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Field evaluations of the granular fly bait, Quick Bayt® and the paint-on fly bait, Agita® against synanthropic flies

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Abstract. The efficacy and residual efficacy of commercial baits, Quick Bayt® (0.5% w/w imidacloprid) and Agita® (10.0% w/w thiamethoxam) against synanthropic flies were evaluated under field conditions. Efficacy was evaluated based on knockdown percentage (KD %). The bait efficacy and residual efficacy evaluation were conducted for a period of 3 weeks and 6 weeks respectively. Baits were applied onto bait targets and placed on fly-count targets to facilitate the counting of flies. All baits were applied according to the manufacturer's recommended application rate. Three replicate treatments for each type of bait were placed at the study site each week. The number of flies feeding on baits and the knocked down flies were counted and collected. The efficacy of Agita® and Quick Bayt® did not differ significantly (t-test, $P>0.05$) over the 3-week period, even though Quick Bayt® had a slightly higher KD% than Agita®. In the residual efficacy evaluation, the (knockdown) KD% of Quick Bayt® was consistent at around 36% for the first five weeks but dropped to 33.8 ± 0.4% on the sixth week. The KD% for Agita® on the first week was 33.6 ± 12.2% and remained relatively consistent for the first 4 weeks at around 31%. KD% dropped to 16.7 ± 3.3% on week 5 and to 15.7 ± 1.2% on week 6. The difference in residual efficacy of the two baits was significant (t-test, $p<0.05$).

INTRODUCTION

The propensity of the adults of many synanthropic fly species to feed on human food, as well as garbage and excrement, gives them the potential for mechanical transmission of pathogenic organisms (Crosskey & Lane, 1993). They are known to carry many pathogens internally in their vomit and faeces and externally on their body. They are known to transmit dysentery, diarrhea, cholera and typhoid (WHO, 1991). Some also cause myiasis in humans and livestock (Hall & Smith, 1993). This is not to suggest that every fly brings disease, but the annoyance and public health risks associated with large populations of flies could be considerable and requires prompt attention.

Considerable use has been made of chemical bait formulations in fly control programmes due to the problems of resistance and lack of effectiveness of some contact insecticides. When contact insecticides are formulated in fly baits, oral uptake appears to slow down the rate of increase of resistance (Barson, 1987). Chemical baits can also be easily replaced and are therefore not left to decay for long periods with a consequent reduction in toxic effect (Webb, 1986).

Neonicotinoids or chloronicotinyls, which resemble the natural product nicotine are a new class of synthetic insecticides and is as a viable alternative to organophosphates, carbamates and pyrethroids for use in bait formulations (Ware, 2000; Cox, 2001). Chemicals in this class include the widely used imidacloprid and newer chemicals such as thiamethoxam (Antunes-Kenyon & Kennedy, 2001).

Imidacloprid is a systemic and contact insecticide used against piercing-sucking insects, flies and termites (Pedigo, 2002). A variety of imidacloprid products including

the granular fly bait Quick Bayt® are being marketed (Cox, 2001; Pospischil *et al.*, 2005). Similar to imidacloprid, thiamethoxam acts by interfering with acetylcholine receptors, however the specific binding sites are still being investigated (Antunes-Kenyon & Kennedy, 2001).

The present study was designed to compare the efficacy of the granular fly bait, Quick Bayt® (Bayer Environmental Science Malaysia) with that of the paint-on fly bait formulation, Agita® 10WG (Distributed by Syngenta) against synanthropic flies. The residual efficacy of both these baits after initial exposure in the field was also evaluated.

MATERIAL & METHODS

Field sites

The field evaluations were conducted in an urban location in Pulau Pinang. The urban location chosen for this study was the Medan Suri food court. A small chicken slaughtering facility and a municipal garbage collection point which are in the vicinity of the food court and located adjacent to each other.

Baits and fly-count targets

Quick Bayt® fly bait consists of red granules containing 0.5% w/w of imidacloprid and 1.0 g/kg of the fly sex pheromone Z-(9)-Tricosene. Agita® 10 WG is a water-soluble granule containing 10.0% w/w of thiamethoxam and 0.5g/kg of Z-(9)-Tricosene. Agita® and Quick Bayt® contain the fly sex pheromone Z-(9)-Tricosene. When dissolved in water Agita® becomes a milky beige suspension broth.

