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INNOVATION IN PERIMETER TREATMENT AGAINST SUBTERRANEAN TERMITES (ISOPTERA: RHINOTERMITIDAE)

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Abstract Pest Management Professionals had the opportunity to use new chemistry of non-repellent active ingredients (termiticides) for subterranean termite control. These active ingredients provide control through reduction of termite populations. The pest control industry has asked if the newer non-repellent termiticides may provide acceptable subterranean termite control with less than full-conventional treatments. This study was undertaken to evaluate the success of an innovative approach to treat structures with non-repellent termiticides using exterior perimeter plus localized interior treatments. In this study, 44 termite infested homes/structures were treated with fipronil (Termidor®, WG or SC) using either an Exterior Perimeter Treatment (EP) or Exterior Perimeter plus Localized Interior Treatment (EP/LIT). The 95% of structures exhibited no termite activity within three months. Two structures had recurring termite activity but they were free from termite infestations after using localized interior treatments. All structures receiving EP or EP/LIT treatments exhibited 100% termite control through the course of this study. According to these data, Pest Management Professionals can expect to use 20-48% less diluted termiticide when using an EP/LIT approach versus a full conventional treatment. Further, it translates into economic savings, improved human safety and minimum environmental hazards.
Key Words Subterranean termites, perimeter treatment, fipronil, termiticides

INTRODUCTION

Subterranean termites are the most fascinating social insects with a mysterious life cycle. With a cryptobiotic life and constant underground movement, subterranean termites can strike unexpectedly anywhere and cause serious economic damage to buildings and products containing cellulose. Termites have damaged residential/commercial/historic buildings, libraries, gymnasiums with wooden floors, wooden coffins, wooden bridges and telephone poles, boats/ships, and railway timbers/sleepers. Many researchers have attempted to document economic losses caused by subterranean termites in the United States. Johnson et al. (1972) estimated an annual cost of termite damage and control at $0.5 billion, Pinto (1981) at $0.7 billion for all types of termite control, and Beal et al. (1994) at $3.5 billion in the United States. Termite control products and practices have changed dramatically from the 1960s. Current control practices require multi-tactics approach including moisture management, biological agents (Waller, 1996; Wright et al., 2002), insect growth regulators as baits (Su et al., 1995; Su and Scheffrahn, 1996; King and Karr, 2000; Prabhakaran, 2001; Su et al., 2001) and conventional termiticides (Kard, 1998 and 2001). Conventional termite treatments consist of a continuous termiticide barrier applied around perimeter of a foundation and under the slab of structures (Kamble, 2002). Termiticide barriers have been commonly used against subterranean termites since the 1940's (Lewis, 1997). However, pest management professionals have experienced control failures. Some of those control failures were implicated to repellency of several termiticides (Lenz et al., 1990; Su et al., 1982 and 1997). Recently, non-repellent termiticides with new chemistry have been registered and served successful alternatives to repellent termiticides. The pest management professionals have asked if the new generation non-repellent termiticides may provide acceptable subterranean termite control with less than full-conventional treatments. Therefore, this study was undertaken to evaluate the success of an innovative approach to treat structures with fipronil (Termidor®), a non-repellent termiticide using exterior perimeter only or exterior perimeter plus localized interior treatment.

MATERIALS AND METHODS

Sites. In this study, 44 homes/structures with existing termite infestations were selected with assistance from local pest control companies (Tables 1-3). Pest Management Professionals (PMPs) and study directors inspected each home to document subterranean activity and treatment specifications. Diagrams of the properties indicating conducive areas, building outline, damage and active infestations were prepared. Research protocols were fully disclosed to property owners and discussed. Termiticide treatments were scheduled after agreements were signed by property owners.

Termiticide and Application. Termidor® (fipronil, active ingredient [AI]), a non-repellent termiticide, was selected for this study. Fipronil SC or WG formulations were used at dilution rate of 0.06, 0.09 or 0.125% AI. Fipronil SC and WG labels were provided to property owners prior to commencing termiticide treatments. Fipronil amounts used in perimeter treatments versus conventional treatments were calculated for comparing economic costs and environmental safety.

Homes/structures were randomly assigned to receive EP treatment only or EP plus LIT treatment. All termiticide treatments were performed by the certified pest management professionals in presence of study directors. In some cases, state regulators were also present during the treatment. All structures were treated by trenching and rodding. Trench was approximately 15.24 cm deep and 15.24 cm wide. The diluted fipronil solution (0.06, 0.09 or 0.125% AI) was applied at the rate of 15.14 liters per 3.048 linear meters per 0.3048 meter of depth. Rod holes in soil and slab were spaced less than 0.3048 m to achieve a continuous chemical barrier in the soil. Number of homes/structures and their locations, construction type, treatment type and fipronil concentrations are listed in Tables 1-3.

Post-Treatment Observations. All treated homes/structures were inspected after termiticide treatments for termite activity at 1-month, 2-month or 3-month intervals as specified in protocols. PMPs and study directors inspected the structures using conventional practices.

