Comparative Efficacy of Varied Concentrations imidacloprid in the Laboratory Management of Termites *(Microtermes natalensis)*

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ABSTRACT

Imidacloprid is a termiticide that is slow-acting timber and soil applied but can be transferred in termite workers. The objective of this study was to determine efficacy of imidacloprid to control of termites on sand. Termiticides were tested at Imidacloprid 200g/L concentrations (2mL/L, 4mL/L, 6 mL/L and 8m/L) were tested. Descriptive analysis presented the mean weight loss for wood blocks under treated sand as follows *E. grandis* 0.003 (Std: 0.02) and *G. robusta* 0.013 (Std: 0.04) whereby only woodblocks under treated sand with 2mL/L were attacked, while the mean weight loss for untreated woods under untreated sand were as follows *E.grandis* was 0.1 (std: 0.06) and *G. robusta* was 0.216 (std: 0.147).However, termites attacked all untreated wood blocks regardless of wood species. It was concluded that Imidacloprid at concentration of 4 mL/L serves as the best concentration threshold required in the control of termites on sand in the management of termites. It was recommended that soil is effective mode of applying imidacloprid termiticide integratedly given that the right concentration levels are utilized.

Keywords: Comparative; efficacy; concentrations; imidacloprid; management; termites.

1. INTRODUCTION

Termites are an essential member of the soil ecosystem and are found worldwide, They are known for searching foods by tunnelling through soil [1]. Their presence is noticeable in tropical and subtropical regions where they represent a significant portion (10%) of the animal biomass [2]. The natural activities of termites help to improve soil pH, organic carbon content, water content and porosity [3]. By improving and adjusting these soil parameters termites assist in creating conditions conducive to primary production, in this process they cause considerable losses to crops, trees and wooden work in buildings [4].In addition, foraging behavior is influenced by numerous factors such as humidity, soil texture, moisture availability, soil compaction and preformed tunnel cavities [5]. Termites are defined as serious pests which cost millions of dollars in annual control [6]. The use of chemical insecticides for soil and crop treatments has been continuously allowed for the present time due to the lack of any effective substitute [7].

Soil termiticides are used to treat soil to establish a toxic zone against termite penetration [8]. Termites remain alive for days on imidacloprid-treated sand and if termites are removed from the treatment, are able to recover. [9] Reported that, *Macrotemes* spp. are the one cause's serious damage to buildings, agricultural crops and trees.

2. MATERIALS AND METHODS

2.1 Description of Study Site

The research was carried out at the Forest Products Research Centre of the Kenya Forestry Research Institute (KEFRI) located at Karura Forest, Nairobi.

2.2 Experimental Design

The experiment was carried out in Aug 2017.The experiment was laid out in a Randomised Block design carried out in the laboratory with five treatments and three replicates. Testing was carried out using imidacloprid at the mass concentration of 200 g/L and fipronil 25 g/L with the latter being the experimental standard. The Protocols for Assessment of Wood Preservatives; A production of the Australian Wood Preservation Committee (AWPC) (2007 revised) was used. The test species used were *Eucalyptus grandis* and *Grevillea robusta.* The treatments using imidacloprid at 200 g/L mass concentrations were carried out at four concentrations (2 mL/L, 4 mL/L, 6 mL/L and 8mL /L) and fipronil 25 g/L mass concentration was carried out at 10 mL/L.

2.3 Laboratory Test

The *E .grandis* and *G. robusta*, timber were 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 72cubes. After that the cubes were subjected into a temperature of 161°Cin oven for 24 h. Then the weights were recorded. Sand were treated with imidacloprid 200 g/l with concentrations of 2mL/L, 4mL/L, 6mL/L and 8 mL/L, Fipronil 25 g/L concentration of 10 mL/L whereby the sand were treated with twenty millitres, at 3 cm radius. Untreated sand serves as control.Untreated wood blocks measuring 1 cm^3 were put onto the treated sand in each of the bottles. Then, subterranean termites (*Microtermes 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 were then kept in an incubator at temperatures between 25-28 °C for one month .Out of untreated wood blocks, the samples that were exposed to termites were 3 at each concentration.

2.4Data Analysis

Descriptive statistics for measures of central tendency such as mean and standard deviation was used in summarizing continuous variables which assume normality distribution. Data analysis was performed using special statistical software called STATA version 13. Pearson's Chi-square test was performed to compare proportions between factors. The results were reported in tables and figures.