Fly-count targets, made out of white expanded polystyrene boards, were used to facilitate knockdown counts of flies. Paper plates (20 cm in diameter) and transparent plastic sheets measuring (30 x 21 cm) were used as bait targets and placed onto the fly-count targets.

Bait evaluation 1: Comparison bait efficacy

This experiment was conducted once a week for 3 weeks. Quick Bayt® granules were distributed evenly into two paper plates ($2g/m^2$, equivalent to manufacturer's recommended practical application rate). Agita® 10WG was prepared according to the manufacturer's recommendation (1.3 kg/ 1liter water) and painted onto two transparent plastic sheets. The transparent plastic sheets did not repel the flies. There were three replicate treatments per day for each of the baits. Fresh baits were used each week. The replicate treatments were randomly placed at the study site throughout the duration of the study.

Bait evaluation 2: Comparison of residual efficacy

This experiment was conducted once a week for 6 weeks. Application methods for both baits in this evaluation are similar to the first evaluation (refer to bait evaluation 1). Ten percent sugar solution was used as the control target and was applied onto cotton pads, which were placed onto paper plates. Three replicate treatments for each of the bait and control targets were randomly placed within the study location every week. The treatments including the control target were placed at the study location 3 meters apart.

The baits and the bait receptacles used in the first week were not discarded and were used again in the following weeks, right until the sixth week. However, the baits could not be left in the field because the study site is a public place. Human activities at the location could disrupt the experiment. Therefore, the baits had to be brought back and kept at the laboratory.

To ensure that the volume of the reused baits was not reduced due to spillage, they were placed with their respective receptacle in clear plastic bags. The clear plastic bags containing the reused baits were stored under room temperature.

Feeding and knocked down fly counts

In both bait evaluations, feeding and knocked down fly count methods were similar. Once the baits were applied onto targets, flies were allowed to feed on the baits from 12 noon to 4pm which is a time when fly density is highest (Habibah, 1997).

The number of flies feeding on the baits were recorded. Dead flies or those that were knocked down within bait targets and fly-count targets were placed in ventilated containers and brought back to the laboratory for identification. Flies were considered knocked down if they were unable to co-ordinate their locomotory movements. Fly species were identified using keys given by McAlpine *et al.* (1981-1989). The knocked down flies were observed after 24 and 48 hours for signs of recovery. The number of flies that recovered from their knocked down state was recorded.

The efficacy and residual efficacy of the baits were evaluated based on knockdown percentage. Knockdown percentage was calculated as the percentage of flies that were knocked down out of the total number of flies that fed on baits.

Data analysis

Knockdown percentages were transformed by Arcsine and tested for normality by using the Kolmogorov-Smirnov statistic. When data was confirmed for normality it was further analyzed using the t-test analysis. The analysis was conducted by a PC version of Statistical Packages for the Social Sciences (SPSS).

RESULTS

Bait evaluation 1: Comparison of bait efficacy

Table 1 shows the mean number of flies counted around the bait targets and the mean percentage of knocked down flies. Overall, the mean number of flies feeding on Agita® (265.2 ± 15.3) was higher compared to Quick Bayt® (196.1 ± 20.5) per replicate.

Mean knockdown percentage per replicate for Agita® was 24.3 ± 2.0 compared to 25.2 ± 6.3 for Quick Bayt®. A t-test analysis showed that the difference in mean knockdown percentage between the two baits was not significant ($t = -0.695$, $df = 10$, $p>0.05$). Therefore, the efficacy in terms of knock down effect of the two baits was not significantly different.

Observations made after 24 hours and 48 hours showed that Agita® had a low percentage of fly recovery. Only one out of the total number of flies knocked down by Agita® recovered from the condition. However, Quick Bayt® showed a higher mean recovery percentage, at 3.3 percent. Most of the flies that recovered from knockdown lost their ability to fly (hoppers) but subsequently survived the treatments.

Figure 1 shows the percentages of different species of flies knocked down by the two different baits. *Musca domestica* was the predominant species knocked down by the two baits. Overall, Agita® and Quick Bayt® knocked down was as follows: 78.3% and 75.3% *M. domestica*, 7.0% and 8.5% *Musca sorbens*, 7.7% and 2.8% *Chrysomya megacephala* and 7.0% and 12.9% *Lucilia cuprina* respectively.

