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Comparative Efficacy of Varied Concentrations Fipronyl in Termites control on treated sand.

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ABSTRACT

Fipronyl are chemical formulations of phenyl pyrozole insecticide that act on the chloride channel of nervous system of insects to hinder chloride metabolism of γ- amino butyric acid of insect's nervous system.Abnormal behaviours of fipronil treated termites were similar; incipient intoxication, followed by ataxia, and lack of ability to walk leading to death.These termites are responsible for damage to timber in agricultural and urban areas. Fipronyl is highly effective, broad-spectrum insecticide which degrades slowly and has a degradation product more toxic and persistent than the parent compound; it is effective insecticides to control termites. The experiment was laid out in Randomized Block Design carried out on Field trial with five treatments and ten replicates. Both termiticides were tested at Fipronyl 200g/l concentrations (2ml/l, 4ml/l and 6ml/l) and Fipronil 25g/l under concentration of (10ml/l).This study found out that Fipronyl 200g/l or Fipronil 25g/l have equal impact on termites since there was no difference in weight loss in *Eucalyptus grandis* and *Grevillea robusta* timber on the treated sand. Termites generally did not get in touch with timbers on treated sand. Therefore it gives a reasonable conclusion that Fipronyl and Fipronil 25g/l are effective termiticides. It was suggested that Treatment standards for soil treatment require a complete drench around the foundation of the structure and around pipes penetrating the slab to ensure that all potential areas of termite entry are protected from attacking the buildings.

Keywords: Comparative, Efficacy, Concentrations, Fipronyl, Termites control, treated sand.

INTRODUCTION

Despite recent advances in the treatment of subterranean termites by using bait technologies Two main methods for subterranean termite control, based on bait technologies and liquid termiticides, have been widely used (Gautam and Henderson 2012, Rust and Su 2012) Termite control largely depends on the use of soil termiticides for the prevention and treatment of structural infestations (Gahlhoff & Koehler 2001). Soil termiticides are used to treat soil to establish a toxic zone against termite penetration (Saran & Rust, 2007). (Hu *et al*.

2005) established that the non-repellent quality of these fipronil allow termites to freely tunnel into treated soil and facilitate transfer between contaminated foraging termites to naive nest mates through social interactions such as trophallaxis, grooming and care-giving activities, resulting in so-called behaviour-based termite control . However, soil treatment with termiticides remains popular in termite control (Anonymous 2002, Su 2002,Su *et al.* 2004). It is good idea to apply an appropriate concentration of a termiticides 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 (Thorne & Breisch, 2001; Ibrahim *et al*., 2003; Shelton & Grace, 2003; Hu, 2005; Remmen & Su, 2005; Su, 2005; Rust & Saran, 2006; Saran & Rust, 2007; Gautam& Henderson, 2011b; Hu, 2011). However, fipronil has been reported to be highly toxic to other non-target and beneficial organisms (Hodgson and Rose 2007) suggested that several studies have linked this pesticide to human health issues. This may mitigate against the pesticide. Fipronil has also been reported to have a delayed action that allows the contaminated termites to maintain normal behaviours for an extended period so as to be able to transfer its lethal effects to those unexposed colony mates through social interactions and thus cause secondary mortality in termites (Osbrink & Lax 2002, Ibrahim *et al.* 2003, Shleton & Grace 2003, Remmen & Su 2005a)

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 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 200g/l and Termidor with the latter being the experimental standard, the untreated wood samples on treated sand and untreated wood samples on untreated sand serving as controls was set up. 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 sand commonly used in the construction Kenya. *Eucalyptus grandis* and *Grevillea robusta* are used for this experiment.The treatments using Fipronyl at 200g/l mass concentrations were carried out at

three concentrations (2ml/l, 4ml/l and 6ml/l).The Fipronil 25g/l mass concentration was carried at 10 ml/l concentrations.