3. Results

A total of 72 (100%) woods categorized into two equal numbers of wood species, each assuming 36 (50%) proportion, All wood blocks were proportionally divided into six groups where 60 (83%) different woods species were tested on treated sand under five different levels of concentrations and the remaining 12(16.7%) different woods species tested under untreated sand were regarded as control group. All those woods were factored out into three identified replicates that is, S1, S2, and S3, whereby each replicate had captured a total of 24 (33.33%) wood blocks (Table 1).

Table 1: Displays the distributions of various characteristics studied.

Characteristic studied		Sample (%)
Wood replicates	S1	24(33.33%)
	S2	24(33.33%)
	S3	24(33.33%)
	Total	72(100%)
sand treatments	T1 or 2 mL/L	12(16.67%)
	T2	12(16.67%)
	T3	12(16.67%)
	T4	12(16.67%)
	T5	12(16.67%)
	T6 or control group	12(16.67%)
	Total	72(100%)

Descriptive analysis presented the mean weight loss for wood blocks under treated sand as follows *E. grandis* 0.003 (Std: 0.02) and *G. robusta* 0.013 (Std: 0.04), whereby only woodblocks under treated sand with 2mL/L were slightly attacked while the mean weight loss for untreated woods under untreated sand were as follows *E.grandis* was 0.1 (std: 0.06) and *G. robusta* was 0.216 (std: 0.147). There was significant evidence to suggest that at least one of the treatment concentrations which had been used to control termites from woods block attack was different from the responsiveness of other treatment. From that it was noted that at least one of untreated wood under treated sand had been slightly attacked by *M. natalensis* termites (P = 0.0308). But when the adjustment of replicates was applied then the results changed to be insignificant (P = 0.6325) (table 2).

Table 2: Summary statistics on weight loss of wood species exposed to *M. natalensis* termites.

Wood species	Mean	Std	Sample	*P*-value
Treated *E.grandis*	0.003	0.02	30	0.0308
Treated *G. robusta*	0.013	0.04	30	
Control *E.grandis*	0.1	0.06	6	
Control *G. robusta*	0.216	0.147	6	

From the results above wood blocks treated with 2mL/L of imidacloprid were slightly attacked but the one treated with 4mL/L and above were not attacked.

4. DISCUSSION

Due to their foraging behaviour, subterranean termites can be able to reach and attack buildings from their nest underground [10].Despite recent advances in the treatment of woods against subterranean termites by using bait technologies more destroyed woods and greater deforestation was found to prevail, a problem which enforced the researcher in this study to exploit other methods of treatment application on woods. Furthermore, this research investigated on an appropriated concentration threshold to apply during control of termites. An effective concentration threshold was found to be 4 mills per liter (4 mL/L) when imidacloprid was applied.

In this study it was found that sand were effective in controlling *Microtermes natalensis* from destroying wood an information which contrasts the use of bait technologies as suggested in [11-12]. Finding in this study seems to support an earlier study which found that termite control largely depends on the use of soil termiticides for the prevention and treatment of structural infestations [13]. In this study it was found that 2 mL/L, Imidacloprid were less ineffective to termites but the cheapest and effective concentration level to all termites in hindering their destructive effort was 4 mL/L. This was equally confirmed in the study [14] which stated that it is good idea to apply an appropriate concentration of a termiticide to achieve a wide coverage, too high concentration may kill termites faster than expected while at lower concentration may not supply a sufficient dose for contaminated termites to transfer a lethal dose to unexposed termites. This study agree with convectional theory, which states that Imidacloprid is both non-repellent and slow acting, and is transferred among workers in vitro. Therefore, Imidacloprid needs to be applied prior to wood attack by termites with the correct level of concentration.

5. CONCLUSIONS

In laboratory test, imidacloprid at concentration rate of 2 mL/L were ineffective in the control of M. *natalensis.* There was insignificant difference in weight loss among timbers treated with different concentration level of imidacloprid at the rate of 200g/L, although the *E.grandis* timbers treated with a concentration level of 2 mills per litre of water were destroyed by termites. Imidacloprid at concentration of 4 mL/L serves as the best concentration threshold required in the control of M. *natalensis* termites treated sand in the laboratory management of termites. However, termites attacked all untreated wood blocks regardless of wood species. Soil was found to be the most effective mode of application in the control of *M. natalensis* termites.

6. RECOMMENDATION

In this research it was suggested that the best concentration threshold to be used to control and even prevent any termites from destroying woods was 4 mL/L of imidacloprid, That level of concentration was found to the cheapest and more effective, hence stops termites from destroying woodblocks this can be achieved so long as recommended concentrations threshold would be applied. It was also discovered that 4 mL/L were the best concentration threshold required to prevent and control *M. natalensis,* on treated sand in the laboratory management of termites.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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