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RESEARCH NOTE

CONTACT TOXICITIES OF ETOFENPROX AND BENDIOCARB AGAINST THE ODOROUS HOUSE ANT (*TAPINOMA SESSILE* SAY)

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In cases where rapid urbanization of a country is not harmonized with proper infrastructure planning and development, vast breeding areas for various pest ants are created, thus elevating the Importance and economical impact of ant infestation. The odorous house ant (*Tapinoma sessile* SAY) is a prevalent household ant found locally in most sub-urban and urban premises (Yap and Lee, 1994). Knight and Rust (1990a) listed this species as one of the most commonly found household ant in Californian man-made structures. Workers of this species are good foragers and are often found invading almost all types of household foods (Harada, 1990). They can withstand a wide range of temperature and humidity with colonies often building nests in cracks and crevices. Odorous house ant colonies usually contain a large number of queens (up to 200) possessing high fecundity characteristics (Smith, 1928).

Biological control involving infesting targeted ant colonies with bacteria, nematodes and fungus are often unsuccessful due to the excellent grooming and cleaning behaviour exhibited by the worker ants (Jouvenaz, 1990). Therefore, chemical control involving various insecticides are still the major method for ant control programmes. A preferred method involves the treatment of various wall and floor surfaces with residual insecticides in order to achieve contact toxicity. Christensen (1989) reported that bendiocarb, carbaryl, chlorpyrifos, diazinon and propoxur are the common active ingredients used to control *T. sessile*. Lee *et al.* (1996) reported that bendiocarb, an odorless insecticide with medium repellency is effective against three common species of Malaysian household ants, namely Pharaoh ant (*Monomorium pharaonis*), crazy ant (*Paratrechina longicornis*) and 'rambutan' ant (*Hypoclinea bituberculata*). Etofenprox (Trebon-), a diphenyl compound acting as both a stomach and contact poison was first introduced in Japan in 1987 and has been reported to be suitable against a wide range of pests (Udagawa, 1986). However, there has been no study conducted on the efficacy of etofenprox against ants. These factors led us to examine the laboratory performances of bendiocarb and etofenprox acting as contact poisons against *T. sessile*.

T. sessile workers were collected from a single large colony infesting a residential building without insecticide treatment. Acclimatization was done by keeping the ants in a plastic aquarium complete with sucrose solution under laboratory conditions of 25 ± 2° C and 71 ± 6% relative humidity. Technical grade bendiocarb (2,2-dimethyl-1,3-benzodioxol-4-yl methylcarbamate) [95%] and etofenprox (2-(4-ethoxyphenyl)-2-methylpropyl 3-phenoxybenzyl ether) [96.3%) were used in this study by diluting them in analytical grade acetone. Bioassay procedure used to determine the toxicity was similar to that of Lee *et al.* (1996). A total of 0.7 ml of the needed insecticide concentration was pipetted into glass petri dishes (9 cm diam.), and allowed to dry in the fume hood. Twenty ants were introduced into treated petri dishes for 4 hr before they were transferred back into a clean petri dish with water and 10% sucrose solution in cotton pad. Mortality was scored at 24 hr after post-treatment. Preliminary range finding test for each chemical was conducted to determine a series of five concentrations which cause a mortality range of 0-100%. Results obtained showed that the suitable concentration range (weight insecticide per petri dish surface area) for bendiocarb was 0.01-0.04 μg/cm² and 0.05-1.00 μg/cm² for etofenprox. Each concentration was replicated three times. Data were pooled for computerized probit analysis to obtain various LC (lethal concentration) values (Daum 1970; Finney, 1971). Knockdown properties of both chemicals from the LC_{50}, LC_{70} and LC_{90} derived earlier were also investigated by exposing 20 ants to each concentration with the number of ants knocked downed scored at selected time intervals. Data were

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Table 1: Contact toxicity of bendiocarb and etofenprox against the odorous house ant (*T. sessile*)

Insecticide	n	LC_{50} (μg/cm²)	LC_{90} (μg/cm²)	Probit Slope (± S.E.)	χ^2/df
Bendiocarb	1080	0.014	0.042	2.70 ± 0.09	0.84
Etofenprox	1080	0.450	3.848	1.37 ± 0.04	0.63

Table 2: Knockdown (KT) of odorous house ant (*T. sessile*) with different lethal doses of bendiocarb and etofenprox

Insecticide	LC	Concent. (μg/cm²)	KT_{50} (min)	Probit Slope (± S.E.)	χ^2/df
Bendiocarb	50	0.014	23.68	5.92 ± 0.22	1.64
	70	0.020	21.56	8.39 ± 0.29	0.13
	90	0.042	16.32	5.62 ± 0.21	1.72
Etofenprox	50	0.450	34.72	1.92 ± 0.09	1.59
	70	1.100	17.42	3.75 ± 0.13	0.31
	90	3.900	8.25	5.98 ± 0.21	1.90

then pooled and the KT_{50} value (time needed to knockdown 50% of tested ants) for each chemical were derived from the probit analysis. StatsGraphics (ver. 5.0) was used to further decipher the relationship between the KT_{50} values and insecticide concentrations with a regression analysis.

The test species showed a homogenous response towards toxicity of both insecticides based on the χ^2 value obtained (Table 1). Results indicated that *T. sessile* was more susceptible to bendiocarb (LC_{50} = 0.014 μg/cm², LC_{90} = 0.042 μg/cm²) compared to etofenprox (LC_{50} = 0.450 μg/cm², LC_{90} = 3.900 μg/cm²). In comparison with another similar study conducted on other common household ants, it is also shown here that *T. sessile* was more tolerant towards bendiocarb compared other species of household ants (*M. pharaonis*, *P. longicornis* and *H. bituberculata*) (Lee *et al.*, 1996). Etofenprox though shown to be highly toxic to other insects (Thompson, 1992), caused a lower mortality rate to *T. sessile* in this study. The high metabolism rate normally found in ants could have contributed to higher internal detoxification of this pyrethroid within the ants. Earlier studies also showed that pyrethroids as residual treatment often resulted in lower efficacy of ant control compared to other longer-lasting chemicals such as carbamates (Williams and Lofgren, 1983; Rust *et al.*, 1996). The knockdown rate of each chemical is exhibited in Table 2. Based on the knockdown time derived from the three dosages, bendiocarb caused a faster knockdown compared to etofenprox at the LC_{50} concentration while for both the higher LC_{70} and LC_{90} concentration, the test insects was knocked down at a quicker rate with etofenprox.

The better killing efficacy demonstrated by bendiocarb is probably due to its lower repellency and detoxification rate by the poisoned worker ants. However, in terms of knockdown time, etofenprox as a pyrethroid provided a more rapid effect especially in higher concentrations. Knight and Rust (1990b) suggested that for the purpose of barrier treatment, chemicals with high efficacy combined with intermediate/high level of repellency will be suitable in stopping the entrance and foraging of worker ants. Although this study showed that both bendiocarb and etofenprox were able to cause high mortality and rapid knockdown, further studies on field performances would be required for both insecticides against various household ant species.

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