RESULTS AND DISCUSSION

Termite Control

Post-treatment termite inspections revealed that 95% of structures had no subterranean termite activity within three months (Tables 4, 5, 6 and 7). Initially, two structures had minor recurring termite activity inside which may be attributed to condition that these structures were not initially treated using a LIT technique. However, these structures were free from termite infestations within three months after receiving fipronil treatments using a LIT technique. It is apparent from the data that fipronil dilution rate at 0.06% was equally effective when compared with 0.09 and 0.125% dilution rates. Fipronil controlled termites within a month in 25% of structures and within two months in 77% of structures, when inspected. The post-treatment termite inspection-intervals differed from year to year because the fipronil protocols were constantly improved based on field experience, regional variations in construction and climatic conditions. Regardless, 100% of structures treated with fipronil using EP or EP/LIT techniques had no active subterranean termite infestations after 24 months (Tables 4, 5, 6 and 7).

Economic Benefits and Environmental Safety

Structures (homes) required 20-48% less amount of diluted fipronil using EP only or EP/LIT technique when compared with conventional treatments (Table 8). There was a total saving of 8,566.40 liters of diluted fipronil using EP and EP/LIT techniques in this study that otherwise would have been used for treating all 44 structures with conventional treatments. Based on this study, pest management professionals have handled much less termiticide amounts and there was also minimum termiticide usage in the interior of homes/structures. Using this innovative treatment approach, human safety was greatly enhanced by handling less termiticides. There was also a least degree of potential for exposure of property owners to termiticides. Since there were no floor or tile drillings as well as clearing the furniture and other items along walls, the property owners were relived from stressful activities. Further, it resulted in a saving of $3,688.70 in termiticide cost for treating all 44 structures with EP/LIT technique (Table 8). In terms of time and wages, there was 35-45% less time required for EP/LIT treatments as compared to conventional treatments. The reduced time and less termiticide amounts resulted into economic benefit that can allow the pest management professionals to charge less to property owners for termite treatments. Environmental hazards are also minimized with less usage of termiticides. Based on field data that supported success of EP and EP/LIT treatments, the Environmental Protection Agency

(EPA) has approved the label for use of fipronil (Termidor) for exterior perimeter treatment only or exterior perimeter plus localized interior treatment.

Table 1. Homes/Structures treated with fipronil for the subterranean termite control in Nebraska, USA

Home Number and Construction Type	Treatment Type	Fipronil Concentration % AI
(Nebraska, 2000)		
1-BA[1]	EP[3]	0.06
2-BA	EP	0.06
3-BA	EP	0.06
4-BA	EP	0.06
(Nebraska, 2001)		
1-BA	EP	0.06
2-BA	EP	0.06
3-BA	EP	0.06
4-BA	EP	0.125
5-BA	EP	0.125
6-BA and PB[2]	EP	0.125

[1]Basement. [2]Pier and Beam. [3]Exterior perimeter treatment only.

Table 2. Homes/Structures treated with fipronil for the subterranean termite control in Arkansas, USA.

Home Number and Construction Type	Treatment Type	Fipronil Concentration % AI
(Arkansas, 2002)		
1-FL[1]	EP[4]	0.06
2-PB[2]	EP	0.06
3-FL	EP	0.09
4-PB	EP/LIT[5]	0.09
5-FL	EP	0.125
6-BA[3]	EP/LIT	0.125

[1]Floating slab. [2]Pier and beam. [3]Basement. [4]Exterior perimeter treatment only. [5]Exterior perimeter plus localized interior treatment only.

Table 3. Homes/Structures treated with fipronil for the subterranean termite control in Texas, USA.

Home Number and Construction Type	Treatment Type	Fipronil Concentration, % AI
(Austin, 2001)		
1-MS[1]	EP[2]	0.06
2-MS	EP	0.06
3-MS	EP	0.06
4-MS	EP	0.06
5-MS	EP	0.06
6-MS	EP	0.06
7-MS	EP	0.06
8-MS	EP/LIT[3]	0.06
9-MS	EP/LIT	0.06
10-MS	EP	0.06
11-MS	EP	0.06
(Austin, 2002)		
1.MS	EP	0.06
2-MS	EP	0.06
3-MS	EP/LIT	0.06
4-MS	EP	0.06
5-MS	EP	0.09
6-MS	EP	0.09
7-MS	EP	0.09
8-PB	EP	0.125
9-MS	EP	0.125
10-MS	EP	0.125
11-MS	EP	0.125
(Bryan, 2000)		
1-MS	EP	0.06
2-MS	EP	0.09
3-MS	EP	0.125
(Bryan, 2001)		
1-MS	EP	0.06
2-MS	EP	0.09
3-MS	EP	0.125

[1]Monolithic slab. [2]Exterior perimeter treatment only. [3]Exterior perimeter plus localized interior treatment only.

Table 4. Subterranean termite control in homes/structures treated with fipronil in Nebraska, USA.

