Evaluation of Methoprene Granular Baits Against Foraging Pharaoh Ants, *Monomorium pharaonis* (Hymenoptera: Formicidae)

by

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ABSTRACT

Field performance of a 0.5% methoprene-based granular bait (Protect-B) was evaluated against foraging Pharaoh ants, *Monomorium pharaonis* (L.) in pantries of dormitories of a university campus. A 1% hydramethylnon containerized bait (bait station) was used for comparison. Results indicated that both bait formulations provided more than 85% reduction in ant counts within 4 weeks post-treatment, and all baited populations were possibly eliminated within 8 weeks post-treatment. Subsequently, no Pharaoh ant was detected up to 12 weeks post-treatment. Upon reduction of Pharaoh ants, ant counts on index cards for several peridomestic species such as big-headed ant (*Pheidole megacephala*), ghost ant (*Tapinoma melanocephalum*) and crazy ant (*Paratrechina longicornis*) were increased. The methoprene bait also provided excellent performance against the big-headed ant, *Pheidole megacephala*, but they did not reduce *T. melanocephalum* and *P. longicornis* numbers. Hydramethylnon bait was ineffective against big-headed ant in this study.

INTRODUCTION

The Pharaoh ant, *Monomorium pharaonis* (L.), a cosmopolitan pest ant species, is one of the most important pest ant species in Malaysia (Yap & Lee 1994; Lee 2000; Lee & Robinson 2001; Lee 2002). This species survives well in warm and humid tropical climatic conditions, as well as indoor environments. The number of foraging ants within a colony varied between 5 – 10% of the total population (Adams *et al.* 1999; Lee 2002) and can be found infesting a building through many possible entries such as water ducts, windows, utility pipes, etc. Its presence is often annoying and can pose potential health risk by mechanically

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contaminating surface substrate of its foraging and feeding paths. Many species of bacterial pathogens have been isolated from the external bodies of the Pharaoh ants collected from various food outlets in Malaysia (Lee 2002).

Perimeter residual spray is a common practice for ant control among Malaysian pest control operators (Lee *et al.* 1996; Chong *et al.* 1998). Residual spraying, particularly use of pyrethroid insecticides has several limitations in control, including unpredictable efficacy due to heterogeneity of treatment surface (Knight & Rust 1990), insecticide repellency (Lee *et al.* 1999) and inability to eliminate the colony (Forschler & Evans 1994). Ant baits containing boric acid, hydramethylnon, imidacloprid, fipronil and insect growth regulators (IGR) had been reported to be effective in controlling the Pharaoh ant (Williams & Vail 1994; Vail & Williams 1995; Vail *et al.* 1996; Klotz *et al.* 1996; Lee 2000; Lee 2002; Lee & Lee 2002).

This present study reports the field performance of a new granular bait formulation containing a conventional juvenile hormone analog, methoprene at 0.5%, versus a commercial bait station formulation (containing 1% hydramethylnon) against Pharaoh ant populations. The effects of both baits against foraging populations of peridomestic pest ant species such as ghost ants (*Tapinoma melanocephalum*), crazy ants (*Paratrechina longicornis*) and big-headed ants (*Pheidole megacephala*) were also assessed.

MATERIALS AND METHODS

The study was conducted in pantries of several dormitories in Universiti Sains Malaysia, Penang, Malaysia. These areas are usually used for food preparation, dish washing and garbage disposal. The sanitary condition of the pantries varied among different hostels, but were generally moderate to poor during the course of this study.

Two baits were tested, namely Protect-B granular bait containing 0.5% methoprene (Balbona Bio, Hungary) and Combat Ant Killer bait station containing 1% hydramethylnon (Clorox, U.S.A.). Pre-sampling was done using index card method as described in Lee (2000) which was essentially a 7.5 x 6.5 cm ruled card baited with 3 g each of honey and peanut butter. A total of 5 index cards were placed at various locations within the pantry where ant trails were sighted. After 45 – 60 minutes, the number and species of ants sighted on the index cards were estimated and identified according to description of Na & Lee (2001). Only pantries with >100 Pharaoh ants per 5 cards were used in this study. The number of ants in sites assigned for each formulation were analyzed to ensure homogeneity in pre-treatment ant counts.

Table 1. Evaluation of 0.5% methoprene granular bait, versus 1.0% hydramethylnon ant bait station against *Monomorium pharaonis*.

