J Trop Med Parasitol 2007;30:64-7.

ORIGINAL ARTICLE

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Efficacy of Hydramethylnon and Fipronil Gel Baits with Laboratory and Field Strains of *Periplaneta americana* (Dictyoptera: Blattidae) in Malaysia

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Abstract

Hydramethylnon (Siege®) 2% w/w and fipronil (Goliath®) 0.05% w/w gel baits were evaluated with laboratory and field strains of *Periplaneta americana* (L). There was a significant difference in the LC50 and LC90 of fipronil and hydramethylnon for both strains ($p < 0.05$). Fipronil had a faster residual effect, causing 100% mortality at 9-11 days on adult laboratory-strain and 10-13 days on adult field-strain *P. americana*; hydramethylnon caused 100% mortality at 11-14 days on adult laboratory-strain and 14-16 days on adult field-strain. Thus, 0.05% w/w fipronil gel bait was more effective than 2.0% hydramethylnon in controlling *P. americana*.

Keywords: hydramethylnon, fipronil, gel bait, *Periplaneta americana*

Introduction

The importance of cockroaches as carriers of enteropathogenic organisms and as mechanical vectors of human pathogens has been widely reported [1-5]. In Malaysia, the importance of cockroaches as domiciliary pests is gaining widespread public attention. Bacteria pathogens have been isolated from cockroaches trapped in houses, food stalls, markets, restaurants, and hospitals [6-8]. Baits have become a popular and effective method of controlling cockroaches [9,10]. Thus, this study was undertaken to evaluate the toxicity and residual effects of gel baits containing hydramethylnon (Siege®) and fipronil (Goliath®) against laboratory and field strains of *Periplaneta americana* in Malaysia.

Materials and methods

Cockroach baits

The bait gel of hydramethylnon (Siege®) was provided by BASF (Malaysia) Sdn Berhad. Siege® contains 2.0% w/w hydramethylnon and 98% w/w inert ingredients. The gel bait fipronil (Goliath®) was provided by Bayer Cropscience (Malaysia) Sdn Berhad. Goliath® contains 0.05% w/w fipronil and 99.95% w/w inert ingredients.

Cockroaches

Laboratory-cultured *P. americana* (L) were used in this study. This laboratory strain was established in the Department of Biomedical Science Insectarium of the Faculty of Allied Health Sciences, Universiti Kebangsaan Malaysia. The field strain was collected from Bandar Baru Sentul, in Kuala Lumpur. Both laboratory and field strains of *P. americana* were starved for 24 hours before use in the trial. Ten nymphs of each strain were placed in each of 12 glass beakers of 2-liter capacity.

The insecticide concentrations used were 0.004 g, 0.012 g, 0.036 g, 0.108 g, and 0.324 g, respectively. The trial of each concentration was conducted in duplicate. Each insecticide gel used was placed in a urine bottle cover and placed inside the center of the beaker. A wet sponge was placed inside the beaker as a source of water for the nymphs and adults during the experiment. The mouth of each beaker was smeared with vaseline to prevent the cockroaches from escaping. For the control, two beakers were utilized with 10 nymphs in each beaker, with wet sponge only. The mortality of the cockroaches was recorded after 24 hours' exposure. The experiment was repeated three times. The room temperature was 24°C ± 1 and relative humidity 55-65%. The above experiment was repeated using female and male *P. americana*. Study data were analyzed by Probit analysis [11].

Residual effect

In this study, nymphs from both laboratory and field strains of *P. americana* were tested on 0.08 g bait gel. Five nymphs of each strain were starved for 24 hours before putting them into a 2-liter glass beaker. A wet sponge was placed inside each beaker as a water source for the cockroaches. Then, 0.08 g of each insecticide gel bait was placed on a piece of bread measuring 4.75 x 5.0 cm as a food source. For the control, only a wet sponge and a piece of bread were placed inside each beaker as a food source. The experiment was conducted in duplicate. Daily observations were conducted and the cockroach mortality was recorded. Three replications were conducted for each bait gel. The experiment was repeated using adult females and males of both laboratory and field strain *P. americana*.

Results and discussion

Table 1 shows the gel bait formulation containing fipronil 0.05% w/w had greater toxicity than hydramethylnon 2% w/w, against *P. americana* laboratory strain for all stages of development (nymphs; male and female adults). There was a significant difference between the LC50 and LC90 of fipronil and hydramethylnon for the nymph and adult laboratory-strain *P. americana* ($p < 0.05$).