Home/ Structure	Treatment Type	Fipronil % AI	Inspection →→→→→	Dates →→→	(months) →→→	→→	→→→	→→	→
(Nebraska 2000)			1	2	3	9	12	24	36
1-BA[1]	EP[3]	0.06	-[4]	-	NTA[5]	NTA	NTA	NTA	
2-BA	EP	0.06	-	-	NTA	NTA	NTA	NTA	
3-BA	EP	0.06	-	-	NTA	NTA	NTA	NTA	
4-BA	EP	0.06	-	-	NTA	NTA	Active	NTA	
(Nebraska 2001)									
1-BA	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	
2-BA	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	
3-BA	EP	0.06	Active	Active	Active	NTA	NTA	NTA	
4-BA	EP	0.125	NTA	NTA	NTA	NTA	NTA	NTA	
5-BA	EP	0.125	NTA	NTA	NTA	NTA	NTA	NTA	
6-BA and PB[2]	EP	0.125	NTA	NTA	NTA	NTA	NTA	NTA	

[1]Basement. [2]Pier and Beam. [3]Exterior perimeter treatment only. [4]Not inspected. [5]No termite activity.

Table 5. Subterranean termite control in homes/structures treated with fipronil in Arkansas, USA.

Home/ Structure	Treat. Type	Fipronil % AI	→→	Inspection →→	Dates →→	(months) →→	→→	→→	→→	→→	→→	→→	→→	→→	→→	→→
(Arkansas, 2002)			1	2	3	4	5	6	8	10	12	14	16	18	22	24
1-FL[1]	EP[4]	0.06	NTA[6]	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
2-PB[2]	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
3-FL	EP	0.09	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
4-PB	EP/LIT[5]	0.09	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
5-FL	EP	0.125	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
6-BA[3]	EP/LIT	0.125	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA

[1]Floating slab. [2]Pier and beam. [3]Basement. [4]Exterior perimeter treatment only. [5]Exterior perimeter plus localized interior treatment only. [6]No termite activity.

Table 6. Subterranean termite control in homes/structures treated with fipronil in Texas, USA.

Home/Structure Construction Type	Treatment Type	Fipronil % AI	→→	Inspection →→	Dates →→	(months) →→	→→	→→	→→	→→	→→	→→	→→	→→
(Austin, 2001)			2	4	6	8	10	12	14	16	18	20	22	24
1-MS[1]	EP[2]	0.06	NTA[4]	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
2-MS	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
3-MS	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
4-MS	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
5-MS	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
6-MS	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
7-MS	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
8-MS	EP/LIT[3]	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
9-MS	EP/LIT	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
10-MS	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
11-MS	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
(Austin, 2002)														
1-MS	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
2-MS	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
3-MS	EP/LIT	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
4-MS	EP	0.06	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
5-MS	EP	0.09	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
6-MS	EP	0.09	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
7-MS	EP	0.09	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
8-PB	EP	0.125	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
9-MS	EP	0.125	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
10-MS	EP	0.125	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA
11-MB	EP	0.125	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA	NTA

[1]Monolithic slab. [2]Exterior perimeter treatment only. [3]Exterior perimeter plus localized interior treatment only. [4]No termite activity.

Table 7. Subterranean termite control in homes/structures treated with fipronil in Texas, USA.

Home/Structure Construction Type	Treatment Type	Fipronil % AI	Inspection →→→→	Dates →→→→→→	(months) →→→→	→→→
(Bryan, 2000)			3	6	12	24
1-MS[1]	EP[2]	0.06	NTA[3]	NTA	NTA	NTA
2-MS	EP	0.09	NTA	NTA	NTA	NTA
3-MS	EP	0.125	NTA	NTA	NTA	NTA
			NTA	NTA	NTA	NTA
(Bryan, 2001)						
1-MS	EP	0.06	NTA	NTA	NTA	NTA
2-MS	EP	0.09	NTA	NTA	NTA	NTA
3-MS	EP	0.125	NTA	NTA	NTA	NTA

[1]Monolithic slab. [2]Exterior perimeter treatment only. [3]No termite activity.

Table 8. Difference in fipronil usage between conventional versus exterior perimeter plus localized interior treatments for subterranean termite control.

Home/Structure Construction Type	No. of structures used	Mean Fipronil Amount/structure Conventional Treatment Liters	Mean Fipronil Amount/structure EP/LIT Treatment Liters	Fipronil Difference = Conv. – EP/LIT Liters	Total Fipronil Volume Difference = Conv. – EP/LIT X No. structures Liters	Total Savings Dollars[5]
MS[1]	27	370.97	295.26	75.71	2,044.17	$ 880.22
FS[2]	3	529.96	302.83	227.13	681.39	$ 293.41
PB[3]	3	662.45	344.47	317.98	953.94	$ 410.77
BA[4]	8	1,173.47	692.73	480.74	3,845.92	$1,656.05
BA/MS	2	1,298.39	946.35	352.04	704.08	$ 303.18
BA/PB	1	1,177.26	840.36	336.90	336.90	$ 145.07
Total =	44	5,212.50	3,422.00	1,790.50	8,566.40	$3,688.70

[1]Monolithic slab. [2]Floating slab. [3]Pier and beam. [4]Basement. [5]Based on the retail price at $0.4306 per liter of diluted fipronil 0.06% concentration.

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