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A MULTI-STATE STUDY TO ASSESS THE EFFICACY OF CHLORANTRANILIPROLE IN CONTROLLING *RETICULITERMES FLAVIPES* (ISOPTERA: RHINOTERMITIDAE) IN INFESTED STRUCTURES

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Abstract The efficacy of Altriset® 20SC (AI, chlorantraniliprole) in controlling structural infestations of the eastern subterranean termite, *Reticulitermes flavipes*, was assessed in Ohio, North Carolina, and Texas. Prior to chlorantraniliprole treatment, termites were collected from the structure as well as from a grid of in-ground monitoring stations encircling each structure. Microsatellite markers were used to genetically fingerprint each of the termite colonies. The structures and stations continued to be monitored for 2 years after the termiticide treatment. Chlorantraniliprole provided effective structural protection as termite activity in and on the majority of structures ceased within ~1 month or less and they continued to be free of termites for the 2-year study duration; a follow-up spot treatment was done only at one house in Texas at 5-months post-treatment and at one house in North Carolina at 8 months post-treatment. A single infesting colony appeared to be associated with each structure prior to treatment.

Key words Termiticide, subterranean termite, colony, microsatellite.

INTRODUCTION

Chlorantraniliprole is an anthranilic diamide insecticide that has low mammalian toxicity and is considered a least risk pesticide (US EPA, 2008). Chlorantriliprole has a unique mode of action wherein it acts on the ryanodine receptor, where it stimulates the release and depletion of intracellular calcium, which causes paralysis of the target insect (Qi et al., 2011).

Altriset® with the active ingredient chlorantraniliprole is a liquid termiticide used as a sub-soil barrier to control subterranean termites. Chlorantraniliprole is a slow-acting non-repellent termiticide and studies have concluded that this type of termiticide allows for a high rate of transfer of active ingredient among nestmates (Bagneres et al., 2009). The objective of this trial was to evaluate the efficacy of chlorantraniliprole applied at 0.05% in controlling termites (*Reticulitermes flavipes* Kollar) in infested structures in multiple regions and to determine the fate of termite colonies in and around each structure post-treatment.

MATERIALS AND METHODS

All structures were infested with Eastern subterranean termites. At pre-treatment live termites were collected from each infestation point at each structure. At each structure, in-ground subterranean termite

stations were installed in two concentric rings around the structure. All stations were monitored on a monthly basis for 3-6 months pre-treatment. All subterranean termites collected pre-treatment were preserved and held for subsequent analyses.

All termiticide applications followed the manufacturer's label instructions. Post-treatment inspections included the exterior of structure and in-ground termite stations. All structures were inspected on or about 1, 2, 3 months, and then quarterly for 24-months post-treatment.

From each station and shelter tube sampled, 10 workers (or all if fewer were present) were genotyped to determine colony affiliation. The DNA of individual workers was extracted and the genotypes for two microsatellite loci, *Rf 24-2* and *Rf 21-1*, were determined following established methods (Parman and Vargo, 2008; Vargo and Parman, 2012). Colony affiliation of groups of collected workers was determined by means of an exact test for genotypic differentiation as implemented in the program GenePop on the Web (Raymond and Rousset, 1995). Groups of workers from the same property that were not significantly differentiated were considered to belong to the same colony. This method has been used to determine colony affiliation in *R. flavipes* after insecticide treatments (Vargo, 2003; Vargo and Parman, 2012).

RESULTS AND DISCUSSION

Ohio Structures

At three of the structures, termite activity ceased within 1 month post-treatment. At the fourth structure, at 1 month post-treatment, several live termites were found among dead termites in a basement above ground station. After that inspection, there was no evidence of live termites found at any inspection.

Ohio Landscape

At each of the four structures, some the same colonies were present pre- and post-treatment. At one structure, the infesting termite colony was eliminated from the landscape during the second year. At three of the structures, termite activity, including the infesting colony, in the landscape persisted for 2 years

North Carolina Structures

Termite activity ceased within 1 month post-treatment at two structures. At the third structure, a spot treatment of chlorantraniliprole was required at 8-months post-treatment due to continued termite activity in damp floor joists. After this treatment, there was no evidence of live termites for the duration of the study. One structure was removed from the study due to a persistent water leak.

North Carolina Landscape

At each of the three remaining structures, some of the same colonies were present pre- and post-treatment in the landscape. At one structure, the infesting colony was eliminated from the landscape with the initial treatment of chlorantraniliprole. At the remaining two structures, the colony initially infesting the structures were last found at 6 months and 18-months post-treatment.

Texas Structures

Termite activity ceased within 1 month post-treatment at three structures. At the fourth structure a spot treatment was necessary in a window at 5-months post-treatment because several live worker and swarmer termites were present. After the spot treatment at 5-months post-treatment, no evidence of live termites was found at this structure.

Texas Landscape

At three of the structures, some of the same colonies were present pre- and post-treatment (Table 1). At three structures the infesting colony was eliminated from the landscape. Colony members were last found in in-ground stations at pre-treatment at two structures and 1-month post-treatment at the third structure. The fourth structure was removed from the study at 19-months post-treatment because the contracted PMP inadvertently performed a spot-treatment with a different termiticide.

Table 1. Results from structures treated with 0.05% chlorantraniliprole to control subterranean termites.

Site	Status at initial inspection		Status at 2 year inspection	
	Termites in structure	Termites in landscape	Termites in structure	Termites in landscape
Ohio	yes	yes	No	yes
North Carolina	yes	yes	No	yes
Texas	yes	yes	No	yes

Table 2. Summary of structures treated with 0.05% chlorantraniliprole to control subterranean termites.

Post-treatment Status	Ohio (4 structures)	North Carolina (3 structures)	Texas (4 structures)
Time to eliminate infesting colony from structure	<1-2 months at 4 structures	<1 month at 2 structures, 9 months at 1 structure	<1 month at 3 structures, 5 months at 1 structure
Spot treatment	0	1	1
Infesting colony eliminated from landscape	1 structure/4	1 structure/3	3 structures/4

Chlorantraniliprole effectively controlled *R. flavipes* infesting houses in OH, NC, and TX and resulted in apparent elimination of the infesting colony from the landscapes at 1 of 4 houses in OH, 1 house in NC, and 3 of 4 houses in TX (Table 2).

The reduction of termite activity in the landscape of the treated structures indicates that chlorantraniliprole is transferred among nestmates. This transfer of chlorantraniliprole has also been confirmed in laboratory trials (Puckett et al., 2012). Chlorantraniliprole has delayed mortality on subterranean termites. This allows donor termites to return to the nests and potentially transfer the active ingredient to recipient termites. Although mortality is delayed, paralysis of the mouthparts is immediate. Therefore, worker termites are unable to continue to feed and cause damage to a structure. Termites that come in contact with chlorantraniliprole have been noted to aggregate (Buczkowski et al., 2012). This increases social interaction, which increases exposure from donor to recipient termites.

CONCLUSIONS

Based on the elimination of termites from the structures, the objective of controlling termites in infested structures was achieved. The reduction of the frequency of termites in the landscape in the current study was noted. Therefore, it can be suggested that to some degree these three behaviors (feeding cessation, aggregation, donor to recipient transfer) are taking place in the field. Based on these facts and the data from the current study, it can be concluded that chlorantraniliprole when applied around a structure for post-construction control of subterranean termites does have some colony level effects in suppression of termites in the surrounding landscape.

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