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EVALUATING A BAITING SYSTEM FOR MANAGEMENT OF TERMITES IN BUILDINGS (INDIA) AND EARTHEN DAM WALLS (BOTSWANA)

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Abstract The Exterra Termite Interception and Baiting System (Ensystex Inc., Fayetteville, NC) was evaluated in field experiments in India and Botswana. Alpha-cellulose powder containing chlorfluazuron (Requiem) was tested for its efficacy in eliminating colonies of various subterranean termite species in buildings and earthen dam walls. Termite baiting has gained wide acceptance for the management of termites in urban environments. Eight infested buildings and eight active mounds were treated at each experimental site (Dehradun, Mysore, and Roorkee) in India. Management of termites around earthen dam walls is a difficult issue since it is essential that the purity of the water for human consumption is maintained. This usually means that toxic soil termiticides cannot be used. The work involved the protection of more than 25 kilometres of dam walls at five major sites (Bokaa, Gaborone, Letsibogo, Nyywane and Shashe Dams) in Botswana. Using 0.1% weight/weight chlorfluazuron there was no evidence of repellence and all colonies were eliminated.
Key Words Bait technology, chlorfluazuron, *Heterotermes*, *Microcerotermes*, *Odontotermes*

INTRODUCTION

The Exterra™ Termite Interception and Baiting System utilises a toxicant incorporated into an edible bait matrix. The toxicant used in Australia, Africa and 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; Peters et al., 2008).

Termites are also important pests of earthen dikes and dams where they build large subterranean cavities which can result in collapse of the structure (Huang et al., 2006). In South China, most of the river dikes and reservoir dams are infested by *Macrotermes barneyi* Light and *Odontotermes formosanus* (Shiraki) (Zhong and Liu, 2002; Wang et al., 2009). Termites in the genera *Macrotermes, Microtermes* and *Odontotermes* (Family Termitidae) are fungus growers and are widespread throughout southern Asia and Africa (Schuurman, 2006). Traditionally these genera have been considered more difficult to manage by termite baiting techniques than genera of lower termites (Family Rhinotermitidae) (Acda, 2007). Management of termites around dam walls is a difficult issue since it is essential that the purity of the water for human consumption is maintained. This usually means that toxic soil barrier treatments with termiticides cannot be used. Additionally, the use of herbicides may be prohibited, which in turn leads to vegetative growth that can only be dealt with manually.

In this study we evaluated the efficacy of chlorfluazuron in eliminating colonies of termites in buildings in India and in earthen dam walls in Botswana. Eight infested buildings and eight active mounds were treated at each of three experimental sites (Dehradun, Mysore and Roorkee, India). The work also involved the protection of more than 25 kilometres of dam walls at five major sites (Bokaa, Gaborone, Letsibogo, Nyywane and Shashe Dams, Botswana). The predominant termite species present in India were: *Heterotermes indicola* (Wasmann), *Odontotermes bellahunisensis* (Holmgren & Holmgren), *O. wallonensis* (Wasmann), *O. feae* (Wasmann) and *O. obesus* (Rambur). In Botswana the termites were mostly *Odontotermes* spp. and *Microcerotermes* spp. We present and discuss the results of this study.

MATERIALS AND METHODS

Aggregation Devices and Applying Baits

The Baiting System with Requiem bait matrix were sourced from Ensystex Australasia Pty. Ltd. New South Wales, Australia. 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 (Quarterra Large Capacity Station) consisted of a 1.3 l cylindrical plastic container with perforated sides and bottom to allow termite entry. Six termite interceptors (*Eucalyptus delegatensis*, 175 mm ↔ 36.5 mm ↔ 5 mm) 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 (with Focus Termite Attractant [Broadbent et al., 2006] in Botswana) using a soil auger to monitor and aggregate foraging termites. A damp bait matrix was added to IGS when termite activity was discovered. A doughy texture was achieved by mixing Requiem (240 g) with 1.5-1.7 l of clean water.

The AGS used was the proprietary Exterra Station: a plastic construction (180mm ↔ 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 L of clean water (1.5 parts water to 1 part bait matrix by volume) and screwed in place on termite-infested timbers. In India, Stations were inspected weekly; whilst in Botswana, each Station was inspected every three months. Stations were replenished if all, or most, of the termite bait was consumed.

India Buildings

Eight infested buildings were selected at each experimental site (Dehradun, Mysore and Roorkee). In-ground Stations were installed strategically around each structure at a distance of about 400 – 600 mm from the perimeter walls. The numbers of Stations used were as follows: Dehradun (100 IGS and 37 AGS); Mysore (95 IGS and 34 AGS); and Roorkee (121 IGS and 65 AGS).

