Influence of sanitary conditions on the field performance of chlorpyrifos-based baits against American cockroaches, *Periplaneta americana* (L.) (Dictyoptera: Blattidae)

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ABSTRACT: The role of sanitation in performance of insecticidal bait stations containing 0.5% chlorpyrifos against the American cockroach, *Periplaneta americana* (L.), was investigated in residential premises. Test sites were chosen from three locations in Penang Island, Malaysia, and clustered according to their sanitary conditions. Results indicated that at 1-week post-treatment, houses with good sanitary conditions showed a significantly faster reduction ($P>0.05$) in the number of cockroaches trapped (>95%) than those with moderate and poor conditions. At 6 weeks post-treatment, all houses treated with insecticidal baits showed no significant difference in terms of reduction rate of cockroach numbers ($P>0.05$), irrespective of sanitary condition. However, the bait performance in houses with poor sanitary conditions could not be sustained up to 12-week post-treatment. ***Journal of Vector Ecology* 25(2): 218-221. 2000.**

Keyword Index: *Periplaneta americana*, American cockroach, baiting, sanitation

INTRODUCTION

Because of their ubiquitous habits and association with humans, cockroaches are important insect pests in the urban environment. They are potential mechanical vectors of human diseases (Brenner 1995, Lee 1997). Inhalants and allergens produced by cockroaches have also received much attention with the increase in household allergy and asthma problems (Kang & Chang 1985, Brenner et al. 1991, Lee 1997). In the Southeast Asia region, the American cockroach, *Periplaneta americana* (L.) is an important pest in residential premises (Lee et al. 1999). Earlier, it was reported as the dominant cockroach pest species in Malaysian households (Oothuman et al. 1984, Yap et al. 1991, Lee et al. 1993, Yap et al. 1997, Lee and Lee 2000). In residential premises, it is commonly found in the kitchen, bathroom and old cabinets, as well as in outdoor sewage tanks. Control of this species is commonly done by Malaysian householders through the use of residual and direct treatment with aerosol insecticides.

Compared with residual and direct treatment methods, baiting is a better option because it can achieve a similar level of control with a reduced likelihood of pesticide misapplication (Robinson 1988). Cockroach baiting with gel or bait stations is an effective method of control, and had been reported to perform well against field populations of the German cockroach (Reierson et al. 1983, Milio et al. 1986, Appel 1990, Appel 1992, Ogg and Gold 1993, Appel and Benson 1995, Lee 1998). Baits also provided good control against the smokybrown cockroach, *Periplaneta fuliginosa* (Smith et al. 1993, 1995, 1997, 1998).

Reports on baiting against American cockroaches have been limited, especially against those inhabiting residential premises. Milio et al. (1986) found moderate control of American cockroaches in poultry house feed rooms with 1.65% hydramethylnon bait stations. Rust et al. (1991) showed that boric acid and hydramethylnon baits failed to provide consistent control against American cockroaches in sewers due to problems with mold, and quick depletion of the baits by the large cockroach populations.

An important factor that has been reported to affect bait performance against German cockroaches in the field is sanitation (Christensen 1991). Although sanitation has been shown not to have a direct relationship with the level of domiciliary cockroach infestation in Malaysia (Lee and Lee 2000), its role on bait performance against American cockroaches is unknown. In this study, we evaluated a 0.5% chlorpyrifos-based bait station against American cockroaches in residential premises under different sanitary conditions to determine the role of sanitation in affecting the performance of insecticidal baits against them.

MATERIALS AND METHODS

Field studies were conducted in residential premises at three different locations on Penang Island, Malaysia, namely Kampung Sg Batu (a rural residential area), Taman Mas (a suburban apartment block) and Kampung Melayu (an urban apartment block). Numerous houses were screened by placing five live traps overnight to choose suitable test sites. Each trap was a 0.45 l glass jar, baited with bread presoaked in local beer, with its upper inside surface smeared with a thin layer of petroleum jelly. Three traps were placed inside kitchen cabinets, one behind refrigerator and another one adjacent to the location where cardboard boxes were sighted. At collection, the cockroaches were counted, identified, and released where they were trapped. The trap counts obtained from this sampling served as the basis for comparison of cockroach trap count after insecticide treatment.

Only houses with American cockroaches (*P. americana*) and with a total number of 8 or more cockroaches trapped per night were chosen for the study. The houses were then assessed for sanitary condition and assigned a rating: 1 = poor (lots of clutter, always with damp/wet floor, leaking pipe, food debris on the floor); 2 = moderate (less clutter, less food debris on floor, no leaking pipe, sometimes with damp/wet floor); 3 = good (practically no clutter, no visible food debris, floor always dry, no leaking pipe). All houses chosen for this study were then clustered according to their sanitary rating. One house from each sanitary cluster was randomly chosen as a control house, together with another house whose owner did not wish to have the house treated with insecticide (n = 4).

