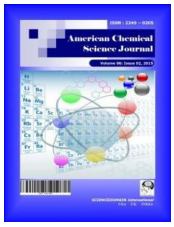

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Efficacy of Varied Concentrations of Fipronyl 200 G/L in the Graveyard (Field Trial Test) Control of Termites

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Authors' contributions

This work was carried out in collaboration between all authors. Author RG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors JJK, JJC, RWN, NO and SM managed the analyses of the study. Authors RG and JJK managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Fipronyl is chemical formulations of phenyl pyrazole insecticide acting on the chloride channel of nervous system of insects to hinder chloride metabolism of γ- amino butyric acid of insect's nervous system. It has good control against *Microtermes nataensis* from attacking buildings. This study evaluated the efficacy of Termidor and Fipronyl 200 g/l commercial formulations at various treatment concentrations on treated timber. Termidor was the experimental standard. The experiments was laid out in a Randomised Block Design carried out in the graveyard with 100 samples, five treatments and ten replicates. Both termicides were tested at Fipronyl 200 g/l concentrations (2 ml/l, 4 ml/l and 6 ml/l) and Termidor under concentration of (10 ml/l). This showed that 2 ml/l, 4 ml/l and 6 ml/l levels of concentrations for Fipronyl or termidor (10 ml/l) have equal impact on termites since there was no significant difference in weight loss in the treated timbers

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compared with untreated timbers that had weight loss. Fipronyl treatment is effective at different concentration. This was determined by assessing the magnitude of timber attack by subterranean termites under different treatment regimes. It is advisable for the user to use Fipronyl 200 g/l at medium concentration this is because 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. Appropriate concentration of a termiticides should be applied to achieve a wide coverage.

Keywords: Efficacy; fipronyl 200 g/l; controlling; termites; graveyard.

1. INTRODUCTION

The Formosan subterranean termite are social insects living in colonies, *Coptotermes formosanus* Shiraki (Isoptera: Rhinotermitidae), is one of the most economically important termite pests and with a widespread global distribution [1,2]. It was established that *Coptotermes formosanus* Shiraki, is the most damaging species [3]. The termite species *macrotemes nataensis* which is widely distributed in Kenya with an extraordinary economic importance, intensive research has been centered on two main methods for subterranean termite control, based on bait technologies and liquid termiticides, have been widely used [4]. According to [5,6] they established that, There is growing evidence that at least some non-repellent termiticides can be transferred among individuals within colonies. However, it was established by [7,8], that termite baits have some obvious advantages in long-term termite control and structural protection for its low chemical expense and environmental friendliness but soil treatment with termiticides remains popular in termite control [9-11]. It was reported by [12] that phenyl pyrazole is chemical that interferes with the function of the central nervous system .It was discovered that, fipronil have activity on termite colonies beyond the immediate zone of treated soil [13-16], therefore it leads to colony elimination. The main objective of this research is to evaluate the efficacy varied concentrations of Fipronyl 200 g/l in the graveyard control of termites when compared to Termidor. Termidor is experimental standard. The severity of the risk posed to termites by Fipronyl 200 g/l and Termidor is primarily dependent upon the insecticide applied and their exposure to it and its residues. Fipronyl is an insecticide that blocks the g-Amino Butyric Acid (GABA)-gated chloride channel of insect nervous systems, it is a highly effective, broad-spectrum insecticide which degrades slowly and has a degradation product more toxic and persistent than the parent compound. Therefore, it is effective insecticides to control termites hence it helps in preventing economic loss due to the damage to timber in both developed and developing countries.

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.

2.2 Experimental Design

The experimental research was carried out in between September 2014 and July 2015. The experiments were laid out in Randomised Block Design carried out with five treatments, ten replicates and one hundred samples. Testing was carried out on Fipronyl at the mass concentration of 200 g/l and Termidor with the latter being the experimental standard, the treated wood samples and controls was set up in a grave yard. The Protocols for assessment of wood preservatives; A production of the Australian Wood Preservation Committee (AWPC) (2007) was used. This was a Wood preservation experiment with the main aim of treating timber commonly used in the construction and furniture industry in Kenya. *Eucalyptus grandis* and *Grevillea robusta*. The treatments using Fipronyl at 200 g/l mass concentrations were carried out at three concentrations (2 ml/l, 4 ml/l and 6 ml/l). The Termidor mass concentration was carried at 10 ml/l concentrations.

