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MINIMUM PERIMETER TREATMENT AGAINST SUBTERRANEAN TERMITES (ISOPTERA: RHINOTERMITIDAE) USING IMIDACLOPRID IN MALAYSIA

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Abstract To minimize pesticide use and intrusion to homes, we evaluate the efficacy of an innovative limited interior perimeter plus external perimeter application of imidacloprid as an IPM option in post-construction termite control in a dilution of ratio 1:400. Seven private houses were chosen for the research. All the structures were treated as minimum interior and exterior drilling showed full control of the foraging termite population inside the structure within 3 months
Key Words imidacloprid, minimum perimeter treatment, *Coptotermes gestroi*

INTRODUCTION

Termites are social insects and in Peninsular Malaysia, there are about 175 species of termites (Tho, 1992). Sajap and Wahab (1997) and Mohd Yusri et.al. (2005) reported five main subterranean termite species caused huge economic damages to structures and crops were *Coptotermes gestroi, C. havilandi, C. kalshoveni, C. curvignathus* and *C. sepanggiensis*. The main nest of those species is difficult to determine because they are not mound builder termites. Other genera such as *Globitermes, Macrotermes* and *Schedorhinotermes* are also important pest although very rare infesting building. In Malaysia, conventional treatment consists of direct chemical spraying on to the active termites and support by drilling, drenching and injecting chemical along and underneath infested building. Since the banning of organochlorine and some of organophosphate (e.g.: chlopyrifos) for anti-termite treatment, new chemical group of termiticide and baiting concept are alternatives available to the pest control industry. According to Lee et al. (1999), the basic principle of subterranean termite control is to establish an impenetrable chemical between the termite colonies and the timber structures within the property. These conventional treatments with repellent termiticide usually use a large volume of chemicals in order to fully saturate the soil under and around a structure.

Traditional application technology associated with soil barrier treatments is destructive to properties and the use of high amount of finished product because it specifies a thorough application to the interior by drilling holes through the foundation, and a uniform application to the exterior perimeter (Potter and Hillery, 2003). To minimize the usage of termiticide inside a house, the minimum interior perimeter plus limited exterior treatment were conducted to seven private houses. The reason for using this method of application is because of the unique characters of imidacloprid of non repellent and the "transfer effect" (Abdul Hafiz and Abu Hassan, 2006).

METHODS AND MATERIALS

Test Sites

Site 1 (Bayan Baru), Site 2 (Bertam), Site 3 (Mengkuang), Site 4 (Gelugor), Site 5 (Kg. Guar Perahu), Site 6 (Bayan Lepas) received minimum perimeter treatment. Site 7 (Taman Rupawan) was given a full internal and external perimeter of the wall with imidacloprid (Premise 200SC 18% w/w). The structures were chosen based on the following criteria: 1) slab on grade construction; 2) clear evidence of an interior infestation of *Coptotermes* spp inside the structures, which included confirming the presence of any one of or a combination of exposed structural damage, exit holes, mud foraging tubes, foraging territory and

population estimation; and, 3) permission given by the owner and the resident to a reasonable access to both the interior and exterior of the structure for the duration of the study.

Feeding Assessment

The effectiveness of tested termiticides on termites was measured by using the amount of materials (pine billets or tissue paper) in the monitoring stations consumed by the termites. In all the trial sites, the amounts of food consumed by the termites were weighed biweekly before and after treatment. The infested blocks from the underground monitoring stations were brought to the Medical Entomology Laboratory, School of Biological Sciences, Universiti Sains Malaysia every two weeks and carefully disassembled. Here, the termites were removed by gently tapping the stakes over a plastic tray. They were them separated from the remaining debris by allowing access to a stack of five pine blocks (20 cm x 10 cm) that had been soaked in water for 24 hours. The termites were allowed to aggregate in the stacks of pine blocks within 4-6 h and were removed and weighed (Tamashiro et al., 1973). All woods were washed and oven-dried for 48 hours at 80°C and weighed to compute the wood consumption before and after feeding (Sajap et al., 2000; Abdul Hafiz and Mohd Hadzri, 2007). For the above ground monitoring station, the weight of the toilet tissue paper was predetermined before being fed by the termites. They were reweighed and recorded biweekly. The infested toilet tissue paper was then brought back to the Medical Entomology Laboratory, School of Biological Sciences, Universiti Sains Malaysia. The infested toilet tissue paper was then unrolled and manually cleaned and the termites were separated. Then it was oven-dried for 48 hours at 50°C and reweighed so to as compute the amount toilet tissue paper consumed before and after feeding (Sajap et al., 2000, Abdul Hafiz and Mohd Hadzri, 2007).