India Mounds

Ten active mounds of *Odontotermes obesus* were selected at each experimental site (Dehradun, Mysore and Roorkee). Mounds were selected on the basis of their physical proximity, ease of access, and other subjective attributes. The minimum height and diameter of selected mounds was 1.1m and 2.5 m, respectively; with a maximum height and diameter of 2 m and 3.5 m, respectively. Eight mounds at each site were treated and two were left as untreated controls. Four IGS were placed at each mound to be treated with 200 g of bait material. At each observation, a small section of mound was separated from the main structure and activity noted.

Botswana Mounds

Detailed transect surveys and mapping programs of termite mounds along the five dam walls were conducted. Mounds within 100m of the dam walls were located when walking the length of each dam along two-metre-wide transects. Whilst many of the mounds were up to 3m high and easy to locate, the majority were significantly smaller and often difficult to locate in the dense jungle scrub that usually commenced about 50m from the dam wall. All mound locations were mapped using General Packet Radio Service (GPRS) technology. IGS (with Focus Termite Attractant) were placed within 10 – 15 m of the dam walls. The position of all IGS was recorded using the GPRS technology.

RESULTS AND DISCUSSION

India Buildings

Termites were aggregated in most (58%) of the Stations within one week; Dehradun (73, 53%); Mysore (82, 64%); and Roorkee (105, 56%). The rate of bait consumption was highest during the first month. The average consumption of bait material per Station was: Dehradun (261g); Mysore (289g); and Roorkee (225g). Termites were aggregated in an additional (16%) of the Stations within two months; Dehradun (27, 20%); Mysore (23, 18%); and Roorkee (24, 13%). Some (26%) Stations remained un-occupied at one year: Dehradun (37, 27%); Mysore (24, 19%); and Roorkee (57, 31%). All termite-infested buildings appeared free from termites within fifteen to seventeen weeks, presumably due to colony elimination.

India Mounds

An increase in the ratio of soldier to worker termites was recorded in treated mounds at two months, and a slight mottled discoloration to the termites was noted. No live termites were found in any of the treated termite mounds at four months: destructive sampling confirmed colony elimination and revealed dried-up fungus gardens. All untreated control mounds were healthy, with the termite queen present.

Botswana Mounds

Several hundred mounds, mostly of *Odontotermes* spp. and *Microcerotermes* spp., were mapped within 100m of most dam walls: Bokaa (223), Gaborone (266), Letsibogo (192), Nyywane (11) and Shashe (491). IGS were installed as follows: Bokaa (316), Gaborone (1,110), Letsibogo (457), Nyywane (47) and Shashe (1,489). When installing the Stations at Gaborone dam a small troop of gray-footed Chacma baboons, *Papio ursinus griseipes* Pocock, was present on the dam wall. They were observant of the Station placement. However, they were not aggressive and ran-off if approached. Within a week of placement, 5 Stations were taken from the ground by the baboons. Fortunately, after breaking the Stations open and, presumably, finding no food present they ceased the practice. The damaged Stations were replaced and no further losses were recorded.

IGS were monitored for termite activity and baited as follows: Bokaa (79, 25%), Gaborone (622, 60%), Letsibogo (337, 74%), Nyywane (16, 34%) and Shashe (1246, 86%). Rebaiting was applied as necessary. For example, 468 out of 1,489 IGS placed at Shashe Dam required rebaiting three months after placement. At six months, all mounds at each of the five dams were free of termites, as confirmed by destructive sampling. Typical progression of colony elimination were initial feeding at IGS, reduced consumption/ numbers of termites over time, caste ratio changes and physiological and behavioural changes to the termites.

Since then no further activity by termites of these species has been reported at the various dams in the areas protected by the Stations. Activity of the harvester termite *Hodotermes mossambicus* (Hagen) was reported in the grassy regions on the top of the dam walls at Shashe Dam.

These data are similar to those reported for fungus-growing termites by Peters et al. (2008). In the present work however, *Odontotermes* spp. colonies were more rapidly eliminated using less bait. The reason for this is that the bait was made less freely available, especially in Botswana. In Australia, termitids 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. 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, as suggested in Peters et al. (2008). Further work is still required, particularly with termitids, to determine the minimum amount of bait to secure colony elimination.

CONCLUSION

Termite baiting with chlorfluazuron appears to be a viable option for fungus-growing termites (some Termitidae), but the response may be different from that of rhinotermitids.

DISCLAIMER

Mention of a proprietary product does not constitute an endorsement or a recommendation for its use by the Department of Employment, Economic Development and Innovation.

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