2.3 Study Sample

The test chemical, Fipronyl 200g/l was tested at three concentrations – 2 ml/l, 4 ml/l and 6 ml/l. Fipronyl 200 g/l was tested against an approved and registered chemical Termidor that have concentration of 10 ml/l. The field experiment had control samples. Graveyard trial was carried

out by using *Eucalyptus grandis* and *Grevillea robusta* commonly used as timbers. These chemicals were applied in dip diffusion.

2.4 Experimentation Design

Wood samples *Eucalyptus grandis* and *Grevillea robusta* samples of size 4 by 2 inches were measured from the market, then sawn into 1metre length and their weights were recorded. Labelling was done by assigning each a code. The samples were immersed for four days in Fipronyl 200 g/l with concentrations of 2 ml/l, 4 ml/l and 6 ml/l, termidor concentration of 10 ml/l. Some samples were kept to serve as controls. After four days the samples were removed and the weights were measured and recorded. The colour changed from golden brown to black on *Eucalyptus grandis* and no colour change in *Grevillea robusta* when treated with termidor. Slight change of colour to black but others no change of colour on *Grevillea robusta* when treated with Fipronyl 200 g/l. The colour changed from golden brown to black on *Eucalyptus grandis.*

2.5 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 difference in weight loss given that different concentration of treatments were applied using different modes of application in the field trial test. Results were presented in form of tables and graphs.

3. RESULTS

3.1 Magnitude of Termites Attack on Treated and Untreated Timbers

There were a total of 100 timbers whose data analysis represented 100% evaluation in experimental trial. The number of timbers in the control group were 20(20%) were not equal to that of intervention 80(80%). Data on weight loss by treatment captured during graveyard trial experiments for both overall and group summary statistics like median, minimum, maximum and Inter Quartile Range (IQR) were calculated. The median weight loss value for Eucalyptus timbers was 0(IQR: 0-0) kilograms and its respective minimum and maximum weight loss were 0 kilogram and 1 kilogram, and for Grevillea timbers had a median 0(IQR:0-0) and its minimum value of 0 kilogram and a maximum value 0.9 kilogram. 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 timbers in the grave yard trial test treated with either Termidor or Fipronyl 200 g/l did not have their weights changed after exposure to termites, representing 80 (80%). This showed that the treatment was so highly effective that it suppressed the termites from finding the foods and for those termites which probed to eat the timber were completely killed by both Fipronyl and termidor. Control timbers had a weight loss of approximately 0.1 were 4(4%), those with a weight loss of 0.2 represented 5(5%), with 0.3 kilograms loss in weight were 5(5%), with 0.4 kilograms change from initial weight before exposure to termites were 3(3%) while all those which had a weight loss of 0.5, 0.8 and 1 kilograms represented a total of 1(1%). The median weight loss for controls and interaction timber were different. Furthermore, the shape of distribution was assessed and was not similar. Also the treated group and the control group had different inter quartile ranges, in graveyard trial test treated group had IQR: 0-0 kilograms while the control group had (IQR: 0.1-0.4 kilograms).

Different concentration of treatments applied to timbers was coded as T1, T2, T3, and T4 and the only control allotment was coded as T5. All timbers that were subjected to different concentration of treatment and showed no change in their weight were in 80(80%), while timbers that were under control (T5) and were attacked by the termites showed different weight loss of (0.1, 0.2, 0.3, 0.4, 0.5, 0.8 and 1) kilograms being in total 80(80%) under field trial test. The difference in weight loss between control and treated timbers indicated that there was significance difference, p- value (0) and adjusted R-squared value (30.91%) of explanatory variable explaining the effect of treatment on termites among 100 timbers. shows how effective the treatment (Fipronyl 200 g/l or termidor) were in preventing termites from destroying timber.