Treatment of Structures

Sites 1, 2, 3, 4, 5 and 6 were treated by using the minimum perimeter treatment technique with imidacloprid. In this technique, the structure was treated with 0.05% imidacloprid solution. The minimum exterior perimeter wall plus the limited interior perimeter wall of building treatments were conducted in selected infested areas where the termites were foraging. The technique was to modify the current practice used by the Pest Control company known as Conventional Corrective Treatment. The main purpose of this treatment specification is to minimize treatment, especially in minimizing drilling through concrete slabs, in the minimum perimeter area of the house where the termites are foraging. Site 1 was treated in week 20. Site 2 was treated in week 26. Meanwhile site 3 was treated in week 13. For Site 4, the treatment was conducted in week 16. Site 5 was treated in week 35 and Site 6 was treated in week 32.

Site 7 (Taman Rupawan) was given a full treatment of the interior and exterior perimeter for every perimeter of the wall. This practice is currently used by the pest control operators. The site was treated in week 14. The equipment used for every trial site included a generator, hose pipe, drum, slab injector and flow meter. Holes were drilled around the perimeter wall of the buildings and the distance between each drilled hole was 45 cm. The imidacloprid was diluted with water in the ratio of 1:400 (0.05%). Five liter solution was injected using an injector into each hole.

Post-Treatment Observations

All treated homes/structures were inspected after being treated for termite activity at 1-month, 2-month, 3-month or 6-month intervals for subterranean termites infestation inside and outside the house. The efficacy of treatment was made based on the rate mean consumption from the monitoring stations biweekly before and after treatment.

RESULT AND DISCUSSION

Minimum Perimeter Treatment.

A total of 86 holes were drilled in **Site 1** (Bayan Baru). The termite activities still remain active in all the monitoring stations after the treatment, but the food consumed by the termites dropped during the first week (Figure 1). In the second week, the food consumption increased. Five weeks after the treatment, the food consumed began to decrease. The second treatment was conducted in week 28. For the second treatment,

wooden structures were injected with the solution of imidacloprid in the ratio of 1:800 using disposable syringe. Small spot spraying of imidacloprid solution was done at every corner of the floor in the ratio of 1:800. One week after the second treatment (week 29), termite feeding ceased in all the above ground monitoring stations. The total mean feeding consumption before the first treatment was 15.43g. The total mean food consumption after the first treatment was 724.08g. After the second treatment, a total of 13.02 g of food was consumed before the termites ceased feeding.

Site 2 (Bertam). A total of 80 holes were drilled. Two weeks after the treatment (week 28), there were no feeding activities in the monitoring stations (Figure 2). The total mean feeding consumption before the treatment was 4.98 g. No new signs of infestation were observed after three months of the treatment.

Site 3 (Mengkuang). A total of 64 holes were drilled. After the treatment in week 13, the population was still active with the mean wood consumption of about 25g (Fig. 3). Five weeks (week 18) after treatment, no termites were detected in any of the underground monitoring stations around the building. The total amount of mean feeding consumption before the treatment was 58.66 g. The total amount of mean food consumption after the treatment was 4.48 g before the termite consumption began to cease on the week 18.

Site 4 (Gelugor). A total of 75 holes were drilled. Two weeks after the treatment, the wood feeding consumption by the termites decreased as shown by the above ground and underground monitoring stations (Figure 4). By week 18, after 4 weeks of the treatment, the food consumption was no longer observed in all the four underground monitoring stations and the two above ground monitoring stations. The total of mean feeding consumption before the treatment was 85.1 g. The total amount of mean food consumption after the treatment was 5.08 g before the termite feeding activities ceased.

Site 5 (Kg.Guar Perahu). A total of 56 holes were drilled. One week after the treatment (week 36), the consumption rate decreased in the above ground monitoring station. Three weeks after treatment (week 40), the feeding activity stopped completely in all the above ground monitoring stations (Figure 5). The total amount of mean feeding consumption before the treatment was 9.56 g. The total amount of mean food consumption after the treatment was 6.39 g before the termite feeding activities completely stopped.

Site 6 (Bayan Lepas). A totals of 56 holes were drilled. Two weeks after the treatment (week 34), the food consumption decreased (Figure 6). In week 36 and 38 the food consumption of the termites decreased and later they ceased feeding. The termite feeding consumption ceased in week 40. The total amount of mean termite feeding consumption before the treatment was 17.94 g. Total amount of mean food consumption after the treatment was 5.41 g before the termite feeding activity ceased.