Treatment was conducted two weeks after the pre-treatment sampling by placing eight Mortein® Plus Nest Kill bait stations (manufactured by Reckitt and Colman, Australia) at each house. The bait material contains food attractant and 0.5% chlorpyrifos as active ingredient. Each bait station contained 3.5 g of bait material. Placements were done at the side of a wall, or at a corner junction, mostly concentrating on the kitchen, dining and bathroom areas. Treatment areas ranged between 8.6 - 12.4 m^2. At least three bait stations were placed in kitchen cabinets in each house. At 1, 2, 6, and 12 weeks post-treatment, sampling was done using the baited glass jar method as described earlier, and trapped cockroaches were released back upon counting. Percentage reduction (PR) in cockroach trap count was calculated using the formula: PR = 100 $[(T_o - T_i)/T_o]$, where T_o = number of cockroaches trapped at pre-treatment, and T_i = number of cockroaches trapped at i^{th} week at post-treatment. PR data obtained for each sanitary condition were analyzed

Table 1. Influence of sanitary condition on field performance of 0.5% chlorpyrifos baits against the American cockroach, *Periplaneta americana*.

Sanitary condition	Pretreatment Count ± SEM[1]	n	% reduction in no. cockroaches trapped ± SEM at $n^{th.}$ week[1]			
			1	2	6	12
3 (Good)	11.8 ± 1.6 a	6	96.3 ± 2.3 a	94.9 ± 3.9 a	98.9 ± 1.1 a	96.3 ± 2.3 a
2 (Moderate)	12.8 ± 2.2 a	4	64.7 ± 4.3 b	95.5 ± 4.6 a	93.0 ± 2.4 ab	95.1 ± 2.8 a
1 (Poor)	11.6 ± 1.0 a	5	66.3 ± 3.8 b	78.0 ± 3.8 b	88.0 ± 5.6 ab	54.0 ± 2.9 b
Control (no treatment)	11.3 ± 1.5 a	4	22.3 ± 11.7 b	25.4 ± 13.0 b	10.0 ± 3.2 c	-9.8 ± 3.2 c

[1]Mean values followed by same letters within the same column were not significantly different (P > 0.05; Kruskal-Wallis one-way analysis of variance).

with Kruskal-Wallis one-way ANOVA and Kruskal-Wallis multiple comparison test, using Statistix® for Windows software.

RESULTS AND DISCUSSION

At one-week post-treatment, houses with good sanitary conditions showed a significantly faster reduction (P>0.05) in the number of cockroaches trapped (>95%) than those with moderate and poor conditions (Table 1). There appeared to be no significant difference between houses with moderate and poor sanitary conditions that were treated with bait stations, and control houses that were not treated. At two-weeks post-treatment, bait performance in houses with moderate sanitary conditions improved, but the number of cockroaches trapped at houses with poor sanitary conditions did not differ significantly from that of the control houses (P>0.05) (Table 1). The bait performance in these houses however, improved at the sixth week post-treatment, where all houses treated with insecticidal baits showed no significant differences in terms of reduction rate of cockroach numbers (P>0.05), irrespective of sanitary conditions. After three months of bait treatment, houses with good and moderate sanitary conditions still maintained very low cockroach counts (>95% reduction) (Table 1). However, bait performance in houses with poor sanitary conditions could not sustain the reduction rate up to 12-weeks post-treatment.

Chlorpyrifos bait stations placed in houses with moderate and poor sanitary conditions generally took longer to achieve the level of effectiveness that was observed in houses with good sanitary conditions. This may indicate that cockroaches in houses with these conditions took a longer time to locate the baits due to availability of competitive food. These data suggest that sanitation affected the effectiveness of baits in the field. As the cockroach forages for food materials solely by chance (Reierson 1995), the presence of food debris and other clutter in houses with moderate and poor sanitary conditions is a competing factor to the attractiveness of bait material. In addition, under good sanitary conditions, cockroaches may be stressed with starvation and dehydration due to lack of food and water sources. This might encourage cockroach foraging and dispersal (Bertholf 1983) and thus the chance of cockroaches coming into contact with the bait will increase. Furthermore, under starved conditions, cockroaches become more susceptible to insecticide action (Lee et al. 1996, Lee and Heng 2000). Gupta et al (1973, 1975) reported that insecticide applications (spraying and dusting) were more effective against German cockroaches in apartments with better sanitation. Lee (1998) also emphasized the importance of good sanitation when baiting against insecticide-resistant German cockroaches in food-outlets.

Good sanitation practice is essential for better control of cockroaches using baiting and other application methods. Other factors that affect the success of cockroach baiting include bait placement (Reierson 1995) and bait numbers (Reierson et al. 1983, C. Y. Lee, unpublished). In summary, this present study has successfully demonstrated that sanitation influenced the performance of bait stations against American cockroaches. A larger scale field study to determine the interactive effects between sanitation, bait performance and bait numbers has been undertaken and will be reported in the near future.

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