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# Evaluation of Imidacloprid against the Housefly *Musca domestica* Linnaeus in the Laboratory

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## Abstract

The objective of this study was to evaluate the effectiveness of imidacloprid (Q-Bayt®) against the Kundang and WHO 213 strains of the female housefly *Musca domestica*. By scatter application of 4.0 g Q-Bayt®, after 24 hours, the mortality rates for the Kundang strain and WHO 213 were 36.7 and 54.4%, respectively. At 48 hours' exposure to Q-Bayt®, the mortality of *M. domestica* Kundang strain increased to 63.3% and WHO 213 to 73.3%. By paint-on application with Q-Bayt® at 1.5 g/ml, after 24 hours the Kundang strain and WHO 213 showed 38.9 and 48.9% mortality, respectively, whereas 75.6% was obtained for the former and 77.8% for the latter at 48 hours' post-treatment. On the whole, Student-t test and Mann-Whitney test showed no significant difference ( $p > 0.05$ ) in mortality rates between the two strains, with either scatter or paint-on application. Thus, Q-Bayt® is a potential insecticide for controlling the housefly *M. domestica*. With regard to the dosage used and mortality rates obtained, paint-on application was more efficient than scatter.

**Keywords:** *Musca domestica*, imidacloprid, scatter application, paint-on application

## Introduction

In Malaysia, the housefly, *Musca domestica* L, the face fly, *M. sorbens* Wiedemann, and blow flies, such as *Chrysomya megacephala* Fabricius, are commonly found foraging on or breeding in garbage and other filth. They are important mechanical transmitters of parasites and bacteria [1-3].

The housefly can adapt easily biologically and physiologically to changes in the environment [4]. It was first reported that houseflies in Sweden did not respond as expected to DDT, in 1946 [5].

Several hundred similar instances have been noted involving many of the newer insecticides, starting with resistance to BHC and dieldrin, first reported in 1948 [6].

Imidacloprid (in the chloronicotinyl nitroguanidine class of chemicals) is a systemic insecticide first introduced in 1984 [7]. In the United Kingdom and Europe, imidacloprid granular sugar bait (Q-Bayt®) containing the sex attractant z(9)-tricosene showed low resistance among the housefly *M. domestica* for years [8,9]. A combination of imidacloprid and permethrin was evaluated for the prevention of leishmaniasis in kennel dogs in Italy; its repellent activity against sandflies prevented canine leishmaniasis [10]. Knockdown and mortality of spinosad,

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imidacloprid, methomyl-containing baits against susceptible *M. domestica* were studied and compared under laboratory conditions. In a feeding assay, imidacloprid affected flies more rapidly than methomyl or spinosad [11].

The objective of this study was to evaluate the effectiveness of Q-Bayt® against the wild strain of the housefly *M. domestica* L (Kundang strain) and WHO 213 (laboratory strain) in the laboratory by scatter and paint-on application of the insecticide.

## Materials and methods

### Housefly sampling

The Kundang strain was sampled using sweep nets at a chicken farm in Kundang, Selangor, and the WHO 213 were obtained from the Institute for Medical Research insectarium. Both strains were reared in an insectarium at 28-30°C and relative humidity 69-72%, at the Department of Biomedical Science, Faculty of Allied Health Sciences, Universiti Kebangsaan Malaysia. Sugar and powdered milk dissolved in water were supplied as food for the adults, and mice chow for the larvae. Three- to 6-day-old female houseflies were used for the experiments.

### Insecticide

The insecticide, Q-Bayt®, containing 0.5% w/w imidacloprid plus a combination of a highly purified z(9)-tricosene with a newly developed Bayer Fly Attractant LEI 179 was supplied by Bayer CropScience (M) Sdn Bhd.

### Scatter application

Thirty female houseflies were placed into the cage measuring 35 x 35 x 35 cm. 0.5 g Q-Bayt® with 3 g sugar granules as bait were scattered randomly by hand in a petri dish and placed inside the cage. The Q-Bayt® was scattered in such a way that no heaps formed in the petri dish. The mortality of the houseflies after 24 hours and 48 hours was recorded. The test was repeated with varying quantities of Q-Bayt® viz, 1, 2, 3, and 4.0 g, respectively. The control cage was provided only with 3 g of sugar to act as the control. The

experiment was repeated four times.

### Paint-on application

Thirty female houseflies were placed inside the cage measuring 35 x 35 x 35 cm. Q-Bayt® mixed with warm water at a rate of 1.0 g/ml water was applied as a paste, with a brush, to a sheet of plywood 34 x 34 cm placed inside the cage. Three grams of sugar granules were placed in the middle of the plywood. The mortality of the houseflies after 24 hours and 48 hours was recorded. The test was repeated with concentrations of 0.1 g/ml, 0.5 g/ml, 1.0 g/ml, 1.2 g/ml, and 1.5 g/ml Q-Bayt®, respectively. The control cage was offered 3 g of sugar on untreated plywood. The experiment was repeated four times.