Table 1. Mean number of flies feeding on baits and mean percentage of knocked down flies per replicate as well as percentage recovery of knocked down flies over a period of 3 weeks (mean ± SD)

Baits	n	Mean no. feeding flies ± SD	Mean knockdown % ± SD	Fly recovery % ± SD
Agita	9	265.2 ± 15.3	24.3 ± 2.0	0.2
Quick Bayt	9	196.1 ± 20.5	25.2 ± 6.3	3.3

n = number of replicates

Bait evaluation 2: Comparison of residual efficacy

The mean number of flies feeding on the bait targets recorded weekly is shown in Figure 2. A mean number of 229.8 ± 14.8 and 204.8 ± 11.8 flies fed on Agita® and Quick Bayt® respectively per week during the 6 week period. Only 83.3 ± 8.9 flies fed on the sugar (control) baits per week.

Figure 3 shows that Quick Bayt® has a higher weekly mean knockdown percentage compared to Agita®. In the first week, the mean knockdown percentage was at 41.5 ± 4.9%, after which a slight decrease in mean percentage occurred but stayed consistent at around 36% for the next 4 weeks. On the sixth week, the mean percentage dropped

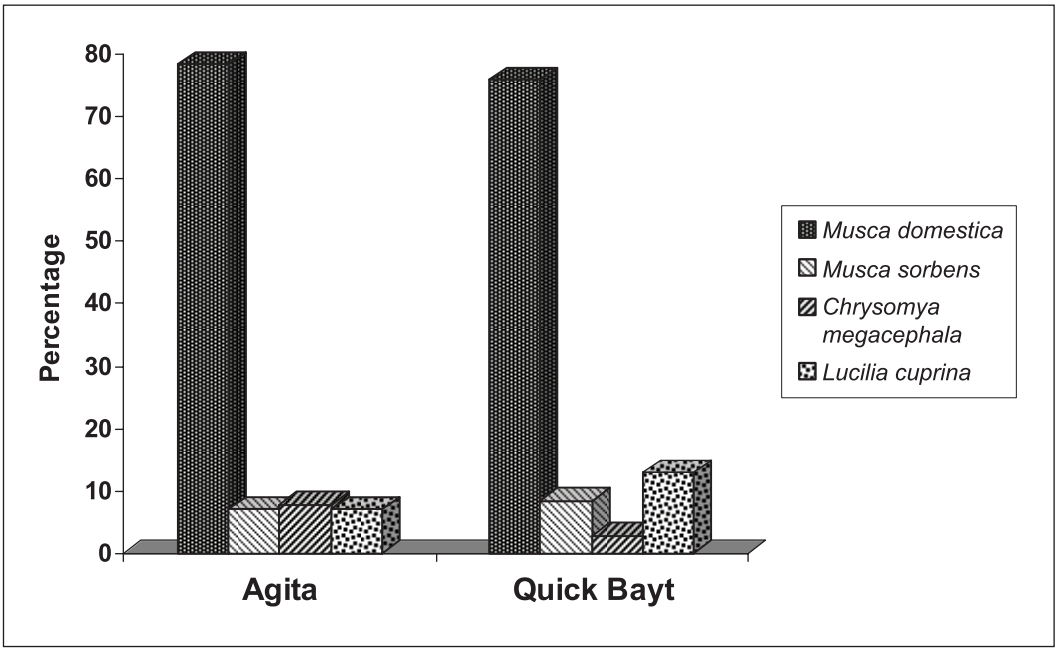

Figure 1. Overall percentages of different species of flies knocked down by Agita® and Quick Bayt®.

