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MOSQUITOES OF URBAN AREAS OF PENANG: ABUNDANCE AND CONTROL

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Abstract Survey on mosquito larvae and pupae were carried out in construction sites and drains in Penang, Malaysia. Species of mosquito larvae were identified from these two habitats. *Aedes albopictus* and *Ae. aegyptii* were the dominant mosquito spp found in the construction sites. Different habitats during the construction activities were related to the abundance of *Aedes* larvae. The drains were found to be the habitat for *Culex quinquefasciatus* larvae. The abundance of *Cx. quinquefasciatus* larvae was found to be high during low rainfall months. Trials on control of mosquito larvae in the construction sites and the drains were carried out by using some insecticides.
Key Words Mosquitoes, construction sites, drains, abundance, control.

INTRODUCTION

Man completely constructed a new ecosystem when they turned from being traveling hunters and gatherers to settling down and building settlements, and then sprawling cities. Urban pests range from mosquitoes and cockroaches to the ubiquitous crows that now infest our towns and cities. Mosquitoes are known to vector several importance diseases such as dengue, malaria, encephalitis and filariasis in urban areas that threatened the health and wealth of the settlements. Abu Hassan et al. (1993) described the physico-chemical factors of the breeding habitats of *Cx. quinquefascitus* in Penang. Ahmad Ramli et al. (1994) and Ahmad Ramli (1996) noted that *Cx. quinquefascitus* was the main nuisance mosquito in Penang. Yap et al. (1988) found that *Cx. quinquefascitus* was one of the four mosquito species of public importance in Malaysia. Construction sites were blamed places for *Aedes* mosquitoes, the vector for dengue (El Badri 1999). Thus, this study we report the breeding and abundance of *Cx. quinquefascitus* in drains and *Ae. albopictus* and *Ae. aegypti* in construction sites and its control in urban areas of Penang, Malaysia.

MATERIALS AND METHODS

Larval Survey. Thirty nine construction sites were examined for water containers that contained mosquito larvae and pupae in the Northeast and Southwest districts of Penang from January to April 1997. The larval survey for *Cx. quinquefascitus* was conducted in Bayan Baru, Taman Seri Nibong, Sungai Nibong, Relau and Batu Uban, Penang. Drains were checked for the larvae of *Cx. quinquefascitus* by using standard dipper. Two concrete drains in Bayan Baru and Taman Seri Nibong were sampled for the immatures of *Cx. quinquefascitus* for a year in 2002 in order to see the relationship between rainfall and their abundance.

Insecticides. Three insecticides (Baytex 50EC containing Fenthion, Abate 500E containing Temephos and Sumithion 40WP containing Fenitrothion) were tested for their efficacy following the label rates as recommended by the manufacturer in the construction sites (Table 1). Field evaluation of three insecticides in three concrete drains were conducted from January 1st to May 15th, 2002 (treated with Baytex EC50 and Agnique MMF) and from January 1st to August 7th, 2002 (treated with Abate 500E). Baytex EC50 and Abate 500E were applied by using a hand-operated compression knapsack sprayer while Agnique MMF was applied by using a 10 ml syringe. Immature stages of mosquitoes were sampled from all drains by a standard dipper 24 hour pretreatment, 24 hour post-treatment and weekly thereafter until significant breeding occurred. When the counts of immature stages exceeded the pretreatment counts, then the sites were retreated with the same dosage for the second round and followed with the next two rounds of the different dosage. (Table 2). Percentage reduction of *Cx. quinquefascitus* immature population was assessed as percentage reduction by using Mulla et al. (1971) for the efficacy of the insecticides.

Table 1. Insecticides, active ingredient and label rate.

Insecticide	Active ingredient	Label rate	Plot size
Sumithion 40WP	Fenitrothion	$5 g/m^2$	$12.2\ m^2$
Baytex 50EC	Fenthion	$0.2 ml/m^3$	$16.2\ m^2$
Abate 500EC	Temephos	$0.025\ ml/m^2$	$15.3\ m^2$

Table 2. Insecticides, recommended dosage and tested dosage.

Insecticide	Treated drain size	Recommended dosage (polluted water)	Tested dose	
			First round	Second round
Baytex EC50 (Fenthion)	Drain 1 ($2.4\ m^3$)	$0.2\ ml/m^3$	$0.20\ ml/m^3$	$0.3\ ml/m^3$
Agnique MMF (Isotaeryl alcohol)	Drain 2 ($9.0\ m^2$)	0.37-$0.47\ ml/m^2$	$0.4\ ml/m^2$	$0.5\ ml/m^2$
Abate 500E (temephos)	Drain 3 ($16.0\ m^2$)	0.0125-$0.025\ ml/m^2$	$0.0125\ ml/m^2$	$0.02\ ml/m^2$

RESULTS AND DISCUSSION

The construction sites were found to breed *Aedes* mosquitoes as blamed. There are various places available to become breeding sites for mosquito immature during the construction of buildings (Figure 1). *Aedes albopictus* was found in flooded floor (50%, n=103) followed by floor recessed opening (22.3%) and basement flooded floor (7.8%). While 47.6% (n=21) of the breeding habitats were with *Ae*. *aegypti*. They were found breeding in the basement flooded floor followed by drains (23.8%) and floor recessed opening and water tanks (9.5%). While *Cx*. *quinquefascitus* was collected in drains and flooded floor (6.1%) in small number. Some breeding habitats were found to be common for both *Aedes albopictus* and *Ae*. *aegypti*. In the present study both vectors species were found breeding in basement flooded floors, drains (shaded), flooded floors (shaded), floor recessed opening and lift wells (shaded). The most preferred habitats for *Ae*. *aegypti* were basement flooded floors and drain. *Aedes albopictus* preferred flooded floor (temporary water pools) (Zainol Ariffin, 1998) and floor recessed openings at the construction sites.

