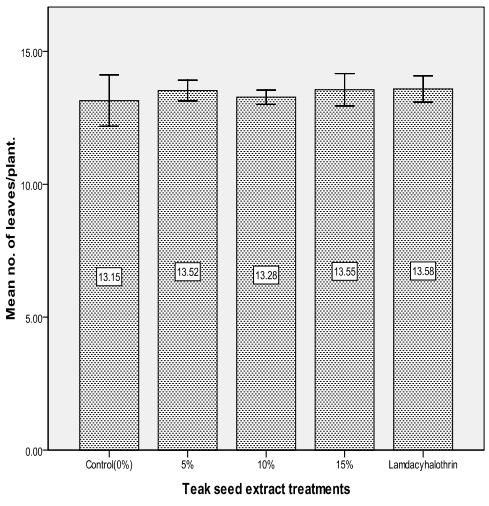

Fig 1: Mean number of leaves of amaranth in teak seeds extracts and insecticide treated plots.

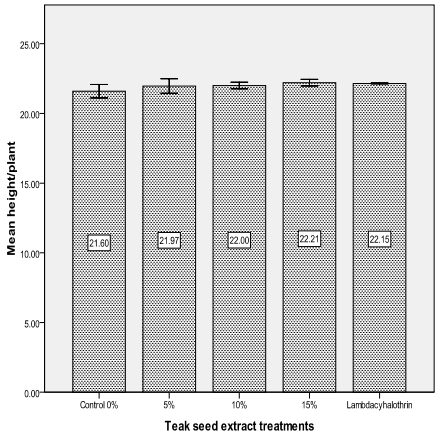

Fig 2: Effect of teak seeds extracts and insecticide application on mean plant height of amaranth

By comparing the number of plants affected by treatment with teak extracts, statistically significant differences were discovered over different concentrations in number of chlorotic plants. Though, no statistically significant differences in number of chlorotic plants (resulting from application of plant extracts) recorded in 10% and 15% teak seed extracts treated plots, number of chlorotic plants recorded in these two treatments (10% and 15%) were significantly different from the control, 5% and lamdacyhalothrin treated plots. This is in conformity with the works of [9] ; [10] that reported that *T. grandis* leaf extract promoted allelopathic effects on germination in sorghum and pigeon peas and on nodulation in Soybeans The non significant number of plants affected by phytotoxicity in the untreated plots

could be as a result of insecticide drift during application.

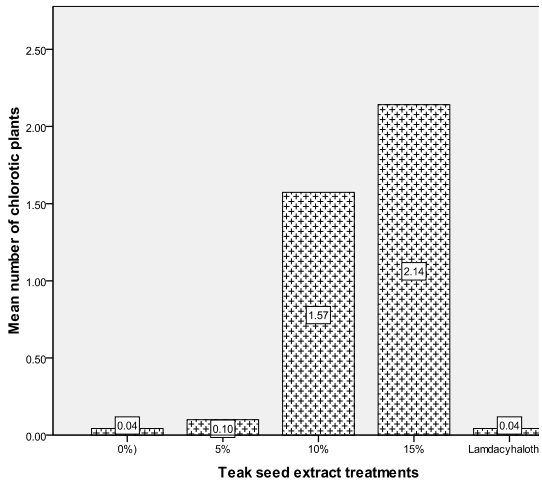

Fig 3: Phytotoxic effect of teak seeds extracts and insecticide application leaves and stems of amaranth

3.2. Percentage reduction in population of green stink bug, *Nezara viridula* in amaranth

Table 1: The effect of teak seed extracts and insecticide treatments on the population of green stink bug, *Nezara viridula* in amaranth

Treatments	24 hrs before spraying	Hours after application		
		24 h	48 h	72 h
0	3.03[a]	2.79[a]	2.94[a]	3.01[a]
5	3.15[a]	1.80[a]	1.92[a]	1.95[ab]
10	2.80[a]	1.51[ab]	1.04[b]	1.00[b]
15	2.25[a]	0.72[c]	0.62[ab]	0.56[bc]
Lamdacyhalothrin	2.25[a]	0.02[d]	0.01[c]	0.15[bc]

Means followed by the same letter(s) in a column are not significantly different from each other according to Duncan Multiple Range Test (p< 0.05) SPSS vs. 17.

Table 1 shows the mean number of green stink bug, *Nezara viridula*, in the experimental plot in 2014 season.

There was a significant difference ($p < 0.05$) in the number of green stink bug 24 hrs after application of treatments in 2014 season. Teak seed extract at 5% was not significantly different in number of green stink bug from the control (untreated) but was significantly different from teak seed extract (10% and 15%) and the insecticide treatments. However, the number of green stink bug in 15% teak extract treatment plot was significantly different from 5% and 10% extracts and the insecticide treatment plot. The percentage reduction in population of green stink bug is as depicted in figure 4.