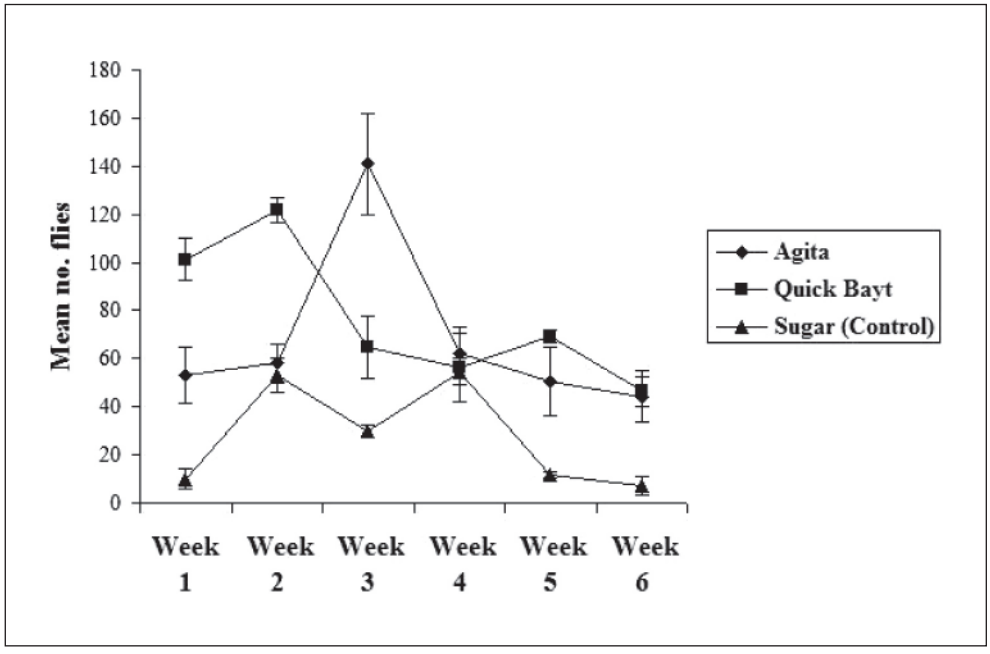

Figure 2. The weekly mean number of flies feeding on baits and control targets. Values are mean ± SD.

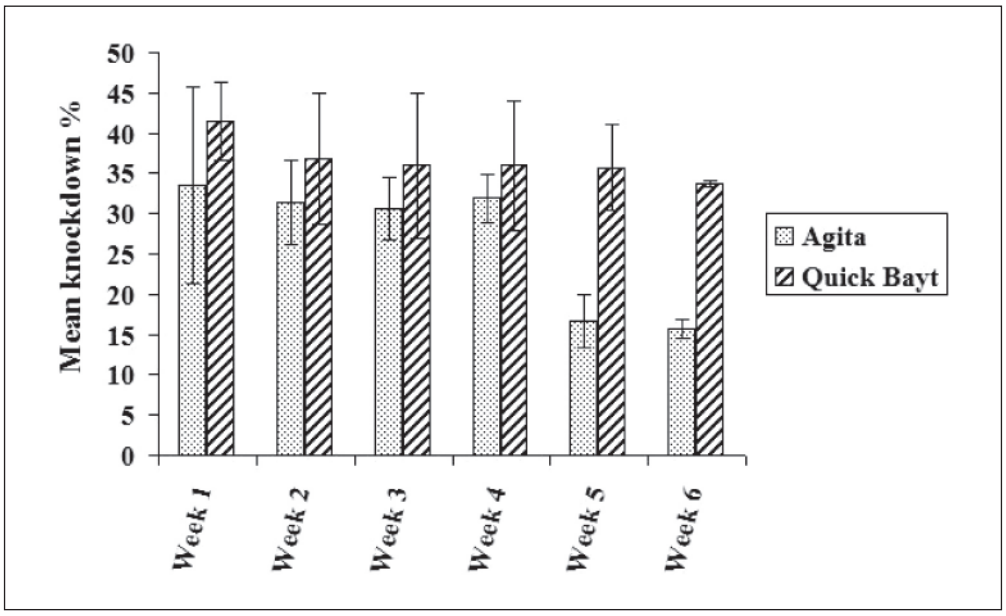

Figure 3. The efficacy of Quick Bayt® and Agita® in the field showing the weekly mean percentage of flies knocked down by the baits. Values are mean ± SD.

only to 33.8 ± 0.4%. This shows that Quick Bayt® residual efficacy remained high even after six weeks.

The knockdown percentage of Agita® was found to be slightly lower than that of Quick Bayt® (Figure 3). The mean knockdown percentage for Agita® for the first week was 33.6 ± 12.2% and remained relatively consistent for the first 4 weeks at 31%. On week 5, however, there was a sharp decrease in efficacy of this bait, as can be seen from the lower knockdown percentage.

The knockdown percentage for Agita® at week 5 and week 6 was 16.7 ± 3.3% and 15.7 ± 1.2% respectively. A t-test determined that the difference in residual efficacy of the two baits was significant ($t_{0.05,\ 10} = -2.919$, $p<0.05$). From this result, it can be seen that Agita® has a shorter residual efficacy compared to Quick Bayt®.

DISCUSSION

Bait Evaluation 1: Comparison of Bait Efficacy

The results show that, the mean number of flies landing on targets baited with Agita® was higher compared to targets baited with Quick Bayt®. The reason for the difference in attractiveness of the two baits is unclear. Both baits have sugar based formulations and both have the fly pheromone Z-(9)-Tricosene added into the formulation. Quick Bayt® has a Z-(9)-Tricosene content of 1.0 g/kg whereas Agita® only has 0.5 g/kg. The discrepancy in the mean number of flies feeding on the baits could be due to the difference in the application methods of baits.