Site 7, full treatment. Site 7 (Taman Rupawan), received full perimeter treatment. A total of 271 holes were drilled. Two weeks after treatment (week 16) the amount of food taken by the termites decreased in the above ground monitoring stations (Figure 7). There was a slight increase in the food consumed in the underground stations. Four weeks post treatment (week 18), no feeding activity was detected in all the above ground monitoring stations, and termite feeding had decreased in the underground stations. In week 20, the termite feeding activities stopped in all the above ground and underground monitoring stations (Figure 7). One of the underground monitoring stations was located in untreated house. The result showed that there was a transfer effect from the treated to the untreated house. From the foraging study, the termite colony of the treated and untreated house was from one colony. The total amount of mean feeding consumption before the treatment was 77.32 g. The total amount of mean food consumption after the treatment was 66.93 g before the termite consumption ceased away.

According to Potter and Hillery (2003), the application of repellent termiticide can be more destructive to property due to the traditional application method. Non-repellent termiticides can be applied solely around the exterior building perimeter plus limited interior, especially at the termite infestation area. The delayed mode of action permits the transfer of toxicant from exposed termites to unexposed nest mates through social interactions including mutual grooming, thus causing secondary mortality in the termite population (Potter and Hillery 2003; Hu and Hickman, 2006; Gurbel et al., 2007; Abdul Hafiz et al., 2007a, 2007b). All the sites that received minimum perimeter treatment controlled the termites within 3-5 weeks. Site 7, which received full treatment controlled termites within 8 weeks. Those sites that used lesser amounts of imidacloprid solution for minimum perimeter treatment controlled termite infestation faster than the site which received

more imidacloprid solution for full perimeter treatment. The perimeter treatment reduced time and amount of termiticide and allowed the pest management professionals to charge less to property owners for termite treatments. Environment hazards may be minimized due to the less usage of termiticide.

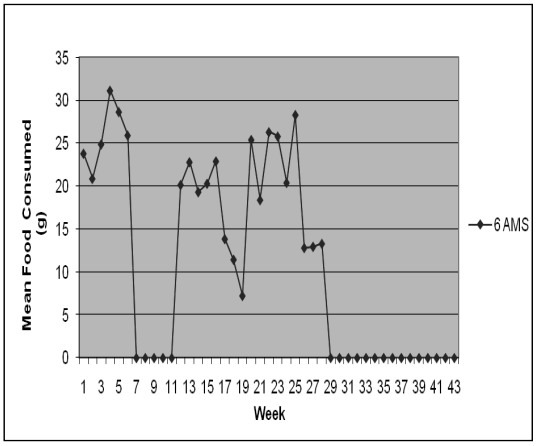

Figure 1. Mean food consumption before and after treatment (wk 29) at Site 1 (Bayan Baru).

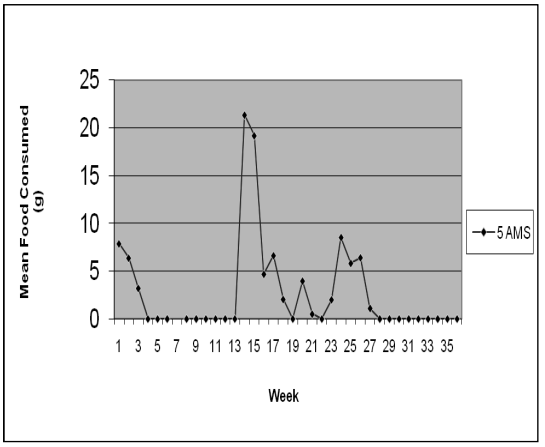

Figure 2. Mean food consumption before and after treatment (wk 28) at Site 2 (Bertam).