Table 2 shows that the gel bait formulation containing fipronil had higher toxicity than hydramethylnon against *P. americana* field-strain. There was a significant difference between the LC50 and LC90 of fipronil and hydramethylnon for field-strain *P. americana* ($p < 0.05$). Laboratory-strain nymphs and adults of *P. americana* were more susceptible to both gel baits than field-strain. Resistance among cockroaches has been reported to most spray insecticides [9]. The fipronil gel baits were still effective for controlling field-strain *P. americana*. However, the hydramethylnon gel bait showed a high lethal concentration against

Table 1 Mortality response to hydramethylnon and fipronil by laboratory-strain *Periplaneta americana* nymphs and adults.

Insecticides	Females			Males			Nymphs		
	LC_{50} (95% CI)	LC_{90} (95% CI)	Slope ± SE	LC_{50} (95% CI)	LC_{90} (95% CI)	Slope ± SE	LC_{50} (95% CI)	LC_{90} (95% CI)	Slope ± SE
Hydramethylnon	0.24 (0.16-0.44)	1.81 (0.81-9.17)	1.44 ± 0.25	0.42 (0.25-0.95)	5.48 (1.99-34.70)	1.15 ± 0.17	0.12 (0.09-0.17)	0.98 (0.57-2.24)	1.41 ± 0.15
Fipronil	0.13 (0.09-0.21)	1.06 (0.55-3.18)	1.42 ± 0.19	0.25 (0.15-0.49)	5.06 (1.80-30.69)	0.97 ± 0.14	0.03 (0.02-0.03)	0.23 (0.16-0.41)	1.44 ± 0.14

Unit in g

Table 2 Mortality response to hydramethylnon and fipronil by field-strain *Periplaneta americana* nymphs and adults.

Insecticides	Females			Males			Nymphs		
	LC_{50} (95% CI)	LC_{90} (95% CI)	Slope ± SE	LC_{50} (95% CI)	LC_{90} (95% CI)	Slope ± SE	LC_{50} (95% CI)	LC_{90} (95% CI)	Slope ± SE
Hydramethylnon	0.43 (0.27-0.93)	3.73 (1.49-22.88)	1.36 ± 0.23	1.36 (0.51-11.31)	64.27 (8.59-6,703.60)	0.76 ± 0.15	0.16 (0.11-0.27)	2.12 (0.96-8.03)	1.14 ± 0.15
Fipronil	0.15 (0.09-0.32)	3.22 (1.08-25.69)	0.96 ± 0.16	0.53 (0.27-1.83)	18.52 (4.16-357.91)	0.83 ± 0.14	0.06 (0.04-0.08)	0.43 (0.27-0.85)	1.46 ± 0.16

Unit in g

Table 3 Residual effect of hydramethylnon and fipronil in causing 100% mortality among laboratory and field-strain *Periplaneta americana* nymphs and adults.

Days	Hydramethylnon			Fipronil			Control		
	nymphs	males	females	nymphs	males	females	nymphs	males	females
Laboratory strain	9	14	11	9	11	9	nom	nom	nom
Field strain	9	16	14	9	13	10	nom	nom	nom

nom = no mortality observed throughout the study period

field-strain *P. americana* males. Laboratory studies in India, evaluating fipronil against *P. americana* and *Blatella germanica* on different surfaces, viz wood, cement, mud and thatch, found that when the gel was applied at the appropriate dosages it could cause >80 percent mortality in both species. In trapping experiments for cockroach control in the USA, laboratory and field studies indicated that abamectin and hydramethylnon were consistently attractive to *B. germanica* and *Supella longipalpa* adults and nymphs [12]. Comparisons of toxic baits for controlling *B. germanica* in France indicated that *B. germanica* found fipronil gel more attractive than abamectin, boric acid, and hydramethylnon gels [13].

Table 3 shows the residual effect of 0.08 g hydramethylnon and fipronil on the mortality of *P. americana* nymphs and adults, both laboratory and field strains. For the laboratory and field strains of *P. americana* nymphs, 100% mortality occurred on day 9 of exposure to both hydramethylnon and fipronil gels. For the males, for both laboratory and field strains of *P. americana*, fipronil showed a higher residual efficacy of 100% mortality on days 11 and 13 than hydramethylnon, with 100% mortality on days 14 and 16, respectively. For female *P. americana*, fipronil also showed higher residual efficacy than hydramethylnon, with 100% mortality for female *P. americana* laboratory strain on treatment day 9 with fipronil, day 11 for hydramethylnon. Among female *P. americana* field-strain, 100% mortality occurred on day 10 with fipronil, and day 14 with hydramethylnon. Thus, fipronil had a faster residual effect, causing 100% mortality, than hydramethylnon. None of the control nymphs or adults died during

the experiment. Apparently, adult field-strain *P. americana* showed 100% mortality for longer than the laboratory strain, when treated with both fipronil and hydramethylnon.

