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EVALUATING A BAITING SYSTEM FOR MANAGEMENT OF TERMITES IN LANDSCAPE AND ORCHARD TREES IN AUSTRALIA, HONG KONG, MALAYSIA, AND THE PHILIPPINES

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Abstract A termite baiting system was evaluated in field experiments in Australia, Hong Kong, Malaysia and the Philippines. Alpha-cellulose powder containing chlorfluazuron (Requiem™) was tested for its efficacy in eliminating colonies of subterranean termites in landscape and orchard trees. Traditional methods are frequently not suitable due to difficulties in creating a soil barrier system. Using 0.1% weight/weight chlorfluazuron there was no evidence of repellence and all colonies were eliminated.

Key words bait technology, chlorfluazuron, *Coptotermes*, *Globitermes*, *Macrotermes, Microcerotermes*, *Nasutitermes, Odontotermes.*

INTRODUCTION

The Exterra™ Termite Interception and Baiting System, utilises a toxicant incorporated into an edible bait matrix (Requiem™). The toxicant used in Australia and South East (SE) Asia is chlorfluazuron (a chitin synthesis inhibitor) and the bait matrix is alpha-cellulose. Both the system and bait toxicant were tested under climatic conditions prevalent in the region, against termite species of economic importance to structural timber. This was required for product registration in these countries (Peters and Broadbent, 2003; 2005, Peters and Fitzgerald, 2003).

Termites are also important pests of trees (Roonwal, 1970); particularly orchard trees (mango, durian and rambutan) and commercial plantation crops (rubber trees, oil and coconut palms). Traditional methods, such as soil barrier treatments with termiticides, are frequently not suitable due to difficulties in creating and maintaining a soil barrier system (Sajap et al., 2000). While bait toxicants are gaining importance to eliminate subterranean termites in the region (Garcia et al., 2007), according to Acda (2004, 2007) the ability of termite baits to control higher termites (Termitidae) under tropical conditions is still unclear.

In this study we evaluated the efficacy of chlorfluazuron in eliminating colonies of termites in landscape and orchard trees in twenty trials conducted in Australia (6), Hong Kong (3), Malaysia (4) and the Philippines (7). The termites in Australia were: *Coptotermes acinaciformis* (Froggatt) and *C. frenchi* Hill; Hong Kong: *Odontotermes formosanus* (Shiraki); Malaysia: *Coptotermes curvignathus* Holmgren, *Globitermes sulphureus* (Haviland) and *Nasutitermes havilandi* (Desneux) and the Philippines: *Coptotermes vastator* Light, *Macrotermes gilvus* (Hagen), *Microcerotermes losbanosensis* Oshima and *Nasutitermes luzonicus* (Oshima). The genera *Globitermes*, *Macrotermes*, *Microcerotermes* and *Nasutitermes* and *Odontotermes* are in the family Termitidae. We present and discuss the results of the study in this paper.

MATERIALS AND METHODS

Aggregation Devices and Application

Requiem is alpha-cellulose powder containing 0.1% weight/weight (w/w) chlorfluazuron. Two types of aggregation devices (Stations) were used to house the bait matrix: in-ground Stations (IGS) and above-ground Stations (AGS).

An IGS basically consisted of a 1.3 L cylindrical plastic container with perforated sides and bottom to allow termite entry. Six wood (*Eucalyptus delegatensis*, 175mm × 36.5mm × 5mm) interceptors lined the outer wall of the IGS allowing for simple termite detection during monitoring and the addition of bait matrix without disturbing the termites. The IGS were installed using a soil auger around the tree to monitor and aggregate foraging termites. A damp bait matrix was added to some IGS when termite activity was discovered. A doughy texture was achieved by mixing the alpha-cellulose powder and chlorfluazuron (240 g) with 1.5-1.7 liter of clean water. he AGS used was a plastic construction (180 mm × 80 mm × 80 mm) with perforations on the bottom allowing termite entry. The device was filled with 140 g of bait matrix mixed with 0.55-0.88 liter of clean water (1.5 parts water to 1 part bait matrix by volume) and screwed in place on the termite-infested tree (over active galleries).