Bait (% active)	n	Mean Pretreatment Count ± S.E.M.	Mean percentage reduction in total pharaoh ant count (± S.E.M.)[1] at post-treatment					
			3-day	1-week	2-week	4-week	8-week	12-week
Control	3	168.7 ± 25.5 a	9.6 ± 2.8a	- 15.9 ± 3.6ab	5.5 ± 2.7a	20.3 ± 2.4a	-1.5 ± 4.5a	-8.8 ± 2.5a
Hydramethylnon (1%)	3	157.7 ± 46.5 a	56.2 ± 7.9a	89.1 ± 5.3c	96.7 ± 1.4b	89.9 ± 8.0b	100 ± 0 b	100 ± 0 b
Methoprene (0.5%)	3	162.3 ± 43.6 a	21.1 ± 3.4a	51.9 ± 2.7bc	82.6 ± 7.1b	87.6 ± 1.6b	100 ± 0 b	100 ± 0 b

[1]mean values followed by same letter within the same column are not significantly different ($P > 0.05$; KW multiple range test).

At 24 hours prior to baiting, each chosen site was sampled again for ant counts. The numbers obtained served as the basis for comparison with the post-treatment ant counts. A total of three partially exposed sachets of Protect-B (20 g each), or three Combat bait stations were placed in the chosen pantries on locations where ant trails were visible during pre-sampling. Three pantries were treated per bait formulation. Control sites were pantries that were not treated. Post-treatment monitoring of ant numbers was done at 3-day, 1, 2, 4, 8 and 12 weeks post-treatment. The percentage reduction (PR) in ant counts at each site was calculated, pooled for each treatment and subjected to Kruskal-Wallis (KW) analysis of variance, and means were separated with KW multiple range test (Siegel & Castellan 1988).

RESULTS AND DISCUSSION

There appeared to be no significant difference between the speed of action of the two bait formulations evaluated against the Pharaoh ant (Table 1). The percentage reduction in ant counts effected by hydramethylnon baits was significantly different ($P < 0.05$) from that of the control at 2nd week post-treatment, while reduction caused by methoprene baits was not evidently significant from that of the former bait at this stage. At 4th week post-treatment, both baits demonstrated >85% reduction in ant counts. By the 8th week post-treatment, no more Pharaoh ant were sighted in all test sites treated with hydramethylnon and methoprene baits. These reductions were further sustained up to 12 weeks post-treatment. The results obtained were considerably promising, compared to those reported earlier by Lee (2000) on resurgence of hydramethylnon-treated populations of the Pharaoh ant at 8th week post-treatment. Edwards and Clarke (1978) reported the eradication of a large Pharaoh ant infesta-

tion (15,000 m^2) in a hospital in 18 weeks using 1% methoprene formulated in ox-liver powder. In another study, a colony treated with 0.5% fenoxycarb was completely eliminated in less than 6 weeks, but reoccurrence was detected after 24 weeks (Williams & Vail 1994).

Methoprene was previously found to be effective against Pharaoh ant (Edwards 1975; Edwards & Clarke 1978; Rupes *et al.* 1978; Wilson & Booth 1981). In this study, granular formulation of methoprene enhanced the distribution of toxicant from foraging workers to immature stages (compared to paste formulation), because solid food is only ingestible by the larvae. In return, the larvae regurgitate the partially digested food back to the workers to be distributed among the colony members (Lee *et al.* 1999). This process of toxicant distribution will cause an inhibitory effect on the colony growth, thus eliminating the colony slowly. In addition, like pyriproxyfen, methoprene affected not only the larval and pupal stages by preventing normal metamorphosis (Edwards 1975), but also reduced egg production of queen and induced sterility, thus decreasing worker numbers produced in longer period (Edwards & Clarke 1978; Rupes *et al.* 1978; Vail & Williams 1995).

In addition to the Pharaoh ant, several peridomestic pest ant species were also found on the index cards, including crazy ant (*Paratrechina longicornis*), big-headed ant (*Pheidole megacephala*) and ghost ant (*Tapinoma melanocephalum*) (Fig. 1). Although all species were allowed to feed freely on the bait, only big-headed ant counts were reduced throughout the sites treated with methoprene baits. This corresponded well with Lee (2002) that big-headed ants responded very well to granular bait, compared to other bait formulations (eg. paste, liquid and gel). We have also earlier eliminated a big-headed ant population with the same bait formulation using a total bait amount of 200 g. Hydramethylnon bait performed poorly against big-headed ants in this study (Fig. 1).

Both bait formulations did not provide good performance against crazy and ghost ants. This concurs well with that reported earlier by Hedges (1998) that *P. longicornis* and *T. melanocephalum* were considerably difficult to be baited. Lee (2002) earlier reported that both crazy and ghost ants preferred liquid-based bait formulation over gel and paste bases. Thus it is essential to take into consideration formulation preference of the relevant pest ant species when a baiting program is executed.