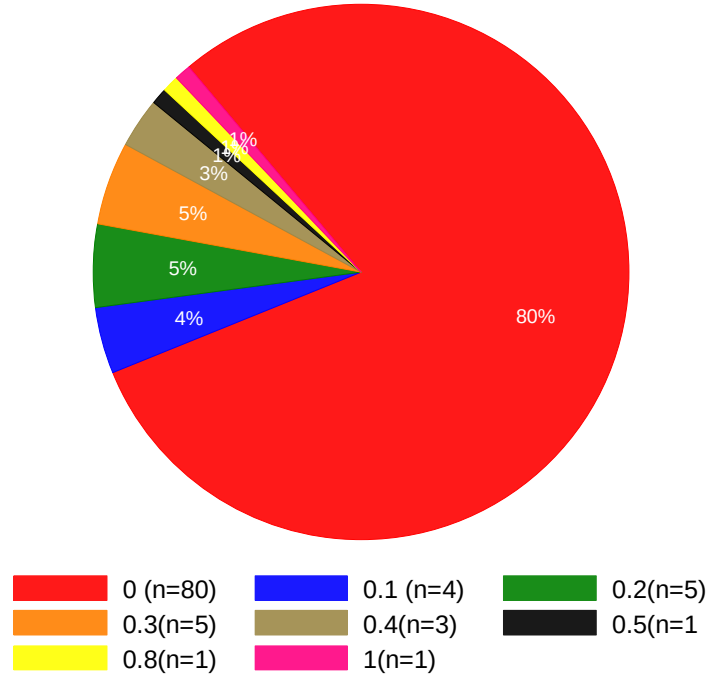

Fig. 1. Distribution of timbers by weight loss in the field trials
(n= numbers of pieces, decimal units are weights)

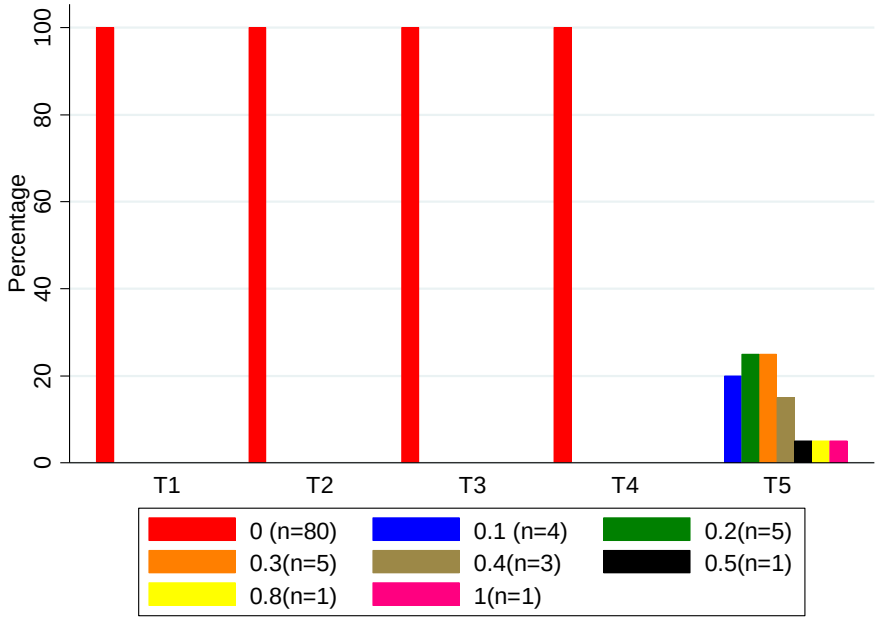

Fig. 2. Distribution of weight loss by treatment during field trial experiment

4. DISCUSSION

There was no difference in termite attack on timbers treated with different levels of concentration of either Fipronyl or termidor, the standard product. This study found out those different levels of concentrations of 2, 4 and 6 ml for Fipronyl 200 g/l or Termidor (10 ml) have equal impact on termites since there was no difference in weight loss in the treated timbers. The results from experiment supported the fact that Fipronyl and termidor were more effective in

controlling termites at different rates. These findings showed that all levels of concentrations for the termiticides were equally effective when applied on timber. These findings are coherent with [17] who suggested that intake of these fluids facilitates the transmission of toxic compounds. It also agrees with [18] who suggested that non-repellent compounds circumvent the difficult task of creating a continuous chemical barrier around a structure to exclude termites. This study analyses the quality of samples based on the two types of treatments (Fipronyl and termidor). From the results of this study showed that there is sufficient support for significant difference in termites attack between untreated and treated timbers with termiticides basing on weight loss rating of termite's attack, p-value (0). The study established that the difference was from untreated timbers which lost their weights after exposure to termites. Therefore, Fipronyl is highly effective against a variety of termites. It disagrees with [19] who found that fipronil did not meet the criteria for liquid termiticides baits. Result from this study show that Fipronyl treatment was as effective as termidor treatment on timbers which is consistent with [20] which showed that termiticides transfer, or the movement of delayed action non-repellent termiticides from exposed termites to naive nest mates, has been the subject of much research over the past decade.