Inspection

Stations were inspected regularly (weekly, fortnightly or monthly) to determine the amount of bait consumed by the termites. The bait was replenished as required at each visit. Bait replenishment was continued until bait consumption ceased. The Stations were then left undisturbed and monitored in case further feeding occurred. If no further feeding was detected, the IGS was cleaned, fresh wood interceptors installed and monitoring continued. The AGS were left in place for a month before removal and further monitoring continued.

Monitoring Colony Health

In the Australian trials, conducted in New South Wales (NSW) and in Queensland (QLD), trees and stumps were drilled to confirm the existence of a termite colony. A long temperature probe which records the temperature within the tree was used to monitor colony health (Gerozisis and Hadlington, 2001). The temperature of a healthy colony of *C. acinaciformis* is about 36°C. Temperatures of 26-34°C often indicate the central nursery area is close to the insertion point. Readings up to 45°C may be obtained shortly after colony demise due to decomposition of dead termites. About two weeks later, the temperature within the tree returns to ambient.

In the other trials, final colony demise was more circumstantial because the Stations and trees were re-inspected at either six or twelve months after bait consumption ceased. The absence of termite activity was strongly indicative of colony demise, but not proof.

RESULTS AND DISCUSSION

Field Trials

Australian Field Trials. Trial 3 was typical of the Australian trials (Table 1). Upon initial inspection, *C. acinaciformis* was found active in the parquetry flooring of the main living room of the house. Heavy termite activity was located in the tree immediately in front of the property. This gum tree was suspected of housing a termite colony, flight holes were visible. The tree was core drilled and live termites were located. The tree was then temperature probed and a reading of 35.2°C was obtained in the root crown of the tree compared with 25.3°C ambient. About 700 g of alpha-cellulose powder and chlorfluazuron was consumed during a 16-week period from two AGS attached to the tree. At that time no live termites were found inside the house or in the fifteen IGS positioned strategically around all sides of the property to monitor for termite activity. The gum tree was again core drilled. Termites were not present and the temperature reading in the root crown of the tree was ambient (25.4°C). No termites were present at the inspection 12 months later and colony elimination was therefore presumed. Results from the Australian trials indicate that C. *acinaciformis* and *C. frenchi* colonies can be successfully eliminated within 16 weeks using 400-1700 g of alpha-cellulose powder and chlorfluazuron**.**

Hong Kong Field Trials. *Odontotermes formosanus* was eliminated from three *Cinnamomun camphora* and one Cypress tree with 11500 g of alpha-cellulose powder and chlorfluazuron applied through 21 IGS and 4 AGS over a 31-76 week period (Table 1).

Malaysian Field Trials. *Coptotermes curvignathus* was successfully eliminated within eight weeks using about 470 g of alpha-cellulose powder and chlorfluazuron per tree, whereas the termitids *G. sulphureus* and *N. havilandi* required 500-625 g of alpha-cellulose powder and chlorfluazuron per tree over 11-18 weeks (Table 1).

Philippine Field Trials. *Coptotermes vastator* was successfully eliminated within eight weeks using 400 g of Requiem per tree, whereas the termitids *Macrotermes gilvus*, *Microcerotermes losbanosensis* and *Nasutitermes luzonicus* consumed 750 -2750 g of alpha-cellulose powder and chlorfluazuron per tree over 6-18 weeks (Table 1). These data are consistent with observations reported by Garcia et al. (2007).

Chlorfluazuron is particularly effective (low total bait consumption over a short time) in eliminating colonies of *Coptotermes* spp. (rhinotermitids) from structural timber and landscape and orchard trees throughout the region. Termitids, particularly the fungus feeding *Globitermes sulphureus*, *Macrotermes gilvus* and *Odontotermes formosanus*, require considerably more total bait consumption over a longer time, but they were eliminated.

