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CHLORANTRANILIPROLE: A NEW TERMITICIDE

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Abstract Altriset™ (18.4% SC, Chlorantraniliprole) exhibited delayed mortality in termites both in topical and limited exposure bioassays. When exposed for as low as 5 minutes on sand treated at ≥25 ppm, worker mortalities reached >90% by day 5. Termites behaved normally (walking, grooming etc.) for several hours after acquiring lethaldoses. Tunneling study showed that it is a non-repellent compound and as little as 1 ppm on sand will stop the termites from penetrating the treated length of the sand column (8 cm). All the concentrations in brief exposures caused 100% mortality in termites.
Key Words Non-repellency, termites, brief-exposures, termite tunneling

INTRODUCTION

Liquid-termiticides still remain the main product of choice to control termites in and around the homes. Cyclodienes (Chlordane, Dieldrin) were used as termiticides in 1960s and 1970s. Due to environmental concerns these termiticides were replaced by organophosphate such as chlorpyriphosin1980s and early 1990s. Pyrethroids were also introduced as termiticides and still being used as liquid-termiticides. In mid and late 1990's two new termiticides containing imidacloprid (Premise®) and fipronil (Termidor®) were introduced in US. These termiticides are considered to be non-repellent and alternatives to pyrethroids. Non-repellent termiticides are perceived to be transferred back to other colony members by exposed workers but researchers have shown both in laboratory and field that there is less probability of that happening in the field (Haagsma, 2001; Ripa et al., 2007; Saran and Rust, 2007; Su, 2005). Such transfer is dependent on a lot of factors such as delayed toxicity, non-repellency, distance from the exposure site, state and size of the colony, and bioavailability of termiticides (Rust and Saran, 2006).

A new insecticide, chlorantraniliprole, belongs to a new chemical class, anthralinic diamides (Lahm et al., 2007). It has a novel mode of action as an activator of insect ryanodine receptors. In termites, it causes delayed mortalities, even after acquiring lethal doses termites show normal movement and behavior for 6-7 hr, affected termites do not feed, there is increased aggregation and grooming among workers, and death finally occurs within 7-28 days. It has acute oral and dermal toxicity of >5,000 mg/kg, making it a low hazard liquid insecticides, and classified as Reduced Risk by EPA.

This study was conducted to elucidate the intrinsic toxicity, post-exposure effects on termite workers, non-repellency and tunneling by termite workers in chloranatraniliprole treated sand.

MATERIALS AND METHODS

Termites. Termites (*Reticulitermes flavipes*) were collected from field in cardboard roll traps. Termites were carefully taken out for bioassays and were used within < 14 days.

Topical Bioassays. A stock solution of chlorantraniliprole (0.1%, w : w) was prepared in acetone and was serially diluted (11 dilutions, 1000 – 0.781 ppm). A small amount (0.25 µl) of dose was applied to dorsal side of thorax of individual termites using a micro-syringe (Hamilton Co., Reno, NV). Termites were then transferred to a fresh petri dish (50 x 9 mm) containing a moist brown paper towel disk as a food source. Four replications per concentration and 10 termites per replication were used. Controls were treated with acetone only. Mortality of termites was recorded daily for 9 days.

Limited Exposure Studies. Termites were exposed for limited time (5 and 60 minutes) to sand treated at 50 ppm (w : w) with chlorantraniliprole (18.4% SC). For each time x concentration combinations termites were exposed in groups of 150 each and then divided in 5 groups of 20 each (at the end of each time intervals) by transferring in petri dishes (50 x 9 mm) containing moist brown paper towel disks. Mortality was recorded for next 7-14 days.

Post-Exposure Behavior. Termites were exposed (limited exposure) as described above and after exposure at different time intervals (0, 1, 2, 3, and 4 hr), termites were allowed to walk over a 15 cm long line drawn on a white print paper sheet with a ball point pen. Termites exposed for 1 and 60 min to 50 ppm treated sand were transferred to clean petri dish with moist paper towel. At each time interval a single termite was used to run a 15 cm long ball point pen line. The amount of time it took to cover 15 cm distance was recorded. A new line was drawn and a new termite was used for each run.

Tunneling Assays. Termite 4 cm) followed by a treated section (8 cm). The tubes were prepared and termites (N=20) tunneling was tested in small tubes (20 cm long x 1 cm diameter) having an untreated section of sand (Saran and Rust, 2007). Distance travelled was recorded every 24 h and mortality was recorded at the end of 7 days.