5. CONCLUSIONS

Termite galleries were evident after 10 months on untreated timber in graveyard trial test, which showed that they were attacked. Termites generally did not get in touch with treated timbers. Therefore, Fipronyl 200 g/l is an effective termicides used at concentration rates of 2, 4 and 6 ml/l and termidor (10 ml) too which is the experimental standard. Significant differences in termites attack between untreated and treated timbers with termiticides were based on weight loss.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Henderson G. The termite menace in New Orleans: Did they cause the floodwalls to tumble? Am. Entomology. 2008;54:156-162.
2. Rust MK, Su NY. Managing social insects of urban importance. Annu. Rev. Entomol. 2012;57:355-375.
3. Song D, Hu XP. Effects of dose, donor-recipient interaction time and ratio on fipronil transmission among the Formosan subterranean termite nestmates (Isoptera: Rhinotermitidae). *Sociobiology*. 2006; 48(1):237-246.
4. Gautam BK, Henderson G, Davis RW. Toxicity and horizontal transfer of 30.5% fipronil dust against Formosan subterranean termites. Journal of economic. 2012;105(5):1766-1772.
5. Haagsma KA, Rust MK. The effect of imidacloprid on mortality, activity and horizontal transfer in the western subterranean termite (Isoptera: Rhinotermitidae). Sociobiology. 2007;50: 1127-1148.
6. Saran RK, Rust MK. Toxicity, uptake and transfer efficiency of fipronil in western subterranean termite (Isoptera: Rhinotermitidae). Journal of Economic Entomology. 2007;100:495-508.
7. Thoms EM, Eger JE, Messenger MT, Vargo E, Cabrera B, Riegel C, Murphree S, Mauldin J, Cherer P. Bugs, baits and bureaucracy: Completing the first termite bait efficacy trials (Quarterly replenishment of noviflumuron) initiated after adoption of Florida rule. Am. Entomol. 2009;55:29-39.
8. Liu JM, Wei G, Huang QC, Yang F, Liu Zh.-Sh, Qin TQ. Current status and prospects of bait for termites. J. Anhui. Agric. Sci. 2011;39:14666-14667.
9. Anonymous. State of the industry 2002. Pest Contr. 2002;70:S1-S23.
10. Su NY. Novel technologies for subterranean termite control. Sociobiology. 2002;40:95-101.
11. Su NY, Ban PM, RH. Scheffrahn. Polyethylene barrier impregnated with lambda-cyhalothrin for exclusion of subterranean termites (Isoptera: Rhinotermitidae) from Structures. Journal of Economic Entomology. 2004;97(2): 570-574.
12. Cole LM, Nicholson RA, Casida JE. Action of phenylpyrazole insecticides at the

GABA-gated chloride channel. Pesticide Biochemistry Physiology. 1993;46:47-54.

13. Potter MF, Hillery AE. Exterior-targeted liquid termiticides: An alternative approach to managing subterranean termites (Isoptera: Rhinotermitidae) in buildings. Sociobiology. 2002;39:373-405.
14. Osbrink WL, Lax AR. Effect of imidacloprid tree treatments on the occurrence of Formosan subterranean termites, *Coptotermes formosanus* Shiraki; 2003.
15. Ripa R, Luppichini P, Su NY, Rust MK. Field evaluation of potential control strategies against the invasive eastern subterranean termite (Isoptera: Rhinotermitidae) in Chile. Journal of Economic Entomology. 2007;100:1391-1399.
16. Parman V, Vargo EL. Colony-level effects of imidacloprid in subterranean termites (Isoptera: Rhinotermitidae). Journal of Economic Entomology. 2010;103:791-798.
17. Bagneres AG, Pichon A, Hope J, Davis RW, Clement JL. Contact versus feeding intoxication by fipronil in *Reticulitermes* termites (Isoptera: Rhinotermitidae): Laboratory evaluation of toxicity, uptake, clearance, and transfer among individuals. Journal of Economic Entomology. 2009; 102:347-356.
18. Hu XP, Hickman B. Exterior perimeter plus limited interior treatments with fipronil as an IPM option for subterranean termite management. International Pest Control. 2006;48:200-203.
19. Su NY. Directional change in tunneling of subterranean termites (Isoptera: Rhinotermitidae) in response to decayed wood attractants. Journal of Economic Entomology. 2005;98:471-475.
20. Gautam BK, Henderson G. Effect of soil type and exposure duration on 9 mortality and transfer of chlorantraniliprole and fipronil on Formosan 99 subterranean termites (Isoptera: Rhinotermitidae). Journal of Economic Entomology. 2011; 104(6):2025-2030.

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