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CHLORANTRANILIPROLE: A NEW INSECTICIDE FOR GLOBAL TERMITE CONTROL

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Abstract Chlorantraniliprole is a new insecticide globally branded as DuPont™ Altriset™ for termite control. Field results from the USA, Japan and Australian in pre-construction (horizontal applications) and post-construction (vertical applications) at the 0.05% rate showed excellent efficacy. Field results from the United States against *Reticulitermes* spp. in pre-construction concrete slab tests showed 90-100% termite control for six years and counting, except in year 5 in South Carolina 80% control was achieved, while in the 6th year 100% control occurred. Field results from Japan in pre-construction covered plots have shown 100% control against *Coptotermes formosanus* for 4 years and counting. In Australia, field results in both pre-construction and post-construction plots against primarily *C. acinaciformis* (Froggatt) showed 100% control for 3 years and counting.
Key Words Altriset, termite control, new insecticides, termiticide field results

INTRODUCTION

Chlorantraniliprole represents new chemistry and a novel mode of action for global termite control. This new active ingredient is in a new class of insecticides called the anthranilic diamides (Lahm et. al., 2005; Cordova et al., 2006). Chlorantraniliprole controls insect pests through activation of insect ryanodine receptors (RyRs), a new mode-of-action for insect control. This activation of ryanodine receptor channels leads to internal calcium store depletion that impairs regulation of muscle contraction. Insects exposed to chlorantraniliprole exhibit general lethargy and muscle paralysis followed by death. Furthermore, chlorantraniliprole is remarkably selective for insect over mammalian RyRs and this selectivity is a key attribute of the low mammalian toxicity. This compound also has a favorable environmental profile (Bassi et al., 2007).

In 2008, chlorantraniliprole was registered by the United States Environmental Protection Agency (EPA) as a Reduced Risk pesticide (Environmental Protection Agency, 2008). The global termite brand name is DuPont™ Altriset™ formulated as a water-based suspension concentrate 18.4% SC. In the United States, chlorantraniliprole received reduced risk status from the US EPA, making it the first reduced risk liquid termiticide. Due to a favorable environmental profile, the label does not require a signal word in the United States. This product passed the two year lab test at the United States Department of Agriculture Forest Service (USDA-FS) laboratory and was installed in the concrete slab and ground board test sties in Arizona, Florida, Mississippi and South Carolina. In addition, numerous laboratory and field studies are being conducted to document termite efficacy. Field sites have been established in the key global termite markets.

Chlorantraniliprole has unique affects on insect behavior. Feeding cessation has been documented in several key crop pests (Hannig et.al., 2009). In termites, this key aspect was investigated to determine the level of feeding cessation after termites tunneled into treated soil. Studies in the United States against *R. flavipes, C. formosanus,* in Malaysia against *C. gestroi* and in Australia against *Mastotermes darwiniensis*, all showed feeding cessation after tunneling in 50 ppm chlorantraniliprole treated soil for 1-4 hours.

MATERIALS AND METHODS

United States Field Trials

Concrete slab tests were established in United States field plots in the states of Arizona, Florida, Mississippi and South Carolina in 2004 with chlorantraniliprole formulated as water based suspension concentrate. Rates tested

were 0.025%, 0.05% and 0.10%. This technique has been utilized for many years by the USDA-FS and the method has been described (Wagner et.al., 2011). This study simulates a pre-construction, horizontal application to soil as the concrete slab tests. The boards that are placed on top of treated soil are inspected once per year for termite activity, and the full year 6 year results are reported (Wagner et. al., 2011). In February, 2011, the Florida plots were evaluated and that 7 year data are reported.

Japan Field Trials

Field trials were established near Kagoshima, Japan in 2005. The plots were established under guidance of the Japanese Wood Preservation Association Termiticide Standard (JWPS-TS-S) and states that a termiticide will pass the field tests if no termite damage occurs to wood for 2 years. Chlorantraniliprole rates evaluated were 0.025%, 0.05% and 0.10%. Five treated plots and five untreated control plots were established for each rate in a lattice shape and plots were separated by 1 meter. A horizontal application of chlorantraniliprole SC simulating a pre-construction was done at 3 liters per square meter. Two pieces of normal and sound sapwood of Japanese red pine (*Pinus densiflora*) were placed on each other in the center of the treated and untreated plots. Wood pieces were 10 cm x 10 cm x 1 cm. Test plots were covered with unglazed clay plant pots 40 cm in diameter. Pine stakes were placed around the plots to lure termites into the field sites. All plots were infested with *C. formosanus.* Plots have been inspected every year, and currently the 4 year data is available.

