RESEARCH NOTE

LABORATORY EVALUATION OF PROPOXUR AND FENVALERATE AGAINST INFECTED AND NONINFECTED *LEPTOTROMBIDIUM FLETCHERI* (ACARI : TROMBICULIDAE)

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Rickettsia tsutsugamushi, the agent causing scrub typhus, is known to be transmitted to man by the bite of an infected larval trombiculid mite which is also referred to as a chigger. One of the known vectors of scrub typhus in West Malaysia is *Leptotrombidium fletcheri* (Womersley and Heaslip). These chiggers are found primarily in grass fields particularly in litter under leafy plants interspersed within the grasses (Dohany, 1978). These vectors exist naturally as infected and noninfected populations (Oaks *et al,* 1983).

Since the disease is endemic in Malaysia, effective control measures have been considered which include vector control, rodent or host control as well as control of access to known endemic foci. Presently, the most practical way to control scrub typhus is vector control. Pesticides and repellents are commonly used for vector control.

The Institute for Medical Research, Kuala Lumpur, has for the past few years implemented a program to evaluate candidate pesticides for control of scrub typhus vectors. Potential control agents identified in the laboratory shall be evaluated further in the field.

Colonies of *L. fletcheri* had been established in the Institute for Medical Research. These colonies were not known to be exposed to any pesticides prior to the study.

The toxicities of propoxur and fenvalerate against 2-weeks old and unfed chiggers from the above colonies were determined. Propoxur (1% in butanone) and fenvalerate (93% technical grade) were kindly supplied by the World Health Organization (WHO) and Sumitomo Chemical Co Ltd, Kuala Lumpur, Malaysia, respectively. These chemicals were diluted to working concentrations with acetone. Acetone alone was used for controls.

The bioassay method used was based on the Pasteur pipet technique developed by Ho and Saleh (1986). Clean Pasteur pipets which had their large open ends covered with cotton cloth were immersed into diluted pesticides of appropriate concentrations. Each pipet was left in the solution for 5 minutes and then dried for 24 hours. A total of 25 chiggers was aspirated into each treated Pasteur pipet. The narrow tips of the pipets were then plugged with plasticine. The pipets were examined under a dissecting microscope to ensure that all the chiggers were alive. Pipets were next placed horizontally in an incubator at 25°C. After 24 hours of incubation, mortalities of the chiggers were recorded. Three replicates were conducted for each concentration and the whole experiment was repeated twice. The LC50s and LC99s of the two pesticides were determined by log-probit analysis and were compared using *t*-test at 95% significance level.

The means of the LC50 and LC99 values from the three repetitions were determined (Table 1). The LC50 of propoxur against infected chiggers were significantly higher than that for noninfected chiggers ($p < 0.01$). The LC99s of propoxur were also significantly different for the two populations ($p < 0.01$).

Fenvalerate exhibited different LC50 values as that of propoxur; its LC50 for infected chiggers was greater than for the noninfected chiggers ($p = 0.03$). However, there was no significant difference in the LC99 values of the two populations ($p = 0.85$). Fenvalerate had significantly higher LC50s ($p < 0.01$) and LC99s ($p = 0.01$) than propoxur for both infected and noninfected chiggers. Data from the three repetitions were then pooled together and the log-probit regression lines (LPRL) were calculated (Table 2). The slopes of LPRLs for propoxur against the infected and

Table 1

Lethal concentrations of propoxur and fenvalerate against *L. fletcheri.*

Pesticide	Chigger infectivity	Mean LC50 = sd (ppm) (n = 3)	Mean LC99 = sd (ppm) (n = 3)
Propoxur	Noninfected	0.33 ± 0.02	1.37 ± 0.14
	Infected	0.52 ± 0.01	2.69 ± 0.06
Fenvalerate	Noninfected	9.88 ± 0.20	112.00 ± 19.60
	Infected	12.10 ± 0.61	114.00 ± 12.60

Table 2

Log-probit regression lines of propoxur and fenvalerate against *L. fletcheri.*

Pesticide	Chigger infectivity	*LC50 (ppm) (95% FI)	*LC99 (ppm) (95% FI)	**Equation of line
Propoxur	Noninfected	0.32 (0.19 - 0.42)	1.36 (0.84 - 6.58)	Y = 3.72X + 21.70
	Infected	0.51 (0.29 - 1.23)	2.69 ($1.17 - 1.29 \times 10^4$)	Y = 3.24X + 18.90
Fenvelerate	Noninfected	9.92 (5.49 − 14.89)	110.69 ($46.87 - 2.09 \times 10^3$)	Y = 2.22X + 11.67
	Infected	12.10 (3.57 − 31.74)	114.10 ($38.31 - 1.18 \times 10^7$)	Y = 2.39X + 11.97

*FI = Fiducial interval
**Y = Probit, X = Log_{10} (concentration)

noninfected chiggers were not significantly different ($p > 0.1$); it was the same for fenvalerate ($p > 0.1$).

The results showed that propoxur is more toxic than fenvalerate for both infected and noninfected *L. fletcheri.* An earlier study against *L. deliense,* which is another vector of scrub typhus in Peninsular Malaysia, also demonstrated the efficacy of propoxur (Ho and Saleh, 1986). Propoxur had been classified as moderately hazardous (WHO, 1988). It merits further field investigations.

In an earlier study with 3 pyrethroids, it was reported that susceptibilities of infected and noninfected *L. fletcheri* were not significantly different (Ho and Saleh, 1991). The results obtained here with propoxur showed that the similarity in susceptibilities is dependent on the pesticide evaluated. The results obtained in this study showed the infected population of *L. fletcheri* had a l-fold higher LC99 than the noninfected population.

Due to the ecology of the areas inhabited by these vectors, a good pesticide for control should have residual activity for at least one month (Traub and Wisseman, 1968). Pesticides which are toxic to chiggers but which have short residual activity, may not be cost effective when used in control activities. Thus the bioassays results obtained here represent only the first screening for the pesticides. It is only after detailed residual effect studies, can these pesticides then be evaluated and recommended for use in crub typhus vector control programs.

REFERENCES

Dohany AL. Vector transmission of scrub typhus and control of vector mites. *Malaysian J Pathol* 1978; 1 : 15 - 8.

Ho TM, Saleh I. Laboratory bioassay of acaricides against *Leptotrombidium deliense* (Prostigmata : Trombiculidae). *Trop Biomed* 1986; 3 : 173 - 6.

Ho TM, Saleh I. Efficacy of three pyrethroids against *Leptotrombidium fletcheri* (Acari : Trombiculidae) infected and nonifected with scrub typhus. *J Med Entomol* 1991; 28 : 776 - 9.

Oaks SC, Ridgway RL, Shirai A, eds. Scrub typhus. *Bull Inst Med Res Kuala Lumpur* 1983; 21 : 25 - 33.

Traub R, Wisseman CL. Ecological considerations in scrub typhus 3. Method of area control. *Bull WHO* 1968; 39 : 231 - 7.

World Health Organization. The WHO recommended classification of pesticides by hazard and guidelines to classification 1988 - 1989. *WHO/VBC/88.953,* 1988.