## Results and discussion

### Scatter application

Table 1 shows mortality rates for female *M. domestica* 24 hours after scattering different quantities of Q-Bayt®. The Mann-Whitney test and unpaired Student t-test indicated a significant difference ( $p < 0.05$ ) in mortality rates between insecticide-treated and untreated houseflies (control). Mortalities of female WHO 213 strain showed no significant difference ( $p > 0.05$ ) except between concentrations of 0.5 g and 4.0 g, respectively ( $p < 0.05$ ). The mortality rates for female Kundang houseflies treated with 0.5 g, 1.0 g, 2.0 g, 3.0 g and 4.0 g, respectively, with ED<sub>50</sub> and ED<sub>90</sub> values of 12.69 g and 3,664.24 g, showed no significant difference other than with the control ( $p < 0.05$ ). There was no significant difference in mortality rates between Kundang and WHO 213 strains ( $p > 0.05$ ).

The Mann-Whitney test and unpaired Student t-test showed a significant difference ( $p < 0.05$ ) in mortality rate between the houseflies treated with Q-Bayt® and the untreated houseflies (control) for both Kundang and WHO 213 strains. The mortality rates for WHO 213 female houseflies treated with 0.5 g, 1.0 g, 2.0 g, 3.0 g and 4.0 g were 47.8% ± 4.4, 52.2% ± 2.2, 62.2% ± 1.1, 65.6% ± 12.4, and 73.3% ± 5.1, respectively. There was no significant difference between the concentrations

**Table 1 Mortality rates for female houseflies *Musca domestica* L Kundang strain and WHO 213 strain at 24 and 48 hours after scattering Imidacloprid (Q-Bayt®) at different dosages (figures are % ± SE).**

		Quantity of Q-Bayt® (g)					
		0.0 (Control)	0.5	1.0	2.0	3.0	4.0
24 hours	Kundang	0.0	21.1 <sup>a</sup>	30.0 ± 5.1 <sup>a</sup>	36.7 ± 5.1 <sup>a</sup>	37.8 ± 6.2 <sup>a</sup>	36.7 ± 8.4 <sup>a</sup>
	WHO 213	1.1 ± 1.1	33.3 ± 1.9 <sup>a</sup>	37.8 ± 4.0 <sup>a</sup>	42.2 ± 1.3 <sup>a</sup>	51.1 ± 5.9 <sup>a</sup>	54.4 ± 2.9 <sup>a,b</sup>
48 hours	Kundang	2.2 ± 2.2	42.2 ± 2.9 <sup>a</sup>	42.2 ± 2.2 <sup>a</sup>	62.2 ± 4.4 <sup>a,b,c</sup>	63.3 ± 3.3 <sup>a,b,c</sup>	63.3 ± 5.8 <sup>a,b,c</sup>
	WHO 213	11.1 ± 1.1	47.8 ± 4.4 <sup>a</sup>	52.2 ± 2.2 <sup>a</sup>	62.2 ± 1.1 <sup>a</sup>	65.6 ± 12.4 <sup>a</sup>	73.3 ± 5.1 <sup>a</sup>

<sup>a</sup> - significant difference ( $p < 0.05$ ) compared with control

<sup>b</sup> - significant difference ( $p < 0.05$ ) compared with 0.5 g

<sup>c</sup> - significant difference ( $p < 0.05$ ) compared with 1.0 g

treated ( $p > 0.05$ ). However, the female Kundang houseflies showed mortality rates of  $42.2\% \pm 2.9$  to  $63.3\% \pm 5.8$  with concentrations of 0.5 g and 40 g, respectively (Table 2). However, application of insecticide at doses between 2.0 g - 4.0 g and 0.5 - 1.0 g showed a significant difference ( $p < 0.05$ ) for the Kundang strain. There was no significant difference in mortality rate between Kundang and WHO 213 housefly strains ( $p > 0.05$ ).

Thus, scatter application of Q-Bayt® was effective at 2.0 g, with high adulticidal effect on both strains of houseflies, Kundang and WHO 213, 48 hours post-treatment.

### Paint-on application

Table 2 shows the mortality rates for female houseflies at 24 hours' post-exposure to Q-Bayt® at different concentrations. The mortality rates for female houseflies treated with 0.5 g/ml - 1.5 g/ml insecticide were significantly different ( $p < 0.05$ ) from the control, for both Kundang and WHO 213 strains. The mortality rate of both Kundang and WHO 213 female housefly treated with 0.1 g/ml and treatment between 0.5 g/ml and 1.5 g/ml showed significant difference ( $p < 0.05$ ). There was no significant difference in mortality rates between Kundang and WHO 213 strains ( $p > 0.05$ ) except for treatment at 1.2 g/ml ( $p < 0.05$ ).