Australia Field Trials

Replicated field trials were conducted in the Mangrove Mountain district, near Gosford in New South Wales, Australia during August 2007 to August 2010 by Agrisearch Services Pty Ltd. A randomized complete block design was used with 5 replicates per rate of chlorantraniliprole (0.05% and 0.10%), and plots within a replicate block were at least 1-2 meters apart. The primary termites in the plots were *Coptotermes acinaciformis*. Horizontal applications simulating a pre-construction treatment were done to soil at 5 liters per square meter and plots were covered with a concrete slab. Vertical uncovered applications simulating a post-construction treatment were to soil at 100 liter per cubic meter. The treatments were installed in accordance with the Australian Standard AS3660.1, AS3660.2 and AS3660.3 and the relevant APVMA guidelines. Each horizontal plot had dimensions of 100 cm x 100 cm. The termiticide was applied to the horizontal barrier plots using low pressure, high volume equipment that delivered a coarse droplet size through a shower head applicator. A 20 cm x 20 cm piece of clean untreated 5 ply pine plywood was placed onto the soil surface in the centre of each plot.

Each vertical plot was 100 cm x 100 cm. In the centre of the plot the soil 40 cm wide x 40 cm wide x 30 cm deep was removed. The soil was placed into an electric concrete mixer and mixed thoroughly with 4.8 L of mixed emulsion (equivalent of 100 L/ m^3). The treated soil was placed back into the hole. A piece of Oregon timber with dimensions of 20 cm high x 10 cm wide x 10 cm wide was placed onto a 15 cm bed of treated soil in the centre of the hole and buried to a depth of 15 cm leaving 5 cm protruding above soil level. Prior to placement in the hole, the block of timber had a 1 cm hole drilled through the centre for the entire 20 cm depth of the timber. The hole at the top of the timber was sealed with a piece of timber. Immediately after the 18 month assessment the Oregon timber in each vertical barrier plot was cut in half and one half was discarded. A piece of *Eucalyptus regnans* with dimensions 20 cm high x 5 cm wide x 10 cm wide was inserted into each of the vertical barrier plots beside the Oregon timber to enhance the possibility of termite attack.

RESULTS AND DISCUSSIONS

United States Field Trials

The results from the USDA-FS concrete slab tests are shown in Figure 1. Based on these positive data, chlorantraniliprole at 0.05% was registered by the US EPA on May 20, 2010. Only the rate of 0.05% is shown because this is the rate approved by the US EPA for both pre-construction and post-construction applications. Termiticides are evaluated by applying the US EPA Test Guideline (OPPTS 810.3600). This guideline recommends 100% control for 5 years in all 4 states with the concrete slab tests. The Florida Rule allows for 90% control. Only the concrete slab test data is shown because these data are used primarily by US EPA to grant a termiticide registration. The uncovered ground board plots simulate a pre-construction horizontal application without a concrete slab, and are not representative of actual pest control professional applications. All pre–construction applications to soil are covered, usually with a concrete slab. Therefore, ground board data is not relevant and is not shown in Figure 1.

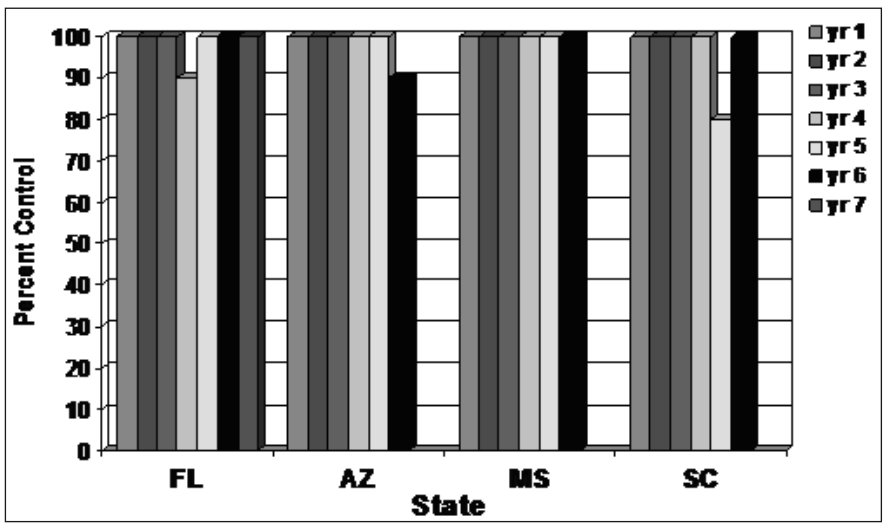

Figure 1. Percent termite control of chlorantraniliprole Altriset ™ 18.4SC from the USDA-FS field plots in 4 states for 1-7 years against *Reticulitermes* spp. in the United States. Fl – state of Florida. AZ – state of Arizona. MS – state of Mississippi. SC – state of South Carolina, United States.

