

## Laboratory evaluation of three traps against *Periplaneta americana* (L.) and *Blattella germanica* (L.)

C.Y. Lee, N.L. Chong and H.H. Yap

School of Biological Sciences, Universiti Sains Malaysia, 11800 Minden, Penang, Malaysia.

**Abstract.** A study was initiated to evaluate the effectiveness of three cockroach traps, viz., Roatel® trap, beaker (600 ml) and sticky trap (Trap A Roach Hoy Hoy®) - TARHH - against *Periplaneta americana* and *Blattella germanica* under laboratory conditions. Roatel® significantly trapped the highest mean number of *P. americana* ( $16.20 \pm 1.94$  cockroaches/trap), followed by TARHH® ( $9.27 \pm 0.69$  cockroaches/trap) and beaker ( $7.00 \pm 0.90$  cockroaches/trap). In trapping *B. germanica*, TARHH® significantly proved to be the most promising trap ( $27.33 \pm 1.62$  cockroaches/trap). It was also found that the Roatel® trap is biased towards trapping more female *P. americana*, whereas the beaker trap caught more male cockroaches of the same species.

### INTRODUCTION

The use of different cockroach traps as devices to assess population level and to detect the location of cockroach infestation has become an important technique in urban entomology (Barak *et al.*, 1977; Baker & Southam, 1977; Reiersen & Rust, 1977; Kardatzke *et al.*, 1981). They are also widely used in studies investigating insecticide efficacy (Ballard *et al.*, 1984a), population dynamics (Owens & Bennett, 1982; Bennett *et al.*, 1984), species composition (Oothuman *et al.*, 1984; Yap *et al.*, 1992) and habitat (Zhai, 1990).

Since the early 1960s, a number of traps had been developed and used for various studies, such as the glass jar trap (Ogata & Mihara, 1962; Piper *et al.*, 1975; Reiersen & Rust, 1977; Fleet *et al.*, 1978; Jeffery *et al.*, 1984; Oothuman *et al.*, 1984; Appel & Rust, 1985), sticky trap (Baker & Southam, 1977; Barak *et al.*, 1977; Kardatzke *et al.*, 1981; Zhai, 1990; Yap *et al.*, 1991) and Roatel® (Chow & Wang, 1981; Ross, 1981).

Basically, the effectiveness of traps vary with cockroach species. Because of this, studies had been done in the past to determine the most effective trap for a particular species (Whitlaw & Smith, 1964; Moore and Granovsky, 1983; Ballard & Gold, 1983; 1984; Owens & Bennett, 1983). However, most of these comparative studies were not relevant to the Malaysian context because most of the traps used were not available locally.

This study was initiated to evaluate the effectiveness of three common and locally available cockroach traps, viz., Roatel® trap, beaker (600 ml) and a sticky trap against *P. americana* and *B. germanica* under laboratory conditions.

### MATERIALS AND METHODS

Two cockroach species were used: The American cockroach, *P. americana* and the German cockroach, *B. germanica*. They were respectively cultured in glass aquaria and Horlicks jars under  $28 \pm 3$  C, humidity  $67 \pm 12\%$  and photocycle L:D = 12:12. Mouse pellet (Gold Coin 702P) and water were provided *ad libitum*.

Three types of trap were evaluated: (1) Roatel®, a product of Fumakilla Japan Ltd., is a plastic trap with four mechanical doors which can only be opened from the outside. (2) A 600 ml beaker (Pyrex®) with its upper surface smeared with haircream (Brylcream®) to render a slippery surface for cockroaches. (3) A sticky trap (Trap A Roach Hoy Hoy® or TARHH). This is produced by Earth Chemical Co., Japan and is made of cardboard and trapizoidal in cross section. The three types of trap were baited with mouse pellets.

