Comparative Magnitude Of *Eucalyptus Grandis* And *Grevillia Robusta* (Untreated Woodblocks) Attack By Subterranean Termites.

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ABSTRACT

This study was conducted to investigate the response of two globally widespread exotic trees *Eucalyptus grandis* and *Grevillea robusta* to natural herbivory by termites. The main objective was to compare the extend by which the two species are attacked by laboratory termites.The research was carried out at the Forest Products Research Centre of the Kenya Forestry Research Institute.The experiments were laid out in a randomised block design carried out in laboratory– with five treatments and six replicates as per the "Protocols for assessment of wood preservatives; A production of the Australian wood preservation committee (2007 revision)".This was an experiment whereby the main target was species used in construction and furniture industry in Kenya; *E. grandis* and *G. robusta*.The mode of treatement of wood blocks involved dip diffusion.The blocks were inspected weekly for visual rating and after four weeks for weight loss techniques in the laboratory test as per the protocol.Categorical variables were summarized as frequencies and its corresponding percentages, while weight loss, the only continuous variable of interest, was positively skewed because of some weighted outlier, therefore it was summarized as median and it's corresponding inter quartile range (IQR).The median weight loss for *Eucalyptus grandis* was 0(IQR: 0-0) grams and its minimum and maximum weight loss was 0 grams and 0.2 grams respectively, while the median weight loss 0(IQR: 0-0) grams for *Grevillea robusta* and its minimum and maximum weight loss was 0 grams and 0.5 grams respectively. From the results the untreated *G. robusta* wood species had more termite attack compared with the untreated *E.grandis* wood. Therefore, *G. Robusta* is highly susceptible to termites attack compared to untreated *E. grandis,* this means there is difference in termites preference and the use of timber instead of woodblocks while carrying out the research is more preferred.

Key words: Comparative, Magnitude, *Eucalyptus grandis*, Grevillia *robusta*, Attack, Subterranean Termites.

INTRODUCTION

Termites are one of the major wood destroying agents in the tropics and with the increasing rate of deforestation. According to Bowyer *et al*., (2003) they discovered that wood products in use throughout the world are subject to infestation by insects. The same authors further

mentioned that of the insects, termites have by far the greatest economic importance. Termites the main pests destroy wood by feeding on its components, thereby reducing its structural ability and appearance therefore reducing its durability. Cellulose being the principal food of termites, wood and wood products such as paper, fabrics and wood structures are avidly consumed, and hence, a constant effort is directed towards their control that is according to Peralta *et al*., 2004. *E. Grandis* and *G. robusta* are both widely used in construction and furniture tree species in Kenya. It is used for electricity poles, fence posts and roof trusses.

MATERIALS AND METHODS

Description of Study Site
The research was carried out at the Forest Products Research Centre of the Kenya Forestry Research Institute.

Experimental Design

The experimental research was carried out in September, 2014.The experiments were laid out in a randomised block design carried out in laboratory– with five treatments and six replicates. Testing was carried out on Fipronyl at the rate of 200g/l and Termidor by following the "Protocols for assessment of wood preservatives; A production of the Australian wood preservation committee (2007 revision)".This was a wood preservation experiment whereby the main target was to use timber used in building; *E. grandis* and *G. robusta.*

Study Sample

E. grandis was tested against *G. robusta*. Both species have equal number of treated and untreated wood samples. On treated samples, chemicals were applied in one way that is by dip diffusion, treated wood samples are 48 in numbers not equal to that of intervention that is 12 in number. Both treated and untreated wood samples add up to 60 woodblocks.

Laboratory Experimentation (Protocol)

Procedure

The *E. grandis* and *G. robusta* timber was sawn into cubes of about 1 cm^3 cubes. The cubes were labelled by giving each code number, weighed and recorded. The numbers of wooden