RESULTS AND DISCUSSIONS

Topical Bioassays. Chlorantraniliprole is effective on termites at even very low doses of 0.29 ng/termite (LD_{50}) and 1.57 ng/termite (LD_{95}) at day 9 (Figure 1). Dose response curves indicate a delayed mortality in termites such that even at higher doses (13-14 ng/termite) termites start dying only after 48-72 hrs. In most cases 100% mortality was achieved only after 5-7 days and at low doses of <3 ng/termite mortalities were observed up to 7-14 days.

Limited Exposures. Delayed mortality was also exhibited in these assays. Regardless of the concentration x time (dose) termites were exposed to, >50% mortality was achieved only after 2 days (Figure 2). Chlorantraniliprole caused only 15-20% mortality at 24 hr even after 60 minute exposure to 50 ppm of treated sand (Figure 3).Thus, both topical and limited-exposure assays indicate that termites are not affected immediately even after acquiring lethal and sub-lethal doses.

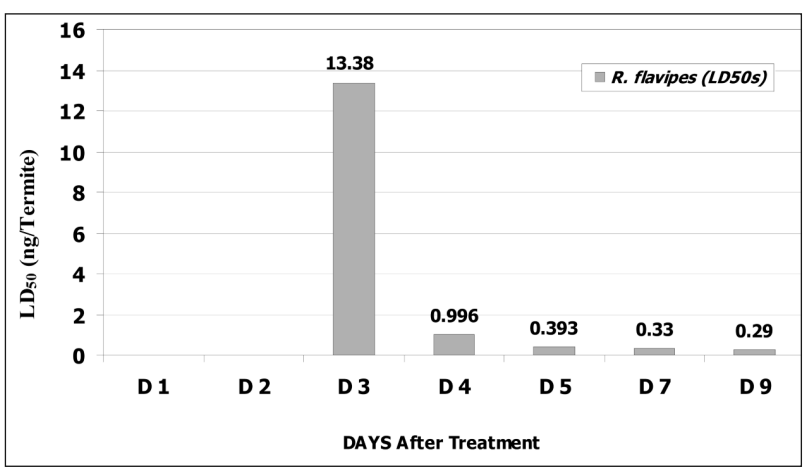

Figure 1. Termite LD_{50} values after topical applications.

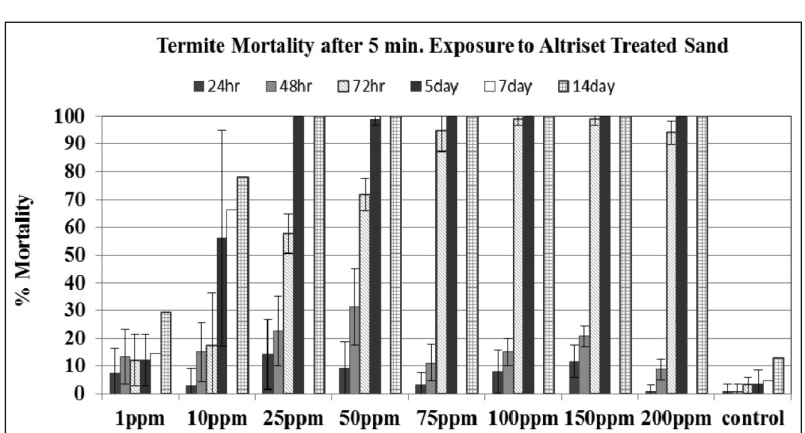

Figure 2. Percent mortality in termites after 5 min exposure to sand treated with 50 ppm chlorantraniliprole.

Post Exposure Behavior Assays. For both the exposure times (1 and 60 minute), termites were not affected due to delayed action of the chlorantraniliprole. At 2-3 hours after exposure, termites were able to walk 15 cm within 11-20 seconds, not significantly different from control termites. However, after exposure termite walking behavior was slightly affected, as there was greater variation in walking speeds of termites exposed to treated sands (Figure 4). Both exposure mortality assays and post-exposure behavior observations support that exposed termites may very well interact with unexposed workers because the intoxication symptoms are effective sufficiently delayed. This may potentially lead to more horizontal transfer of sub-lethal and lethal doses among termite workers.