Study Sample

The test chemical, Fipronyl 200g/l was tested at three concentrations – 2ml/l, 4ml/l and 6ml/l. Fipronyl 200g/l was tested against an approved and registered chemical Fipronil 25g/l that have concentration of 10ml/l. The field experiment was carried out by using *Eucalyptus grandis* and *Grevillea robusta* commonly used as timbers. These chemicals were applied on sand in soil drenching.

Experimentation Design(protocol)

Field soil mixing

This field soil mixing experimentation was carried out under graveyard trial test mainly for one objective that was to determine the efficacy of Fipronil 25g/l and Fipronyl 200g/l at various treatment concentrations on treated sand. 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.Holes of 20cm length were dug then the different solutions was bored in 2 litres of solution after which the samples were placed in the hole and the sample was protected all round with plastic pipe of 30cm length.As per Following the Protocols for assessment of wood preservatives; A Production of the Australian wood preservation committee (2007 revision) .

Data Analysis

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 soil drenching in the field trial test . Results were presented in form of tables.

RESULTS

Magnitude of termite's attack on timber under treated and untreated sand ,

This was to evaluate efficacy of Fipronil 25g/l and Fipronyl 200g/l commercial formulations at various treatment concentrations under treated and untreated sand. Whereby there were a total of 100timbers whose data from the experiment respectively was included for analysis this represented 100% evaluation. The number of timbers in the control group 20(20%) were not equal to that of intervention 80(80%). Data on weight loss by treatment captured during experiment for both overall and group summary statistics like median, minimum, maximum and inter quartile range (IQR) were presented in Table1.The median weight loss value for Eucalyptus timbers was 0(IQR: 0-0) kilograms and its respective minimum and maximum weight loss were 0.1 kilogram and 1kilogram, and for Gravellier timbers had a median 0(IQR:0-0) and its minimum value of 0 gram 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 was under sand treated with either Fipronil 25g/l or Fipronyl did not have their weights changed from the weights after exposure to termites, representing 80(80%). This showed that the treatment was so highly effective that it suppressed the termites from attacking untreated timber under treated sand and for those termites which probed to eat the timber were completely killed by both Fipronyl and Fipronil 25g/l. Under sand treatment each concentration of treatmentT1, or T2, or T3, or T4 and the control group T5 were allotted equal number of timbers, 10 pieces of timbers, from each species (Eucalyptus and Gravellier). For all the 50(50%) Eucalyptus timbers used in the experiment, each different treatment T1, or T2, or T3, or T4 and the control group T5, were allotted or subjected 10 timbers. Similarly, 10 timbers of Gravellier timber 50(50%) were under different treatment T1, or T2, or T3, or T4 and the control group T5 .When mode of application is only on sand the effect of Fipronyl or Fipronil 25g/l on termites is exactly the same as dip diffusion. Generally, Weight loss, the only variable of interest in field study had median value 0(IQR: 0-0) and specifically, control group had minimum (0.1) and maximum value (1). It was clear from the results, that there was significant difference between timbers monitored under treated sand and those which were under control within the same field of study, p- value (0) with adj. R-squared value of 27.54% for the treatment which was an explanatory variable. That suggested a clear evident of the working effect of Fipronyl or Fipronil 25g/l.

Table1: Findings of weight loss stratified by treatment and control group as compared with its overall.

Outcome Variable	**Experiment type**	**Grouping factor**	**Freq(%)**	**min**	**max**	**IQR**	**median**
Weight loss		**control**	**20(20%)**	**0.1**	**1**	**0-0**	**0**
		Treated sand	**80(80%)**	**0**	**0**	**0-0**	**0**
		overall	**100(100%)**	**0.1**	**1**	**0-0**	**0**

Table 2: Distribution of timbers by species and treatments applied under soil mixing experiment.