Further work is required, particularly with termitids, to determine the minimum amount of bait to secure colony elimination. In Australia, for example, *Nasutitermes exitiosus* (Hill) can consume bait for lengthy periods; in excess of 6 months (Broadbent, unpublished data). Examination of these colonies showed that only workers and soldiers from the final instar moult were present. Termites affected by chlorfluazuron stopped feeding on timber (Lenz et al., unpublished data), possibly due to softening of their mouthparts (Rojas and Ramos-Morales, pers. commun.), but survived on the bait. Consequent work, involving removal of the bait at three months, resulted in quick colony elimination, presumably due to the inability of the termites to consume other food sources.

Table 1. Locality, termite species and treatment details with the Exterra Termite Interception and Baiting System in Australia, Hong Kong, Malaysia and the Philippines.

Trial No.	Locality	Termites	Tree	No. wks	Mass consumed (approx.)
Australia					
1	Bateau Bay Central Coast NSW*.	*Coptotermes acinaciformis*	2 × *Eucalyptus longifolia*	16	1500 g per tree
2	Narraweena, Sydney, NSW.	*C. acinaciformis*	1 × eucalypt tree, 1 × stump	16	1700 g
3	Mosman overlooking Sydney Harbour, NSW.	*C. acinaciformis*	1 × eucalypt tree	16	700 g
4	Girvan, NSW.	*C. acinaciformis*	1 × eucalypt tree	15	400 g
5	Brisbane, QLD*	*C. acinaciformis*	3 × eucalypt trees	16	400 g per tree
6	Sydney, NSW.	*C. frenchi*	1 × eucalypt tree	13	400 g
Hong Kong					
7	Tai Shui Hang	*Odontotermes formosanus*	1 × *Cinnamomun camphora*	54	2400 g
8	Tsing Yu	*O. formosanus*	1 × *C. camphora*	76	4300 g
9	Tsing Yi	*O. formosanus*	1 × *C. camphora* 1 × Cypress tree	31	4800 g
Malaysia					
10	Langkawi	*Coptotermes curvignathus*	5 × Royal Palms	8	470 g per tree
11	Bintulu, Sarawak, Borneo.	*Nasutitermes havilandi*	3 × Coconut Palms	18	600 g per tree
12	Bintulu, Sarawak, Borneo.	*Globitermes sulphureus*	2 × Coconut Palms	11	625 g per tree
13	Bintulu, Sarawak, Borneo.	*N. havilandi*	2 × Mango trees	12	500 g per tree

* NSW = New South Wales; QLD = Queensland.

Table 1 (Cont.). Locality, termite species and treatment details with the Exterra Termite Interception and Baiting System in Australia, Hong Kong, Malaysia and the Philippines.

Trial No.	Locality	Termites	Tree	No. wks	Mass consumed (approx.)
Philippines					
14	Plantation in Laguna.	*Microcerotermes losbanosensis*	1 × Coconut Palm	17	1000 g
15	Plantation in Laguna.	*Nasutitermes luzonicus*	3 × Coconut Palms	12	750 g per tree
16	Montemar Beach Club Bagaac, Batan.	*Macrotermes gilvus*	1 × fire tree	6	2750 g
17	Urban Park in Manila City.	*M. gilvus*	1 × tree	18	1200 g
18	Mango orchard in Davao.	*M. gilvus*	9 × Mango trees	10	900 g per tree
19	Mandarin Oriental Hotel, Manila.	*C. vastator*	1 × tree	8	400 g
20	Fruit orchard in Palawan.	*M. gilvus* & *C. vastator*	2 × Mango, 2 × Oil Palm 1 × Durian, 1 × Rambutan	10	7000 g

DISCLAIMER

This article reports the results of research only. Mention of a proprietary product does not constitute an endorsement or a recommendation for its use by the Department of Primary Industries and Fisheries.

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