A field trial that used fipronil baits against *B. germanica* in Korean restaurants for 2 days per week reduced the cockroach population by 90.9%, with 96.4% in Chinese restaurants, and 89.4% in beer-hall kitchens after 4 weeks' treatment [10]. Studies in India on the control of cockroach infestations in cookhouses of urban households indicated that fipronil gel treatment was more efficient than propoxur insecticide [14].

In conclusion, this study found that 0.05% w/w fipronil gel bait was more effective than 2.0% hydramethylnon gel bait in controlling both laboratory and field-strain *P. americana* in Malaysia. Thus, fipronil could be utilized for controlling cockroaches in the field, especially in restaurants, kitchens, and wet markets.

Acknowledgements

We wish to thank the Faculty of Allied Health Sciences, Universiti Kebangsaan Malaysia, for providing research facilities. We appreciate the support of technical staff; Mr John Jeffery, Mr Abdul Rahman Law Abdullah, and Mr Jamil Rafaai. Last but not least, BASF (Malaysia) Sdn Berhad for providing the hydramethylnon (Siege®) and Bayer Cropscience (Malaysia) Sdn Berhad for providing the fipronil (Goliath®).

References

1. Greenberg B, Sanati M. Enteropathogenic types of *Escherichia coli* from primates and cockroaches in a zoo. J Med Entomol. 1970;7:744.
2. Klowden M, Greenberg B. Development of *Periplaneta americana* (L.) cell cultures and their infection with enteroviruses. J Med Entomol. 1974;11:173-8.
3. Klowden M, Greenberg B. *Salmonella* in the American cockroach: evaluation of vector potential through dosed feeding experiments. J Hygiene. 1976;77:105-11.
4. Ash N, Greenberg B. Vector potential of the German cockroach (Dictyoptera: Blatellidae) in dissemination of *Salmonella enteritidis* serotype *typhimurium*. J Med Entomol. 1980;17:417-23.
5. Cochran DG. Cockroaches-biology and control.*WHO/VBC/82.856*.
6. Rampal L, Oothuman P, Jeffery J, Daud MZ, Shekhar C, Senan P, *et al*. Bacterial pathogens from the intestinal tracts of various species of cockroaches. Med J Malaysia. 1983;38:104-7.
7. Vythilingam I, Jeffery J, Oothuman P, Razak ARA, Sulaiman A. Cockroaches from urban human dwellings: isolation of bacterial pathogens and control. Southeast Asian J Trop Med Public Health. 1997;28:218-22.
8. Sulaiman S, Cheon YK, Aziz AH, Jeffery J. Isolations of bacteria pathogens from cockroaches trapped in downtown Kuala Lumpur. Trop Biomed. 2003;20:53-7.
9. Agrawal VK, Tilak R. Field performance of imidacloprid gel bait against German cockroaches (Dictyoptera: Blatellidae). Indian J Med Res. 2006;124:89-94.
10. Ree HI, Lee IY, Jeon SH, Yong TS. Field trial on the control effect of fipronil bait against German cockroaches. Korean J Parasitol. 2006;44:255-7.
11. Raymond M. Log-probit analysis basic programme of microcomputer. Cariers ORSTOM Serie Entomologie. J Med Entomol. 1985;22:117-21.
12. Nalyanya G, Liang D, Kopanic RJ Jr, Schal C. Attractiveness of insecticide baits for cockroach control (Dictyoptera: Blatellidae): Laboratory and field studies. J Econ Entomol. 2001;94:686-93.
13. Durier V, Rivault C. Comparisons of toxic baits for controlling the cockroach, *Blatella germanica*: attractiveness and feeding stimulation. Med Vet Entomol. 2000; 14:410-8.
14. Tilak R, Tilak VW, Yadav JD, Gupta KK. Efficacy of fipronil and propoxur in the control of German cockroaches (Dictyoptera: Blatellidae). J Commun Dis. 2002;34:65-9.