Type of experiment	Treatments						
	species	*TI*	*T2*	*T3*	*T4*	*T5*	*TOTAL(%)*
Sand treatment	*EU*	*10*	*10*	*10*	*10*	*10*	*50(50%)*
	GR	*10*	*10*	*10*	*10*	*10*	*50(50%)*

T1-Standard recommended dosage **T2-** Higher dosage **T3-** Lower dosage **T4**-Termidor and **T5**- Control. **EU**-*Eucalyptus grandis* and **GR**- *Grevellia robusta*

DISCUSSION

There was no difference in termite attack on untreated timbers under treated sand with different levels of concentration of either Fipronyl or Fipronil 25g/l, the standard product. This study found out those different levels of concentrations of 2, 4 and 6 ml/l for Fipronyl or Fipronil 25g/l (10 ml/l) have equal impact on termites since there was no difference in weight loss in the untreated timber under treated sand. The untreated timbers under untreated sand had a weight loss of varying values, of 0.1kg to 1kg. Similarly, the results from the experiment supported the fact that Fipronyl and Fipronil 25g/l were more effective in controlling termites at different rates on treated sand, a recent field study carried out by the Author in Kibwezi (2014-2015); the median weight loss for the untreated timbers under

treated sand was 0 kilograms while the control group varied from 0.1-1 kilograms. These findings are coherent with Saran and Rust, (2007) who reported that Soil termiticides are used to treat soil to establish a toxic zone against termite penetration. It also agrees with Osbrink & Lax (2002), Ibrahim *et al.*(2003), Shleton & Grace (2003), Remmen & Su (2005a) that have reported that Fipronil has also been reported to have a delayed action that allows the contaminated termites to maintain normal behaviours for an extended period so as to be able to transfer its lethal effects to those unexposed colony mates through social interactions and thus cause secondary mortality in termites. Although the use of Fipronil 25g/l termiticides still remains a challenge in many developing countries like in Kenya because lack of information, Fipronyl as an alternative could still be used for termites control with fairly accurate results in areas where Fipronil 25g/l is not readily available or have environmental effects. A problem where concerns have been voiced about its environmental and human health effects was found out in the study by (Hodgson and Rose 2007).

This study analyses the quality of samples based on the two types of termicides treatments (Fipronyl and Fipronil 25g/l) used during the study unlike Gautam and Henderson (2012) study which show that only termite baits were used to protect timbers was more effective but they reported that termite baits have some obvious advantages in long-term termite control and structural protection for its low chemical expense and environmental friendliness. From the results of this study it is clear that there is sufficient support for significant difference in termites attack between untreated timber under treated and untreated sand with termiticides basing on visual and weight loss rating of termite's attack, p-value (0). The study found out that the difference was from untreated timbers under untreated sand which lost their weights after exposure to termites. Therefore Fipronyl is highly effective against a variety of termites. It disagrees with Su (2005) who found that fipronil did not meet the criteria for liquid termiticides baits. Result from this study shows that Fipronyl treatment was effective just as Fipronil 25g/l treatment on sand which is consistent with Hu (2005) who demonstrated in laboratory studies that fipronil does not repel termites from either tunnelling into treated soil or remaining in contact with the treated soil long enough to acquire lethal doses .

CONCLUSION

Termite galleries were evident after 10 months on untreated timber under untreated sand, which showed that they were attacked hence it enable us to conclude that There is difference in termite attack on treated and untreated sand with different concentrations of tested termicides. Termites generally did not get in touch with timbers on treated sand. Therefore it

gives a reasonable conclusion that Fipronyl are effective soil termicides at the rates of 2, 4 and 6 ml/l which were as good as Fipronil 25g/l, the experimental standard.

RECOMMENDATIONS

Further exposure time of wood samples to termites is advisable to give a clear evaluation on the efficacy of Fipronil 25g/l and Fipronyl 200g/l commercial formulations at various treatment concentrations on treated sand. It was suggested that Treatment standards for soil treatment require a complete drench around the foundation of the structure and around pipes penetrating the slab to ensure that all potential areas of termite entry are protected from attacking the building. 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 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. So it is good idea to apply an appropriate concentration of a termiticides to achieve a wide coverage.

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REFERENCE

Anonymous 2002. State of the industry 2002. Pest Contr. 70: S1-S23.