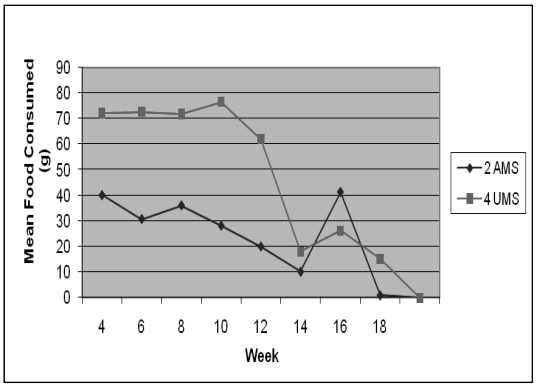

Figure 3. Mean food consumption before and after treatment (wk 13) at Site 3 (Mengkuang)

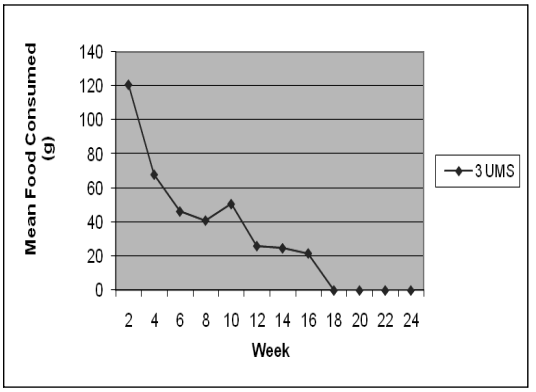

Figure 4. Mean food consumption before and after treatment (wk 14) at Site 4 (Gelugor)

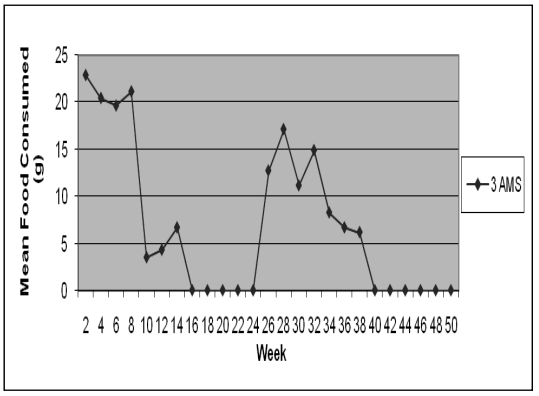

Figure 5. Mean food consumption before and after treatment (wk 36) at Site 3 (Kg. Guar Perahu)

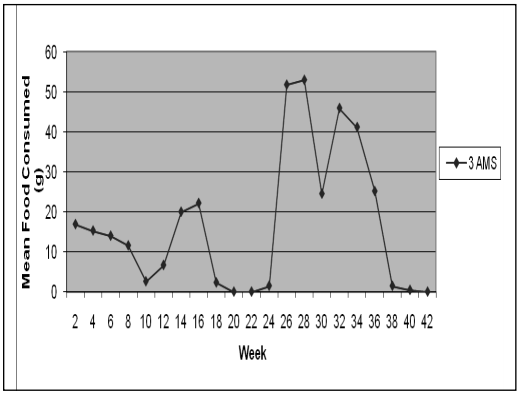

Figure 6. Mean food consumption before and after treatment (wk 34) at Site 6 (Bayan Lepas)

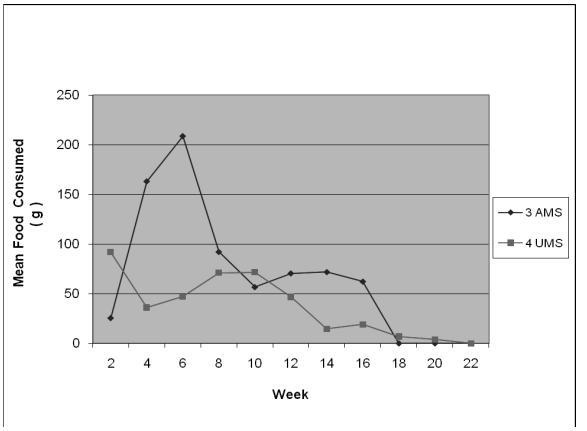

Figure 7. Mean food consumption before and after treatment at Site 5 (Taman Rupawan). UMS = Underground monitoring station, AMS = Above ground monitoring station

CONCLUSION

The studies show that after the treatment the colony feeding activities ceased within 3-8 weeks. Even though the test results of the minimum application technique look promising, but we are not yet ready to declare the elimination of these termites at the colony level. It is well known that termite feeding in monitoring stations can fluctuate over time. Thus, the absence of termites over a short term does not necessarily mean that colonies were eliminated. Long term monitoring of termites in our studies and other test sites will provide the best determination for colony elimination following the application of imidacloprid. As a conclusion from this study demonstrates that the minimum perimeter treatment minimizing the termiticide used, caused less number of holes drilled on the floor, utilized less chemical and reduced labor cost and time saving. Most important is lesser amount chemical into injected into the environment but still provide effective and longer protection which it is a good option to pest control.

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