In the state of Florida, chlorantraniliprole provided 100% termite control for years 1-3, and 90% control (1/10 plots had termite damage) in year 4, but by year 5 termite damage did not occur and 100% control was achieved from years 5-7. The untreated controls in Florida had 71% termite attack over the life of the study. In the state of Arizona, low termite pressure exists in the untreated controls and only 1% of the plots were attacked over the life of the study (Wagner et.al., 2011). Chlorantraniliprole provided 5 years of 100% control, and year 6 had 90% control. The state of Mississippi (MS) is considered the most severe site, due to high termite pressure and severe high temperatures and high humidity, and most termiticide products fail in MS. The untreated control plots had 86% termite attack over the life of the study in MS. Chlorantraniliprole provided excellent results with 100% termite control and counting. South Carolina (SC) had 55% of the untreated control plots attacked over the life of the study. In SC, chlorantraniliprole provided 100% control for the first 4 years, and year 5 showed 90% control, while in year 6 termite attacks did not occur and 100% control was achieved.

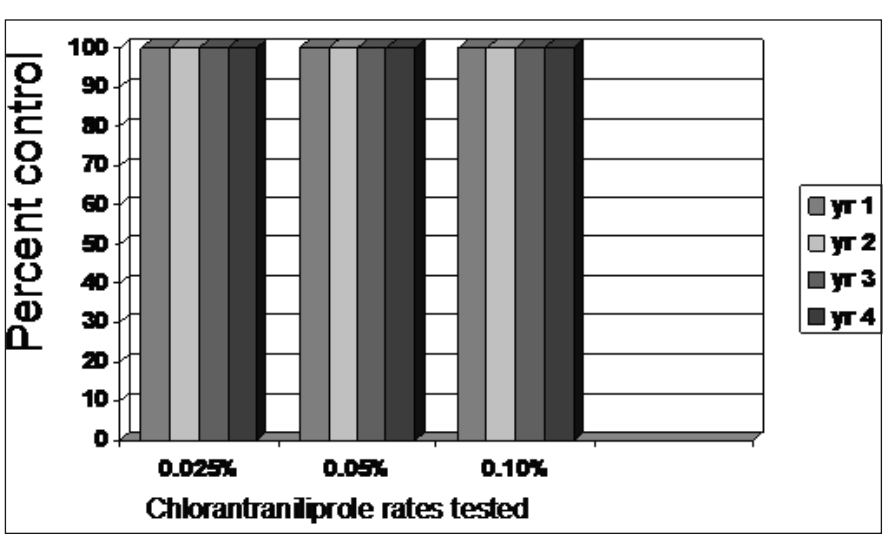

Figure 2. Percent termite control of chlorantraniliprole from the Kagoshima, Japan field plots for 4 years against *Coptotermes formosanus*.

Japan Field Trials

Results from the field trial infested with *C. formosanus* showed 100% control for 4 years and counting with chlorantraniliprole (Figure 2). Control boards were attacked every year and heavy damage was reported. All 3 rates provided 100% termite control. These results confirm similar efficacy against *Reticulitermes* spp found in the USA. The Formosan termite has larger termite colonies and is a more aggressive species and more difficult to control in most cases. Chlorantraniliprole has been launched in Japan based on passing the 2 year field trials and the required lab trials.

Australian Field Trials

Field trials in Australia infested with *C. acinaciformis* showed 100% control for 3 years and counting with chlorantraniliprole (Figure 3), applied as a horizontal, pre-construction application. The untreated control plots