Another interesting phenomenon observed in this study was the occurrence of ghost ants and big-headed ants as the major ant species in locations where Pharaoh ants have been eliminated (Fig. 1). Earlier, Lee (2002) reported increase in crazy and ghost ant numbers upon

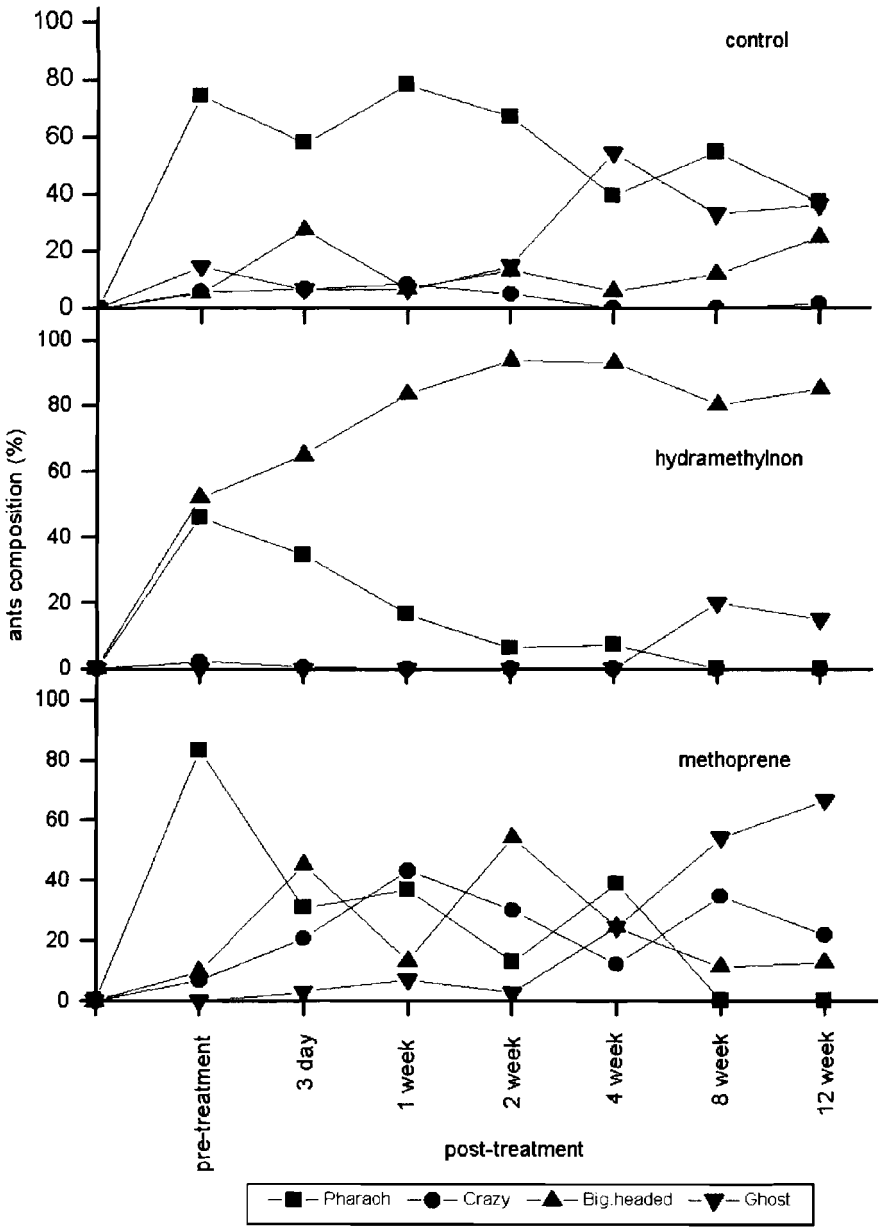

Fig. 1. Composition of peridomestic ant species upon baiting against *Monomorium pharaonis*.

elimination of *Monomorium* populations with imidacloprid baits. The author suggested that upon elimination of a more dominant species, other tramp species such as ghost and crazy ants (which initial foraging territories were limited by the *Monomorium* spp.) were now able to forage at a wider area for food and thus were found in larger numbers on index cards. This observation warrants further investigation.

In summary, 0.5% methoprene granular bait (Protect-B) was demonstrated to be an excellent bait formulation against Pharaoh ants and big-headed ants in this study. It was however, indirectly shown to be ineffective against ghost and crazy ants. Further studies should be conducted using more test sites to further substantiate current findings.

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