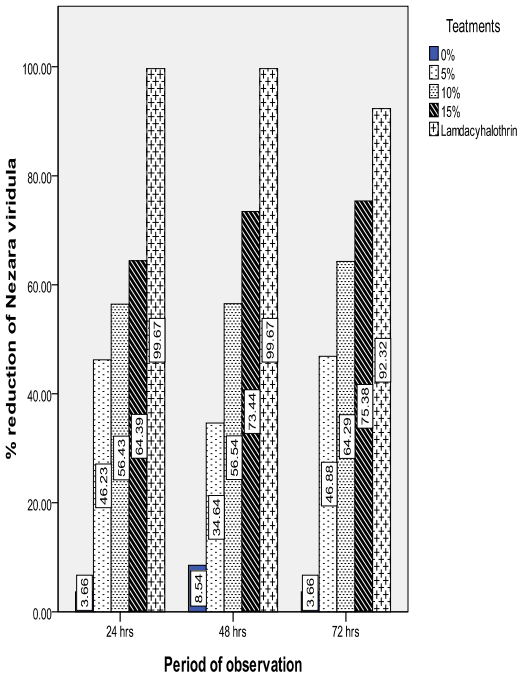

Fig 4: Percentage reduction of *Nezara* spp by teak seeds extracts and insecticide in 2014

Amongst the seed extracts of teak, the highest reduction (64.39%) 24 h after application of treatments was recorded in (56%) in the population of the bugs 24 hrs after application of treatments was recorded in 15% seed extract treated plots. 10% and 5% teak seed extracts were second and third most effective treatments 24 h after application of treatment with 56.43% and 46.23% respectively. The results of this study agree with the work of Sathyan *et al.,* (2014), which proved that teak products such as leaf applied at 5.0% was found to be effective by reducing the leafhopper with the mean population 3.80 /3 leaves.

None of the teak seed extracts could be compared to the conventional insecticide, lamdacyhalothrin (99.87%) in reduction of *Nezara viridula* population. However, in the control plots minor reduction (3.66%) in population of the green stink bug was recorded. The data also indicated significant difference two days after the treatment with 8.54%, 34.64%, 56.54%, 73.44% and 99.67% recorded in treatments 0%, 5%, 10%, 15% and pyrethroid respectively. Similar trend was observed 120 h after application of treatments.

3.3. Percentage reduction in population of *Zonocerus variegatus* in amaranth

The effect of teak seed extracts and insecticide treatments on the population of *Zonocerus variegatus* in amaranth is as shown in Table 2. The results indicated there was a significant difference ($p < 0.05$) in the number of *Zonocerus variegatus* 24 hrs after application of treatments. Teak seed extract at 5% was not significantly different in number of *Zonocerus variegatus* from the control (untreated) but was significantly different from teak seed extract (10% and 15%) and the insecticide treatments. The highest reduction in population of the insect was recorded in chemical insecticide treated plots. Amongst the teak seed treatments, 15% teak seed extracts caused the greatest mortality of *Zonocerus* variegates (64.39%) 24 h after application of treatment(figure 5)

Table 2: The effect of teak seed extracts and insecticide treatments on the population of *Zonocerus variegatus* in amaranth.

Treatments	Spraying Application			
	Before first spray	24 hrs	48 hrs	72 hrs
0	4.04^{a}	3.57^{a}	3.28^{a}	2.80^{a}
5	4.38^{a}	3.02^{a}	2.04^{a}	1.95^{ab}
10	5.02^{a}	1.5^{ab}	1.04^{b}	1.00^{b}
15	3.68^{a}	$.94^{ab}$	1.62^{ab}	0.56^{bc}
Lamdacyhalothrin	5.96^{a}	0.00^{c}	0.04^{c}	0.15^{c}

Means followed by the same letter(s) in a column are not significantly different from each other according to Duncan Multiple Range Test (p< 0.05) SPSS vs. 17.

There was no significant difference in percentage reduction in population of *Zonocerus variegatus* between 10% and 5% teak seed extracts at 56.43% and 46.23% respectively at this period of observation. At 48 h after application of treatments, similar trend was recorded in percentage reduction with the synthetic insecticide producing the greatest mortality (99.67%), followed by 15% seed extract treatment (73.44%).