At 48 hours' post-exposure, the mortality rates for the Kundang strain treated with 0.5 g/ml

- 1.5 g/ml Q-Bayt® were significantly different ( $p < 0.05$ ) from the control. On the other hand, the mortality rates of the WHO 213 strain at 0.1 g/ml - 1.5 g/ml were significantly different ( $p < 0.05$ ) from the control. Of the various concentrations applied, at 0.1 g/ml and 1.0 g/ml - 1.5 g/ml, the mortality rates for the female Kundang houseflies were significantly different ( $p < 0.05$ ). However, the mortality rates of houseflies at 1.5 g/ml and 0.5 g/ml were significantly different ( $p < 0.05$ ) for the Kundang strain. The mortality rates for the Kundang strain at 0.1 g/ml and 0.5 g/ml were significantly different ( $p < 0.05$ ). For the WHO 213 strain, application at 0.5 g/ml - 1.5 g/ml was significantly different from 0.1 g/ml ( $p < 0.05$ ), and 1.2 g/ml - 1.5g/ml was significantly different from 0.5 g/ml ( $p < 0.05$ ), respectively.

The Student-t test and Mann-Whitney test showed no significant difference ( $p > 0.05$ ) in mortality rates between the Kundang and WHO 213 strains.

Thus, the paint-on application of Q-Bayt® at 1.5 g/ml had a strong adulticidal effect on both strains of housefly 48 hours' post-treatment. Methomyl bait plus z-9-tricosene (muscamone®) was evaluated against *M. domestica* L population in a chicken farm in Malaysia. Application at 10 mg ai/m<sup>2</sup> caused a 14.8% reduction in the adult fly population after 24 hours, and 50 mg ai/m<sup>2</sup> caused a reduction of 61.7%; meanwhile, the control

**Table 2 Mortality rates of the female housefly *Musca domestica* L Kundang strain and WHO 213 strain at 24 and 48 hours post paint-on application with imidacloprid (Q-Bayt®) at various concentrations (figures are in % ± SE).**

		Quantity of Q-Bayt® (g)					
		0.0 (Control)	0.1	0.5	1.0	1.2	1.5
24 hours	Kundang	1.1 ± 1.1	12.2 ± 2.9	17.8 ± 4.4 <sup>a</sup>	23.3 ± 1.9 <sup>a</sup>	26.7 ± 3.3 <sup>a</sup>	38.9 ± 4.8 <sup>abc</sup>
	WHO 213	0.0	4.4 ± 1.1	16.7 ± 3.9 <sup>a</sup>	32.2 ± 2.9 <sup>abc</sup>	43.3 ± 3.9 <sup>abc</sup>	48.9 ± 4.0 <sup>abcd</sup>
48 hours	Kundang	3.3 ± 1.9	13.3 ± 3.2	38.9 ± 4.8 <sup>a</sup>	47.8 ± 1.1 <sup>ab</sup>	56.7 ± 8.4 <sup>ab</sup>	75.6 ± 4.4 <sup>abc</sup>
	WHO 213	0.0	8.9 ± 2.9 <sup>a</sup>	32.2 ± 6.8 <sup>ab</sup>	53.3 ± 12.0 <sup>ab</sup>	68.9 ± 2.9 <sup>abc</sup>	77.8 ± 2.9 <sup>abc</sup>

<sup>a</sup> - significant difference ( $p < 0.05$ ) compared with control

<sup>b</sup> - significant difference ( $p < 0.05$ ) compared with 0.1 g/ml

<sup>c</sup> - significant difference ( $p < 0.05$ ) compared with 0.5 g/ml

<sup>d</sup> - significant difference ( $p < 0.05$ ) compared with 1.0 g/ml

\* significant difference ( $p < 0.05$ ) between strains

population increased to 132.7% after 24 hours [12]. In studies in England, using z-9-tricosene-baited targets for controlling *M. domestica* outdoors on a landfill site, the fly populations were generally distributed over a large area, although a short-range attractant was used [13]; it seems unlikely that z-9-tricosene is sufficiently attractive to houseflies to provide an effective and economic lure in outdoor situations [13]. A study evaluating z-9-tricosene and food odors for attracting *M. domestica* to baited targets was conducted in deep-pit poultry units in southern England [14]. Targets treated with an Alfacron-sugar mixture and baited with 2.5 g of 40% z-9-tricosene beads caught significantly greater numbers of both male and female *M. domestica* than control targets.

In conclusion, the present study indicated that Q-Bayt® can be used for controlling the housefly, *M. domestica*. Despite paint-on application yielding greater activity than scatter, both can be used as control measures for the housefly.

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