blocks were 60 cubes for both - 30cubes from each species. After that the cubes was subjected into a temperature of 161°C in oven for 24 hours. Then the weight was recorded. Samples were immersed for four days in Fipronyl and *Termidor*. The treatment mode of wood blocks was by dip diffusion. There were done in 6 replicates. After treatments each block was dried by air drying in the shade or the open for four days as outlined in the Protocols for assessment of wood preservatives; A production of the Australian wood preservation committee (2007 revision). Sand was collected, washed and then sterilized in an oven for 24 hours at 161°C. This was put in 27 clear plastic test bottles of 300ml, with each being filled 1/3 full. Thirty millimetres (30ml) of distilled water were sprinkled on to the sand till it was wet and kept for two hours .Then two blocks of the treated and untreated blocks measuring $1cm^3$ were put onto the sand in each of the bottles. Then subterranean termites of the species *natalensis* from a single colony comprising of 360 females and 40 males were introduced according to a procedure adapted from AWPA E1-97 standard (Standard method laboratory for evaluation to determine resistance to subterranean termites, 1997).The test bottles was then kept in an incubator at temperatures between 25-28 °C. Out of treated wood blocks, the samples that were exposed to termites were 6 at each concentration.

Assessment of magnitude termite attack on timber under different treatment attacks

The blocks were inspected weekly for visual rating and after four weeks for weight loss techniques in the laboratory test as per the protocol "Following the Protocols for assessment of wood preservatives; A production of the Australian wood preservation committee (2007 revision)". During each inspection, the blocks were removed, cleaned by scrapping soil or sand off the blocks surface and intensity of termite attack assessed.

Table 1: Shows how the visual ratings for termite attack were rated, depending on magnitude of Timber attack

Description of attack	Rating	Percentage(attack)
Sound	0	(0% attack)
Trace	1	(1-10% attack)
Slight	2	(11-30% attack)
Moderate	3	(31-50% attack)
Severe	4	(51-80 attack)
Fail	5	(81-100% attack)

Data Analysis

Data analysis was performed using STATA version 13 special edition after the data had been entered in Excel package before being exported to STATA software. Categorical variables were summarized as frequencies and its corresponding percentages, while weight loss, the only continuous variable of interest, was positively skewed because of some weighted outlier, therefore it was summarized as median and it's corresponding inter quartile range (IQR).Two-way ANOVA was the only statistical technique which was used to find out if there was any significant difference in weight loss.

RESULTS

There were a total of 60 wood samples whose data from laboratory experiment were included for analysis. This represented 100% evaluation in experimental trial. The number of wood samples in the untreated group 12(20%) were not equal to that of treated group 48(80%). Data on weight loss by treatment captured during laboratory experiment for both overall and group summary statistics like median, minimum, maximum and inter quartile range (IQR) were calculated. The median weight loss for Eucalyptus was 0(IQR: 0-0) grams and its minimum and maximum weight loss was 0 grams and 0.2 grams respectively, while the

median weight loss 0(IQR: 0-0) grams for Grevillia and its minimum and maximum weight loss was 0 grams and 0.5 grams respectively. In the experiment this variable (weight loss) was significant for the grouped factors median and IQR statistics which is a measure of variability in data. Majority of the wood samples in the laboratory test treated with either *Termidor* or Fipronyl did not have their weights changed from the weights after exposure to termites, representing 48(80%).

Evaluation of Timber weight loss stratified by treated and untreated as compared with its total number of samples

Outcome variable	Experiment type	Grouping factor	Freq. (%)	min	max	IQR	Median
Weight loss	Laboratory	Untreated	12(20%)	0.1	0.5	0.2- 0.3	0.2
		Treated	48(80%)	0	0	0-0	0
		overall	60(100%)	0	0.5	0-0	0

Untreated wood samples which were under experimental test in the laboratory and had weight loss of approximately 0.2 grams represented 6(10%), Untreated wood samples which lost their weight approximately to 0.3 grams represented 3(5%), those wood samples which lost weights approximately to 0.1 grams represented 2(3%) and other untreated wood samples 1(2%) lost approximately to 0.5 grams. The median weight loss for untreated and untreated wood samples were different. This mean that untreated woods were less attacked than treated.

