Elimination of Colonies of the Mound Building Termite *Macrotermes gilvus* ((Hagen)) Using Chlorfluazuron Based Termite Bait in Philippines.

by

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Abstract

Work was undertaken to study the effectiveness of chlorfluazuron based termite bait in eliminating the termite species *Macrotermes gilvus* (Hagen) under field conditions. Three active mounds were chosen for this study, two acted as test mounds and the other as the control. Four in-ground stations were installed around each mound. Interception occurred almost immediately in all the stations, which were baited. The control mound was baited with bait matrix without the active ingredient. Stations were re-baited every 2 weeks for 10-12 weeks until bait consumption ceased in the test mounds. The mounds were left undisturbed for 4 more weeks before being destructively sampled. The desiccated remains of workers, soldiers, late instars and queen were found upon sampling the treated mounds. A few live termites were located in the mounds but were found contaminated with the bait. The control mound remained healthy and did not show any visible sign of negative impact. The bait successfully suppressed and eliminated all the two *M. gilvus* colonies within 16 weeks from commencement of feeding.

Key words: *Macrotermes gilvus*, chlorfluazuron, termite baiting

Introduction

Termite control is estimated to form the largest segment in the global pest control industry and is worth US Dollar 8 billion (International Pest Control, 2009). This would easily give an estimate on the gross damage termite cause economically around the world. The economic damage caused by termite runs to millions of dollars in United States, Australia and Japan but never been quantified in developing countries. This situation has been further aggravated by the withdrawal of the persistent organochlorines as soil barrier treatments from world markets. The replacement termiticides now available are less persistent, thus placing structures under greater risk and requiring repeated treatments.

Termite baiting systems have recently evolved as a major technique to protect structures and timber against termites. This technique makes use of the inherent termite behaviors of interdependence, trophallaxis, mutual grooming and cannibalism to distribute the bait toxicant throughout the colony, resulting in population loss and sometimes colony elimination. A number of bait toxicants and baiting systems have been developed and evaluated over the last few years for the control of subterranean termite species. Successfully commercialized among them are hexaflumuron (Su, 1994) diflubenzuron (Rojas and Morales-Ramos, 2004), chlorfluazuron (Peters and Fitzgerald, 2003; Sukartana *et al.*, 2009), and noviflumuron (Sajap, 2005). Most of the published data has

however been restricted to tests on invasive termite species belonging to the genera *Coptotermes*. There is little published data against other genera particularly belonging to higher group of termites.

The current study investigates the efficacy of chlorfluazuron based termite bait on active termite mounds belonging to the species *Macrotermes gilvus.* Chlorfluazuron is a benzoylphenyl urea that acts as a potent chitin synthesis inhibitor, across various orders of insects (Haga *et al*, 1982; Hajjar and Casida, 1979). This result in abnormal deposition of chitin and abortive molting when ingested. The species chosen for this test, *M. gilvus* is one of the most prevalent and destructive subterranean termites found in Asia pacific region. The distribution of the termites is most common in suburban and rural areas of Philippines damaging structures, landscape trees and fruit trees.

Materials and methods

Materials

All materials used for the study were provided by Ensystex Inc., NC. USA. These include in-ground stations (IGS), Termite Bait (containing 1.0g/kg chlorfluazuron), control bait (bait matrix without chlorfluazuron) timber interceptors made from *Eucalyptus delegatensis* and various specialist tools.

Site description

The trial was established in a property in Antipolo, 55 km north from Manila City, Philippines. The property is a one hectare of suburban land covered with fruit trees. The entire property had over 15 *M. gilvus* mounds of various sizes.

Mound selection

This investigation was designed to study the process of colony elimination using live and active mounds. For this purpose three active mounds were chosen, spaced at distances not less than 50 meters from each other. Two mounds acted as treatment and one as control mound.

Installation of In Ground Stations and baiting

Four in-ground stations, each with 6 timber interceptors were placed around each of the three mounds. The distance of the IGS were fixed approximately100 cm from the center of the each mound. The IGS were locked and kept undisturbed for a period of 2 weeks before monitoring began. Once it was determined that feeding on the interceptors had occurred, indicating the presence of active termites in the station, the termite bait was added. The control mound received the bait without the active ingredient.

