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SHORT COMMUNICATION

PRELIMINARY FIELD EFFICACY OF TRANSFER EFFECT OF SLOW ACTING TERMITICIDE (IMIDACLOPRID) ON SUBTERRANEAN TERMITES POPULATION *(COPTOTERMES GESTROI)* (WASMANN) (ISOPTERA: RHINOTERMITIDAE)

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Abstrak: Anggaran populasi anai-anai *Coptotermes gestroi* (Isoptera: Rhinotermitidae), aktiviti mencari makanan dan kawalan menggunakan termitisid tindak balas perlahan, Premise® 200SC yang mengandungi 18.3% w/w imidacloprid dikaji di Penanti, Seberang Perai Utara, Pulau Pinang, Malaysia. Tiga stesen pemantauan bawah tanah dipasang pada tapak kajian ini. Daripada kajian tangkap tanda lepas tiga kali (TMR), populasi *C. gestroi* ialah 2 142 215 ± 86 949. Keluasan perilaku mencari makanan dan jarak maksimum masing-masing adalah 14.45 m^2 dan 10 m. Purata kadar pemakanan kayu per dua minggu dalam julat 54.4–130.1 grams/stesen sebelum rawatan. Rawatan dijalankan dengan membuat satu penghadang berterusan imidacloprid di sekeliling salah satu dari tiga UMS dengan menembak masuk larutan termitisid ke dalam tanah pada kadar bancuhan 1:400 (Premise® 200SC:air) dan lima liter bancuhan Premise® 200SC setiap lubang pada jarak 33.3 cm setiap lubang. Aktiviti anai-anai berhenti 8 minggu selepas rawatan. Pada ketiga-tiga UMS, hal ini menunjukkan bahawa berlakunya kesan "pemindahan racun" dan berkemungkinan menghapuskan keseluruhan populasi anai-anai tanah.

Kata kunci: *Coptotermes gestroi,* Imidacloprid, Pemindahan Racun, Termitisid Tindak Balas Perlahan

Abstract: Population estimation of *Coptotermes gestroi* (Isoptera: Rhinotermitidae), foraging activity and control by using a slow acting termiticide, Premise® 200SC containing 18.3% w/w imidacloprid was studied in Penanti, Seberang Perai Utara, Penang, Malaysia. Three underground monitoring stations (UMSs) were established in this site. The triple mark recapture (TMR) technique estimated the population *C. gestroi* was 2 142 215 ± 86 949. The foraging territories and maximum foraging distance were 14.45 m^2 and 10 m, respectively. Mean wood consumption rate per two weeks ranged from 54.4–130.1 grams/station before treatment. The treatment was done by creating a continuous imidacloprid barrier in the soil surrounding one of the three UMS by injecting five liters of Premise® 200SC solution with dilution ratio of 1:400 (Premise® 200SC:water) per hole into the soil spaced 33.3 cm apart. The activities of the termites stopped eight weeks after the treatment. In all three UMSs, this showed that the "transfer effect" of this termiticide had taken place and probably had eliminated the whole colony.

Keywords: *Coptotermes gestroi,* Imidacloprid, Transfer Effect, Slow Acting Termiticide

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There are 175 species of termites in Peninsular Malaysia and they are all social insects (Tho 1992). In Malaysia, five species of termites are of economic importance as they bring damage to structures and crops (Sajap & Wahab 1997). The five species of termites are *Coptotermes gestroi*, *C. havilandi, C. kalshoveni, C. curvignathus* and *C. sepanggiensis*. All these species are subterranean termites which do not build mound. Since organochorinated termiticides have been banned, alternative termiticides are sought. The usage of Premise® 200SC containing imidacloprid is a non-repellent termiticide, in the soil, affects termites as they pass through the treated zone. It also produced transfer effect among the members of a termite colony through grooming and incidental contact. Previous research showed that the active ingredient of Premise®, imidacloprid, is transferred between individual termites (Thorne & Breisch 2001; Shelton & Grace 2003; Tomalski & Vargo 2004) and that effect can reach beyond the treatment area (Osbrink & Lax 2003; Abdul Hafiz & Abu Hassan 2006; Gurbel & Abu Hassan 2006; Abdul Hafiz *et al*. 2007).

Billets (2.5 × 2.5 × 15 cm) of the pine woods were installed in the ground within the range of 1.5 to 3 m apart around buildings/structures. Approximately 100–300 stakes were used for every study site.

Pine billets that were infested with termites were replaced at the UMSs. In this site, three UMSs were established. The UMSs used in this research are similar to those as described by Su and Scheffrahn (1988). An UMS consists of a hollow plastic container (20 cm in diameter by 19 cm in height). A bundle of nine pine stakes, oven-dried for 48 h at 80°C, cooled on a tray, and weighed before use, were placed in the bucket at the UMS. The buckets were buried at a depth of approximately 2.5 cm below the lid. The UMSs were examined every 2 weeks so as to observe termite feeding activities.

The infested blocks consisting of nine pine billets tied together were taken from the UMSs and brought to the Entomology Laboratory, School of Biological Sciences, Universiti Sains Malaysia fortnightly. They were then carefully disassembled. After that, the termites were removed by gently tapping the stakes over a plastic tray. Termites were separated from the remaining debris by allowing them to access to a stack of five pine blocks (20 × 10 cm) that had been soaked in water for 24 h. After a 4–6 h aggregation on pine blocks, they were removed and weighed (Tamashiro *et al*. 1973). The recovered termites were weighed on an analytical balance and their numbers were estimated based on the weight of 100 workers from the same wood block. Wood billets from the UMS and the toilet tissue paper rolls from the above ground monitoring station were washed, oven-dried and weighed to compute the feeding consumption from above ground and UMS.