Polytanks (Duplex® PC 150BS 4213) measuring 130 x 130 x 70 cm, each with its upper inside surface smeared with an 8-cm band of haircream (Brylcream®) was used to confine the cockroaches. The three candidate traps were then placed randomly at different corners of the tank together with its control trap (unbaited).

Water was provided at the remaining corner. Fifteen each of adult females and males and two sets of fifteen nymphs each (mixed sex) were acclimatized in harborage for 24 hours before being used for experiments. The four harborage were then randomly stacked in the centre of the polytank.

Each experiment began at 4.30 p.m and ended at 8.30 a.m the next day. Five trials with three replicates each were carried out for each cockroach species. Cockroaches caught were counted and categorized to adult males, adult females and nymphs. After every trial, the beaker and Roatel® traps were rinsed with 35% ethanol and recycled; new sticky traps were used in every trial.

Data were analysed using Analysis of Variance (ANOVA); Duncan's Multiple Range Test was used to separate the means.

## RESULTS

Table 1 shows the results of the laboratory evaluation of three traps against *P. americana* and *B. germanica*. Significant differences ( $P < 0.05$ ) were found between the traps in terms of trapping efficiency. For the American cockroach, the Roatel® trap caught the highest mean number of cockroaches ( $16.20 \pm 1.94$  cockroaches/trap), followed by TARHH ( $9.27 \pm 0.69$  cockroaches/trap) and the beaker trap ( $7.00 \pm 0.90$  cockroaches/trap). In trapping the German cockroach, TARHH was the most efficient trap with  $27.33 \pm 1.62$  cockroaches/trap while the Roatel® trap and the beaker trap caught  $1.60 \pm 0.46$  cockroaches/trap and  $1.80 \pm 0.31$  cockroaches/trap, respectively.

Table 2 shows the mean percentage of *P. americana* and *B. germanica* in different traps according to sex or stage. The results showed the Roatel® trap is significantly biased ( $P < 0.05$ ) towards trapping of *P. americana* adult females. On the other hand, the beaker trap significantly trapped more adult male cockroaches of the same species. The beaker trap was also shown to be significantly ( $P < 0.05$ ) more efficient in trapping nymph of the German cockroaches.

## DISCUSSION

From the study, it can be seen that different traps are biased towards the trapping of different cockroach species because of factors such as cockroach size, strength and habit.

The greater efficiency of the Roatel® trap as compared to the other two traps is probably due a combination of factors. Firstly, the Roatel® trap does not alert the cockroach to any danger as it enters the trap. This is in contrast to the beaker trap, where the slippery band alerted the cockroach to possible danger ahead, as has been observed in the study by Ballard & Gold (1984), who used petroleum jelly in their glass jars. This semi-repellent effect of Brylcream® on cockroaches is most probably due to the physical stimulus on the cockroaches at contact with the cream barrier rather than due to a long-range chemical effect.

Also the greater strength of the American cockroach as compared to that of the German cockroach would enable the former to tear itself from the sticky traps; only American cockroach tarsi and pretarsi were observed in the sticky

Table 1. Mean number of cockroaches caught per trap in laboratory evaluation of three traps against *Periplaneta americana* and *Blattella germanica*

Type of Trap	Mean number of cockroaches/trap $\pm$ S.E. <sup>1</sup>	
	<i>P. americana</i>	<i>B. germanica</i>
Roatel®	$16.20 \pm 1.94$ a	$1.60 \pm 0.46$ a
Beaker	$7.00 \pm 0.90$ b	$1.80 \pm 0.31$ a
T.A.R.H.H. <sup>1</sup>	$9.27 \pm 0.69$ b	$27.33 \pm 1.62$ b

<sup>1</sup>Mean values not followed by the same letter in these two columns are significantly different ( $P = 0.05$ ), by Duncan's multiple range test.