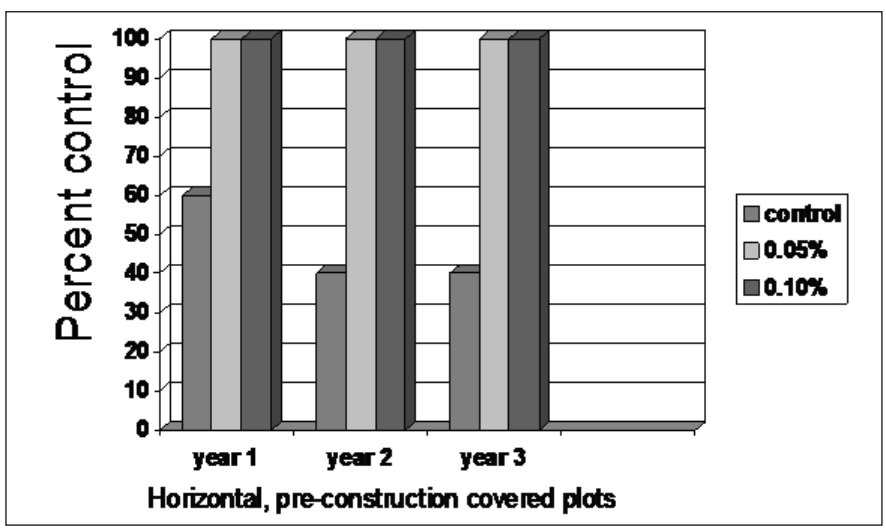

Figure 3. Percent termite control of chlorantraniliprole from Gosford, New South Wales, Australia horizontal, pre-construction field plots for 3 years against *Coptotermes acinaciformis*

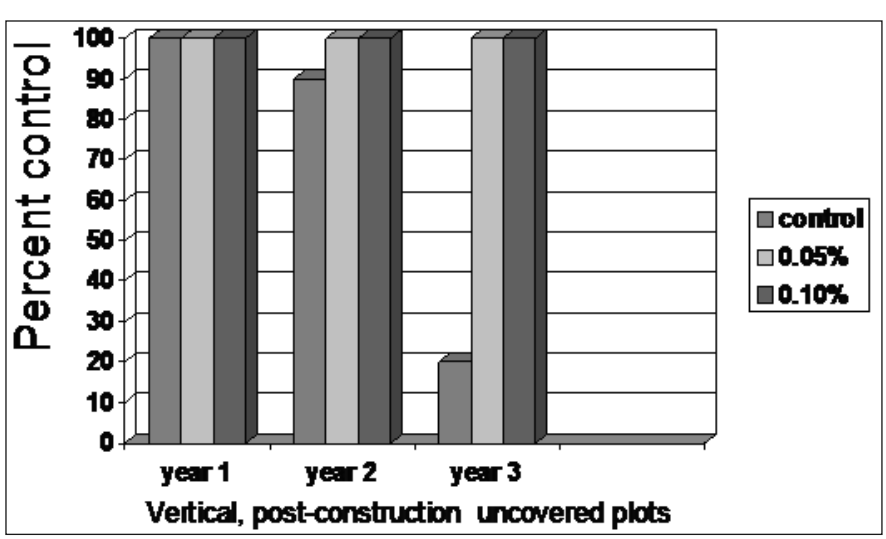

Figure 4. Percent termite control of chlorantraniliprole from Gosford, New South Wales, Australia vertical, post-construction field plots for 3 years against *Coptotermes acinaciformis*.

had 60% control, or 40% of the plots were attacked by *C. acinaciformis*.in year one (2008). Years two and three (2009 and 2010) the control plots had 40% control, or 60% of the plots were attacked. These plots had moderate infestations of *C. acinaciformis*. As a simulated pre-construction application, chlorantraniliprole showed excellent control of another *Coptotermes* species, similar to the results in Japan against *C. formosanus*. Vertical applications, simulating a post-construction treatment, showed 100% control for 3 years and counting with chlorantraniliprole (Figure 4). The first year of the test in 2008 showed no attacks by *C. acinaciformis* in the controls and chlorantraniliprole treated plots. By year 2 (2009), the untreated control plots had 90% control, or 10% were attacked. And by the third year (2010), the untreated control plots had 20% control, or 80% were attacked by *C. acanaciformis*, which allowed for a valid test. The USDA-FS does not conduct vertical type test in the United States, and this test in Australia allowed for data collection from field plots that simulated post-construction, against a very aggressive termite species.

CONCLUSIONS

Field results have documented that chlorantraniliprole is an effective liquid termiticide. Soil residual studies simulating both pre-construction and post-construction termiticide applications have shown a long residual for chlorantraniliprole, confirming the efficacy results. This novel chemistry and unique mode of action will allow pest management professionals to utilize a new termite control product. The superior efficacy coupled with low mammalian toxicity and low environmental impact will separate chlorantraniliprole from existing liquid termiticides currently on the market.

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