After the establishment of ≥ 2 monitoring stations, a mark recapture program was carried out to estimate the foraging territory and the population size. For each termite collection, the mean body weight of the termite workers were determined by weighing five groups of 10 individuals each. The number of collected workers was determined by the total weight of collected workers and the mean worker weight. Termite workers collected from a station with a heavy activity (active feeding activity) were stained with 0.1% (wt/wt) Nile Blue A by a no choice feeding of stained filter paper (Whatman No. 1, 9.0 cm diameter) for

five days. The stained termites were released into one of the UMSs. The total number of stained termites released depends on the total number of termites recaptured from the active monitoring station and it varied for every study sites. The monitoring stations at each site were checked and the bait from the monitoring stations was collected seven days after the release so as to record the stained termites recaptured from the monitoring stations for that cycle. The Mean Begon Model was used to estimate the foraging population (Begon 1979). The mark released recapture cycle was repeated for three rounds. The foraging territory of a colony was defined as the area encompassed by the stations containing termites during the TMR cycles.

The number of marked and unmarked workers was recorded for each cycle. A weight mean model (Begon 1979) was used to estimate the foraging populations (N) and associated standard error (SE):

$$N = (\sum M_i n_i) / [(\sum m_i) + 1]$$

$$SE = N \sqrt{[1/(\sum m_i + 1)] + [2/(\sum m_i + 1)^2] + [6/(\sum m_i + 1)^6]}$$

Where,

n_i – the number captured
m_i – the number of marked individuals among captured termites
M_i – the total number of marked individuals up to the ith cycle

The number of marked termites released, termite recaptured and marked termites among recaptured termites during the TMR procedure are shown in Table 1. One week after the release, the initially marked termites were recaptured from most of the interconnected monitoring stations. Estimated foraging populations were 2 142 215 $\pm$ 86 949 (Table 1) with the foraging territory covered an area of 14.45 m^2. Mean food consumed by the foraging termites ranged from 54.4–130.1 grams/station before treatment.

A one meter square quadrate was laid in the middle made and the UMS. Twelve holes were spaced apart 33.3 cm around the one meter square quadrate. Premise® 200SC (imidacloprid) was diluted in the ratio of 1:400 (0.05%). The treatment was conducted on week 28 by injecting a five liter solution of Premise® 200SC into each hole such that the transfer effect could be traced to the other two stations within the termite colony. Termite activity was observed every week in all UMSs (Fig. 1).

Table 1: Number of marked termites released (r_i), number of termites captured (n_i) and number of marked termites among those captured (m_i) during a TMR program.

Colony (traps)	First collection & marking	Cycle	r_i	n_i	m_i	N ± SE
Guar Perahu	30 053	1	23 817 (2)	16 397 (1, 2, 3)	170	2 142 215 ± 86 949
		2	16 397 (1, 2, 3)	7 939 (1, 2, 3)	273	
		3	12 152 (1, 2, 3)	11 359 (1, 2, 3)	165	

The mean feeding consumption activities of the termites from the three UMSs is shown in Figure 1. Two weeks after the treatment, feed consumption of the termites decreased on week 30. By week 32, the wood feeding consumption increased (after four weeks of treatment), but by week 34 the consumption decreased after six weeks of treatment. By week 36 (eight weeks after the treatment) there was no longer wood feeding consumption in all the three UMSs. Presumably the transfer effect of imidacloprid had occurred since the treatment was conducted only at one of three UMSs. Imidacloprid is a non-repellent formulation; the termites did not realize the existence of imidacloprid barrier in the soil and consequently passed the active ingredient to the other termites in the colony through grooming and trophallaxis.

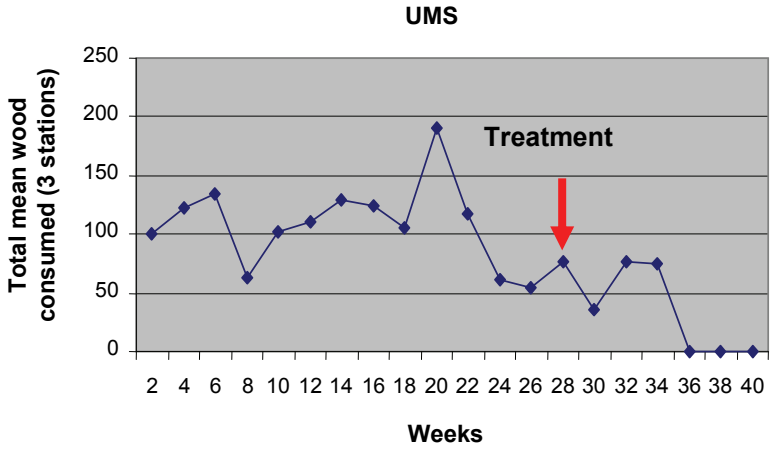

Figure 1: Food consumption before and after treatment of *C. gestroi*.

The results demonstrated that Premise® 200SC containing imidacloprid could be successfully employed to control termites with minimum treatment. Its non-repellency and slow acting property were able to masked. Its activity such that the termites had transfer the active ingredient, imidacloprid to the other termites in the two UMSs because the TMR technique (foraging population) showed that all termites from these three UMSs were from one colony.

Generally, the reduction in pesticide used by itself represents a benefit to both the public at large and the environment besides saving money and time (Hu & Hickman 2006; Waite *et al.* 2004) while the control was realized without compromising the protection from termites damage.

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