Tunneling Bioassays. For all the tested concentrations (1, 10, 25, 50, 75, & 100 ppm), termite tunneled in treated sand (Figure 5). This indicates that Altriset™ is a non-repellent termiticide. Termites did tunnel for longer distance in 1 ppm treated sand (< 7 cm) but termites were not able to tunnel through total 8 cm treated sand and their survival was highly affected due to tunneling in treated sand. At concentrations ≥10 ppm termites tunneled <2.0 cm, regardless of the concentrations. In controls, termites tunneled through 8 cm untreated sand by day 7. Thus, termites could not tunnel completely through treated sand column at all the concentrations tested.

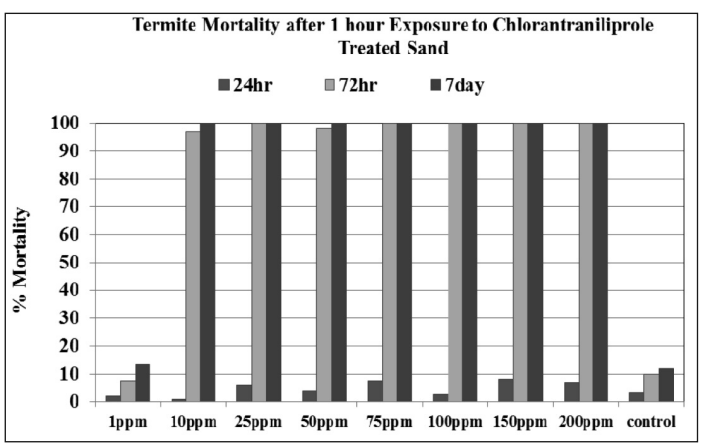

Figure 3. Percent mortality in termites after 1 hr exposure to sand treated with 50 ppm chlorantraniliprole.

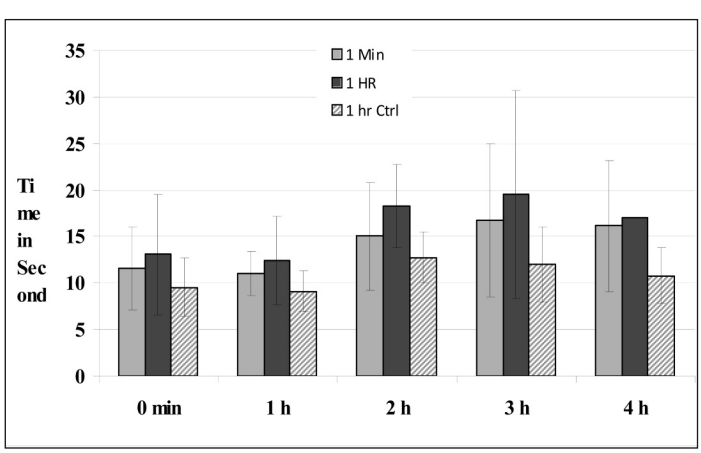

Figure 4. Post-exposure behavior of termites exposed to sand treated with 50 ppm chlorantraniliprole.

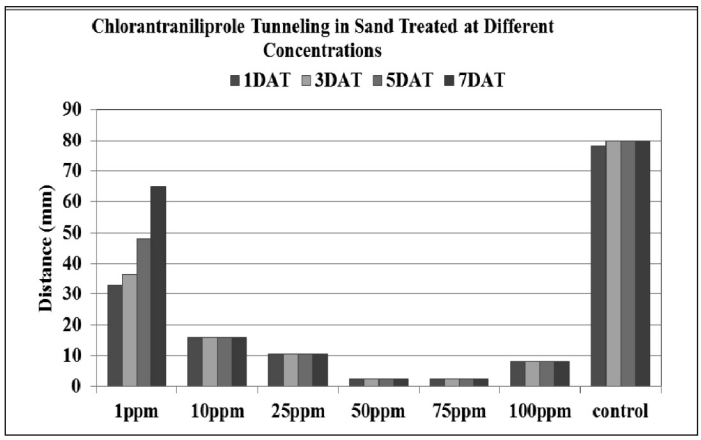

Figure 5. Distance tunneled by termites in chlorantraniliprole treated sand.

CONCLUSIONS

Chlorantraniliprole exhibits delayed mortality in termites and its formulated termiticide is also non-repellent causing 100% mortality in termites exposed to treated sand for as little as 5 minutes. Its delayed action and non-repellency may lead to a better horizontal transfer in field situations compared to other faster acting non-repellent termiticides.

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