Results of the present study show that there was no significant difference in the efficacy of Quick Bayt® and Agita®. This contradicts results of the study by Novartis Animal Health Inc. (2002) in two pig-breeding units in Poland where Agita® demonstrated clear superiority compared to imidacloprid against houseflies. There were significant differences in the accumulated number of dead flies after 24 hours as well as the reduction of live flies on animals between the two products. When used against fruit flies (Tephritidae) however, thiamethoxam (2-4% AI) was significantly less effective than imidacloprid (2% AI) (Ayyappath *et al.*, 2000). Unlike the previous

studies, the present study evaluated the efficacy of the baits against a broad range of fly species which includes houseflies as well as other synanthropic flies and not just targeted at specific species. Therefore, the results might indicate that when used against a population of flies of different species, Agita® and Quick Bayt® provide the same level of efficacy.

In a study comparing the effectiveness of thiamethoxam and azamethiphos baits against houseflies in restaurants, thiamethoxam and azamethiphos based baits were found to be equal in terms of their attraction and killing effect (Msangi *et al.*, 2006). Imidacloprid baits however, have been shown to be significantly better than methomyl and azamethiphos based products in several studies (Yashiro, 1999; Tobar, 2000). In the present study, the lack of a significant difference between the efficacies of the baits could be due to the fact that both imidacloprid and thiamethoxam are from the same class of synthetic insecticides (Neonicotinoids). However, Quick Bayt® had a higher percentage of fly recovery compared to Agita®. In a practical situation, these surviving flies represent a potential for population survival and resistance in fly populations (Webb, 1986).

Bait Evaluation 2: Comparison of Residual Efficacy

Evaluation of the residual efficacy of insecticides or chemical baits is important in formulating effective fly control programs. There is a need to maintain efficacy of baits over a longer period in order for it to be effective and economically viable for use in fly control programs (Freeman & Pinniger, 1992; Wright *et al.*, 1999).

The results show that a higher number of flies fed on Quick Bayt® compared to Agita® over the six-week sampling period. However, residual efficacy was not evaluated in terms of fly visits but on persistence of the knockdown effect over time. Quick Bayt® had a higher knockdown percentage compared to Agita® throughout the sampling period. This was expected, as the results of the bait efficacy evaluation (bait evaluation 1) shows that Quick Bayt® did have a slightly higher knockdown percentage than Agita®, though the difference was not significant. The mean knockdown percentage of Quick Bayt® remained consistent throughout the sampling period and did not vary greatly even 6 weeks after initial exposure of the bait. This result agrees with the results of the Nipcam study (2002). In the study, Quick Bayt® remained active under field conditions at least 6 weeks after application.

The difference in knockdown percentage over the six-week period between Agita® and Quick Bayt® was found to be significant. This result shows that Quick Bayt® has a longer lasting efficacy compared to Agita®. The reason for this difference could be the fact that the pellets or granules of Quick Bayt® are homogenous pellets. Unlike other products, where only the surface is treated, the whole sugar based pellet is treated with Quick Bayt®. Another reason could be that Agita® was applied on plastic sheets and when the bait dried up, small flecks of the bait layer started flaking off the plastic sheets. Therefore, for practical use of this bait on plastic sheets it would need to be constantly repainted with Agita® to maintain its effectiveness. However, the repeated exposure of the chemical to the applicator may not justify the use of plastic sheets in this manner. Plywood or wooden boards and cardboard could be used as an alternative to plastic sheets in order to ensure that the bait does not flake. Hamill *et al.* (2003) compared biodegradable, plastic and wooden imidacloprid treated spheres for the control of Tephritid flies. The plastic spheres were found to be a viable alternative for the control of the flies, although the same problem as the present study was encountered due to the use of plastic as a bait receptacle.

Other Quick Bayt® formulations such as the Quick Bayt® Spray formulation have also shown longer lasting efficacy. Pospischil *et al.* (2005) demonstrated that Quick Bayt® Spray containing imidacloprid WG 10 had a residual efficacy of 8 weeks compared to Spinosad GR 1.0. In the study, efficacy of Spinosad decreased after week 4, while Quick Bayt® Spray efficacy remained high.

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