Bait preparation and application

The termite bait is in the form of processed cellulose powder consisting of proprietary cellulose/feeding matrix (999.0 g/Kg) with the bait toxicant chlorfluazuron (1.0 g/Kg). To prepare the bait, distilled water was added to the powder in a clean plastic bucket and the mixture stirred using a spatula to achieve a "dough" type consistency. A mixing ratio of 250g of bait to 1000mL of water was used. A plastic scoop was used to fill the IGS with the bait mixture. The amount of dry bait in grams was measured before adding it to IGS throughout the study period.

Monitoring colony health

Colony health was determined by inspecting the IGS every two-week. Stations were replenished with fresh bait as required based on consumption. The monitoring and bait supplementation process

continued until a complete cessation of feeding activity was noticed in the test mounds. However the control mound continued to receive the control bait until destruction.

Mound destruction

On cessation of feeding in the test mounds, a 4 week time interval was strictly followed prior to mound destruction. During this 4 week period IGS with uneaten bait was kept undisturbed, allowing the termites to return and initiate feeding. After the 4 weeks from cessation of feeding the mounds were destructively sampled and the soil thoroughly examined for termites. The control mound was also sampled similarly.

Results and discussion

First inspection

The site was inspected two weeks after installation of the in-ground stations on the two test and one control mounds. Termites were found consuming the wooden interceptors in all the stations. This indicated that all three mounds selected were healthy and fit for continuation of the tests.

Baiting and subsequent inspections

Week 2: Following successful interception of termites in the in-ground stations, the termite bait was added to each station. In the control mound the control bait as added. The bait mixture in the form of "dough" was loosely dropped in the station without compacting until the stations were completely filled.

Week 4 and 6: Inspection revealed large number of worker termites and near total consumption of bait in most stations. A large amount of mud-packing was observed in all the stations, filling the space previously occupied by the bait. The degree of consumption varied but not significantly among all the IGS. Most IGS showed over 90% consumption and no station showed less than 60% consumption. Mostly worker termites were found feeding in the stations. Irrespective of the feeding all the stations were again replenished with the bait to allow continuous feeding.

Weeks 8: A considerable reduction in feeding was noticed from week 8 onwards on all three mounds. All the IGS on the test mounds from week 8 onwards showed a large amount of uneaten bait with lesser numbers of active termites compared to all previous visits. The ratio of soldiers to workers in the stations showed marked increase than previously noticed.

Week 10 and 12: **A** complete cessation in bait feeding was observed at week 10 for mound 1 and week 12 for mounds 2 of the test mound. The total amount of bait used at week 12 is depicted in Table 1. The Stations were left undisturbed with the uneaten bait for 4 weeks for further monitoring.

Week 16: A final inspection to confirm colony elimination occurred 16 weeks from the date of installation of IGS on the test mounds. These mounds were thus identified as potentially eliminated due to the lack of visible activity and absence of repair works on inspection spots. Each mound was destructively sampled using a pick and shovel and observations made. The control mound was sampled simultaneously.

Table 1: Total amount of termite bait (dry weight) added for each of the sampled *M. gilvus* mounds.

Duration	Amount of bait added per mound (dry weight)		
	Control Mound	Treated Mound 1	Treated Mound 2
Week 2	1000 gm	1000 gm	1000 gm
Week 4	800 gm	800mgm	800 gm
Week 6	800 gm	600 gm	600 gm
Week 8	800 gm	200gm	600 gm
Week 10	750 gm	0 gm	150 gm
Week 12	800 gm	0 gm	0 gm
Total at week 12	4950 gm	2600g	3150 gm

Careful observation of the content of the test mounds revealed lack of activity inside. Further examination revealed desiccated bodies of worker and soldier castes in a number of spots inside the mounds. The dead termites were bundled together in mass. No live workers were found in the test mounds number 1. In test mound number 2, a few primary and secondary soldiers were found. A few early instars were located in the mounds also. These were possibly in egg forms when the bait was being consumed and hatched in course of the colony elimination.

The queen and king could not be located in the royal chamber in mounds 1, but in mound 2 a dead queen was located in the royal chamber with a few live worker and soldier termites in immediate vicinity. The bodies of these workers should dark pigmentation characteristic with bait consumption.

The control mound showed no visible effects and termites continued to feed on the control bait until destroyed. The weekly consumption of the bait remained high and uniform in this period.

Conclusions

This study proved that the termite bait using chlorfluazuron as an active ingredient is effective in critically suppressing and possibly eliminating colonies of higher group of termite *M. gilvus.* The exact mode of transfer of the bait toxicant to the colony is still unclear in this study and efforts are being made to determine this in another study.

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