Gahlgoff, J.E.J. & Koehler, P.G. (2001) 'Penetration of the eastern subterranean termite into soil treated at barious thicknesses and concertrations of Dursban TC and Prmis 75'. *J Econ Entomol* 94 pp. 486-491.

Gautam, B. K., G. Henderson, and R. W. Davis. 2012. Toxicity and horizontal transfer of 0.5% fipronil dust against Formosan subterranean termites. J. Econ. Entomol. 105:1766-1772

Gautam, B. K., and G. Henderson. 2012. Escape behavior of the Formosan subterranean termite (Isoptera: Rhinotermitidae) in response to disturbance. J. Insect Behav. 25:70-79

Gautam, B. K., and Henderson, G. (2011). Effect of soil type and exposure duration on mortality and transfer of chlorantraniliprole and fipronil on Formosan 99subterranean

termites (Isoptera: Rhinotermitidae). *Journal of economic entomology*, *104*(6), 2025-2030.

Hodgson, E., and R. L. Rose. 2007. Human metabolic interactions of environmental chemicals. J. Biochem. Mol.Toxicol. 21: 182-186.

Hu, X. P. 2005. Evaluation of the efficacy and non-repellency of indoxacarb and fipronil treated soil at various concentrations and thicknesses against two subterranean termites (Isoptera: Rhinotermitidae). J. Econ. Entomol. 98: 509-517

Hu, X. P. 2011. Liquid termiticide: their role in subterranean termite management, pp. 114-132. In P. Dhang (ed.), Urban Pest management: An Environmental Perspective. CAB International, Oxfordshire, United Kingdom.

Ibrahim, S.A., G. Henderson, & H. Fei 2003. Toxicity, repellency, and horizontal transmission of fipronil in the Formosan subterranean termite (Isoptera: Rhinotermitidae). J. Econ.Entomol. 96: 461-467.

Osbrink, W.L.A. & A.R. Lax 2002. Effect of tolerance of insecticides on substrate penetration by Formosan subterranean termites (Isoptera: Rhinotermitidae), in independent monitors. J. Econ. Entomol. 95: 989-1000.

Remmen, A.N. & N.-Y. Su. 2005a. Time trends in mortality for thiamethoxam and fipronil against Formosan subterranean termites and eastern subterranean termites (Isoptera: Rhinotermitidae). J. Econ. Entomol. 98: 911-915.

Rust, M. K., and N.-Y. Su. 2012. Managing social insects of urban importance. Annu. Rev. Entomol. 57: 355-375.

Rust, M. K., and R. K. Saran. 2006. Toxicity, repellency and transfer of chlorfenapyr against western subterranean termites (Isoptera: Rhinotermitidae). J. Econ. Entomol. 99: 864-872.

Saran, R. K., and M. K. Rust. 2007. Toxicity, uptake, and transfer efficiency of fipronil in western subterranean termite (Isoptera: Rhinotermitidae). J. Econ. Entomol.100: 495-508.

Shleton, T.G. & J.K. Grace 2003. Effects of exposure duration on transfer of Nonrepellent termiticides among workers of *Coptotermes formosanus* Shiraki (Isoptera:Rhinotermitidae). J. Econ. Entomol. 96: 4556-460.

Su, N.-Y. 2002. Novel technologies for subterranean termite control. Socio-biology 40:95-101.

Su, N.-Y., P.M. Ban & R.H. Scheffrahn 2004. Polyethylene Barrier Impregnated with Lambda-Cyhalothrin for Exclusion of Subterranean Termites (Isoptera: Rhinotermitidae) from Structures. J. Econ. Entomol. 97(2): 570–574.

.Su, N.-Y. 2005. Directional change in tunneling of subterranean termites (Isoptera: Rhinotermitidae) in response to decayed wood attractants. Journal of Economic Entomology. 98: 471-475..

Thorne, B. L., and N. L. Breisch. 2001. Effects of sub lethal exposure to imidacloprid on subsequent behavior of subterranean termite *Reticulitermes virginicus* (Isoptera: Rhinotermitidae).J. Econ. Entomol. 94: 492-498.