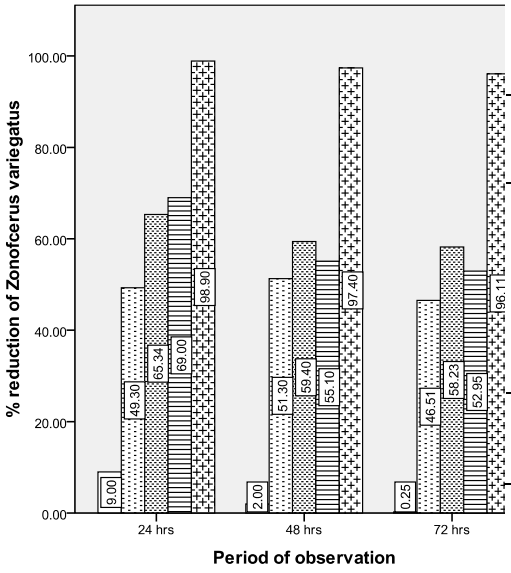

Fig 5: Percentage reduction of *Zonocerus variegatus* by teak seeds extracts and insecticide

3.4. Percentage reduction in population of coreid pod bugs, *Clavigralla tomentosicollis,* in amaranth. The effect of teak seed extracts and insecticide treatments on the population of coreid pod bugs, *Clavigralla tomentosicollis,* in amaranth is as shown in Table 3. The results indicated there was a significant difference ($p < 0.05$) in the number of coreid pod bugs 24 hrs after application of treatments.

Table 3: The effect of teak seed extracts and insecticide treatments on the population of coreid pod bugs, *Clavigralla tomentosicollis* in amaranth.

Treatments	24 hrs before spraying	Hours after application		
		24 h	48 h	72 h
0	2.46[a]	2.37[a]	2.25[a]	2.37[a]
5	2.97[a]	0.76[a]	0.96[a]	1.52[a]
10	3.12[a]	1.19[b]	1.24[a]	1.92[a]
15	3.25[a]	1.33[c]	1.33[a]	1.26[a]
Lamdacyhalothrin	3.24[a]	0.01[d]	0.01[a]	0.24[a]

Means followed by the same letter(s) in a column are not significantly different from each other according to Duncan Multiple Range Test (p< 0.05) SPSS vs. 17.

While the treatments were significantly different from the control, percentage reduction in population of the sucking bug recorded in 5% teak seed extract plot (48.62%) and in 10% teak seed extract treated plot(51.02%) were not significantly different from each other. 10% teak seed extract treatment caused the highest reduction (66.10%) amongst the seed extracts 24 h after treatment (figure 6). At 48 h after application of treatments, there was no significant

difference in percentage reduction amongst the three teak seed extracts ($p>0.05$). While 5% teak seed extract caused percentage reduction of 48.48%, teak seed extract applied at 10% caused 51.04% percentage reduction in population of the sucking bugs. 15% teak seed extract caused 65.61% reduction at 48h after application of treatment. At 72 h after application of treatments, there was significant difference in percentage reduction in population of *Clavigralla tomentosicollis* ($p < 0.05$). Though, the teak seed extracts were significantly different from the control, there was no significant difference between 10% and 15% teak seed extracts in percentage reduction in population of *Clavigralla tomentosicollis* .

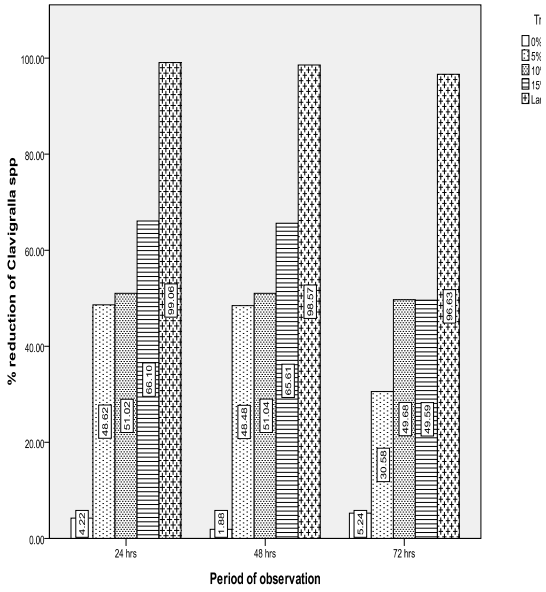

Fig 6: Percentage reduction of Clavigralla *tomentocicollis* by teak seeds extracts and insecticide

4. Conclusion and Recommendation

Teak seeds extracts were effective in controlling the insect pests of amaranthus most especially, the coreid bugs, *Clavigralla tomentosicollis*, grass hoppers, *Zonocerus variegatus* and the green stink bug, *Nezara viridula.* The teak seed extract applied at 15% was most effective in reducing the insect pests. The effectiveness of the extract was not as much as the conventional insecticide used in the experiment. Further work is recommended as the high doses of the extracts were found to be phytotoxic.

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