Furthermore, the shape of distribution was assessed and was not similar. Also the treated group and the untreated group had different inter quartile ranges, (IQR: 0-0 grams) and (IQR: 0.2-0.3 grams) respectively for the laboratory experiment.
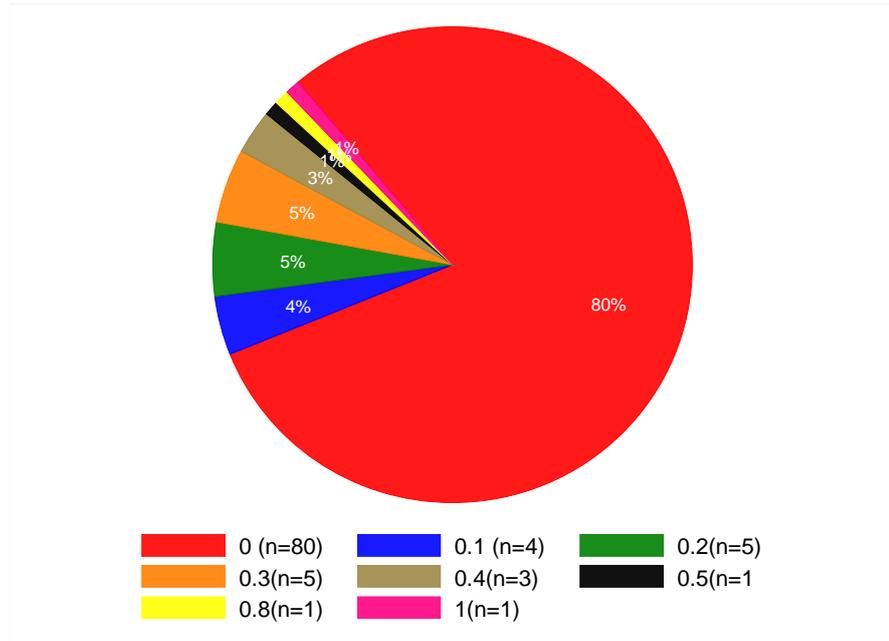
Figure 2: Distribution of wood samples weight loss in grams basing on laboratory experimentation.

Legend (n= numbers of wood samples, decimal units are weights in grams)

The difference in weight loss between control and the treated timbers in the laboratory test indicated that there was a significant difference, p- value (0) with adjusted R-squared value of 39.2% for the explanatory variable. Those treated wood blocks which were not attacked by the termites and ranked visually as sound were 48(80%), those which were attacked by termites slightly during laboratory experimental and ranked as slight were 10(17%), those which were attacked moderately and ranked as moderate was 1(2%) and those which were severely attacked by termites and classified as severe was 1(2%). The test for difference in ranking visually of weight loss findings was significant, p- value (0) in the studies. The results from experiment supports that the difference between the weight loss of the treated and untreated timbers basing on the visual ranking of the timbers after being exposed to termites were present. That was due to the fact that approximately 69% of the explanatory variable (different concentration of treatments) gave enough evidence of no

destruction of timbers by the termites treated with either Fipronyl or termidor.
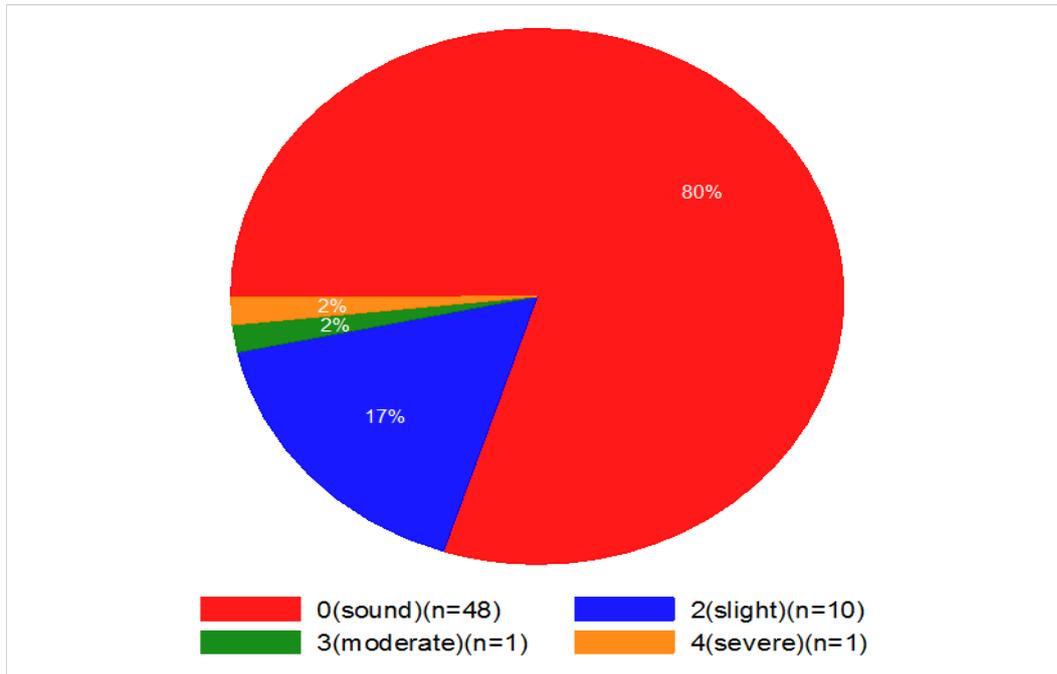
Distribution of timber weight loss during the laboratory experiment categorized by visual ranking