<sup>2</sup>Trap A Roach Hoy Hoy ®

Table 2. Mean percentage of *Periplaneta americana* and *Blattella germanica* trapped in different traps according to sex or stage

Type of trap	Sex/stage	% of cockroaches caught/trap <sup>1,2</sup>	
		<i>P. americana</i>	<i>B. germanica</i>
Roatel®	Female	41.78 a	5.78 a
	Male	21.78 b	2.67 a
	Nymph	22.22 b	3.56 a
Beaker	Female	12.44 a	0.89 a
	Male	24.89 b	2.22 a
	Nymph	4.67 a	4.44 b
TARHH <sup>3</sup>	Female	16.89 a	46.67 a
	Male	19.56 a	48.89 a
	Nymph	12.67 a	44.22 a

<sup>1</sup>Percentage of cockroaches caught/trap = (100 x Mean number of cockroaches of that sex or stage) + total number of cockroaches of that sex or stage used in the experiment.

<sup>2</sup>Mean values not followed by the same letter in the same column and row are significantly different (P = 0.05), by Duncan's multiple range test.

<sup>3</sup>Trap A Roach Hoy Hoy®

traps in the experiments. Likewise the greater strength of the American cockroach has allowed it to push through the Roatel® trap door as compared with the German cockroach.

The smaller size and consequently lesser strength in the German cockroach as compared to the American cockroach, are probably the two main factors contributing to its significant capture by the sticky trap as compared to the other two traps. It is less able to push through the Roatel® trap door and to escape from the sticky trap because of these factors. This supports the findings of Ballard & Gold (1984), who have shown that the German cockroach is more easily captured by sticky traps when compared to glass jars and electrical traps.

The Roatel trap was also shown in this study to be significantly biased in trapping adult female American cockroaches. On the other hand, the beaker trap is biased towards adult males of the same species. From our observations, the adult male American cockroach tends to climb more rather than crawl whereas the adult female did the opposite. This correlates well with the observation by Appel (1986) that American cock-

roach adult males are usually observed at a higher level than adult females. This behavioural factor probably caused the gender bias of these traps as the trap entrance for the Roatel® traps is located lower than the entrance for the beaker traps.

As a whole, several factors have been found, in past studies and also in this present study, to influence the effectiveness of a cockroach trap, viz., trap design (Moore & Granovsky, 1983; Ballard & Gold, 1983; 1984; Owens & Bennett, 1983); trap placement (Ebeling *et al.*, 1966); immediate correction action, trap proneness and weight to strength ratio (Moore & Granovsky, 1983) and exploratory behaviour (Ballard *et al.*, 1984b).

In conclusion, it can be seen under laboratory conditions that the choice of trap is a very important factor in the success of cockroach studies involving the use of traps. For example, the sticky trap was found to be the best device for the study of cockroach stages/sex since it is not stage or gender biased. However, it is not so suitable in population dynamics studies because the trapped individuals cannot be released back

into the population. Similarly the Roatel® trap is not suitable in gender related studies in the American cockroach since it is gender biased in this species, although quantitatively this trap caught the highest number as compared to the other two traps studied. The beaker trap has been found to be the most unsuitable trap for gender and stage related cockroach studies for both *P. americana* and *B. germanica* species since it catches a low number of individuals as compared to the other two traps as well as being gender and stage biased.

This observation would most probably also be valid under field conditions. In fact, when in the field, the beaker trap with bait has been observed to be easily toppled over by foraging rats. This is another weakness of this trap. Similarly, the sticky trap also attracts the attention of rats which are drawn to the cockroaches stuck to the traps. The Roatel® trap is generally exempt from this form of disruption.

*Acknowledgements:* The authors wish to thank the IRPA Research and Development Programme, Ministry of Science, Technology and Environment, Kuala Lumpur, Malaysia for research support; the Dean, School of Biological Sciences and Coordinator, Vector Control Research Unit (VCRU), Universiti Sains Malaysia for the use of laboratory facilities; Mr. Koay Chew Aik, Mr. Lim Sui Yaw and Mr. Ong Chee Teong for technical support.

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