DISCUSSIONS

There was no significant difference [p<] in termite attack on timbers treated with different levels of concentration of either Fipronyl or *Termidor*. This study found out that the untreated timbers had a weight loss of varying values, of 0.2 to 0.5 gm .Termite's prevalence in *G. robusta* and *E. Grandis* was noted to vary. The untreated *G. Robusta* wood species had more termite attack compared with the untreated *E. Grandis* wood. These findings showed that all levels of concentrations for the termiticides were equally effective when applied on timber from the results it is coherent with Nyeko & Olubayo (2005), reported that *Eucalyptus* species are highly susceptible to termites. Only one termite exposed to untreated timber of *E. grandis* and three termites exposed to untreated timber of *G. robusta* survived for 28 days.

Termite galleries were evident after 28 days on untreated blocks. The galleries increased with increase in blocks exposure time. All the untreated samples were attacked in the first month of establishment of the experiment because *G. robusta* and *E. Grandis* is highly susceptible to termite attack and offers no resistance. Any resistance offered would be due to the chemical treatment. It is also agree with Johnson, 2000 who noted that effectiveness of chemicals to control biological attack on wood depends upon the wood, the chemical used and the pests that are present and environmental conditions following treatment towards the end of the month all treated samples irrespective of the chemical used were not attacked because the chemicals offered resistance to the termites.

This is in coherent with what Johnson, (2000) discovered that the effectiveness of chemicals to control biological attack on wood depends upon the chemical used since both chemicals contain different toxicity levels. From the results of this study it is clear that there is sufficient support for significant difference in termite attack between untreated and treated timbers with termiticides basing on visual and weight loss rating of termite's attack, p-value (0) in the laboratory studies. The study found out that the difference was from untreated wood samples which lost their weights after exposure to termites.

 CONCLUSIONS
Termite galleries were evident after 28 days on untreated blocks in laboratory test, which showed that they were attacked. Termites generally did not get in contact with treated block samples .Therefore, there was Significant difference [p<] in termites attack between untreated and treated timbers, these were mainly based on visual and weight loss rating where treated wood block samples was ranked as sound indicating that it was not attacked and untreated wood block samples were ranked slight, moderate, trace and severe to give clear indication of magnitude of attack. It was clear from the results that *G. robusta* were more attacked compared to *E. grandis*. From the results it is clear indication that further exposure time of

wood samples to termites is advisable and field trial is required to give a clear difference in

termite attack on treated and untreated ones.

COMPETING INTERESTS
Authors have declared that no competing interests exist.

REFERENCES
Bowyer, J.L.; Shmulsky, R.; Hay Green, J.G. 2003.*Forest products and wood science: an

introduction*. 4th edition. Iowa state press. USA. 553p.

Peralta, R.C.G.; Menezes, E. B.; Carvalho, A.G.; Aguiar-Menezes, E. L. 2004. Wood

consumption rates of forest species by subterranean termites (isoptera) under field

conditions. *R. Arvore* 28(2):283-289.

Johnson, S.W. 2000. Preservative treated wood in the land - scape. University of Nevada,

RENO.FACT SHEET 95-29.ww.unce.unr.edu/publications/files/ho/other/fs9529.pdf,

(consulted 15/05/2008).[Links]

Nyeko, P.; Olubayo, M.F. 2005.Participatory assessment of farmers' experiences of termite

problems in agro forestry in Tororo district, Uganda. Agricultural research and

extension network AgREN. Network paper

nº.143.www.odi.org.uk/networks/agren/papers/agrenpaper_143.pdf. (consulted

04/09/2008).   [Links]