Field efficacy of the three insecticides used in the construction sites is shown in Figures 2, 3 and 4. Temephos (Abate 500E) showed a 100% reduction of immature population of *Aedes* mosquitoes up to 6 to 7 weeks. Baytex 50EC maintained a 100% reduction on the immature population of mosquitoes up to 2 to 4 weeks while Sumithion 40 WP showed a 100% reduction on the immature population of mosquitoes up to 2 to 3 weeks. In all insecticides, the density of the immature population of mosquitoes started to rise after the above mentioned period of reduction. However, the effectiveness of the three insecticides falls short of the manufacturer’s claim. Temephos (Abate 500E) spraying frequency was recommended at 2-3 months but in this study it was only 8 weeks then breeding of *Aedes* mosquitoes occurred. Fenitrothion (Sumithion 40WP) was effective for 3 weeks not as the manufacturer’s claim for 3-4 months.

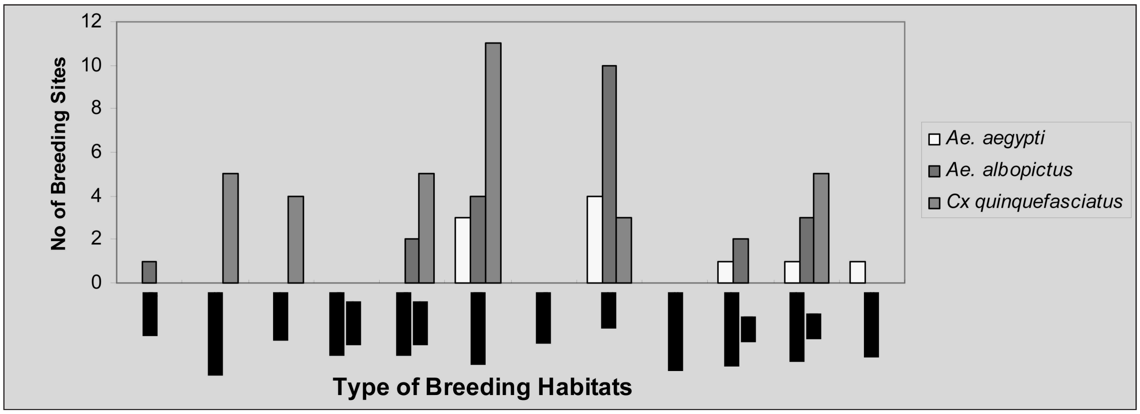

Figure 1. Mosquito breeding habitats in the construction sites, Penang, Malaysia.

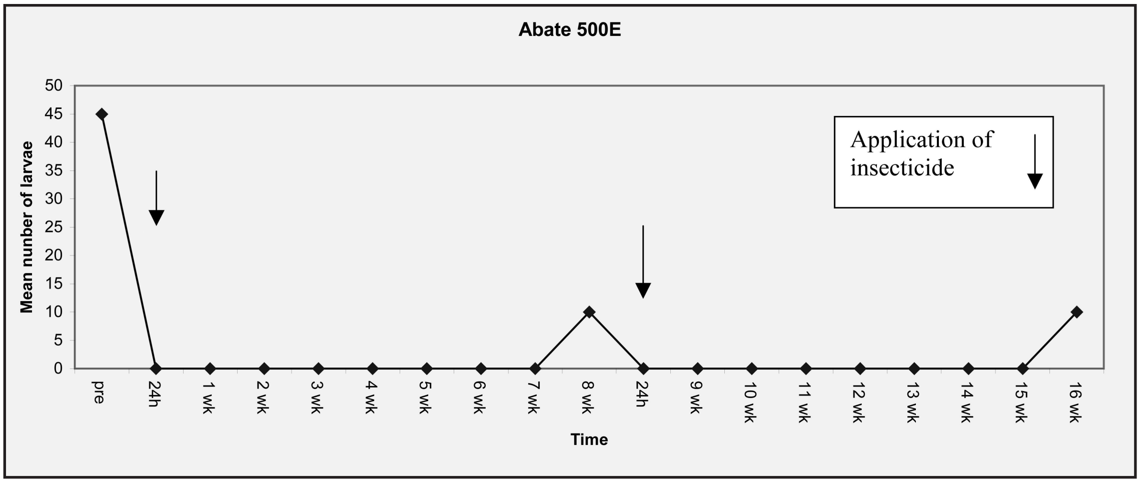

Figure 2. Field efficacy of Temephos (Abate 500E) against mosquito immature population in construction site.

The drains were dominated by *Cx. quinquefasciatus* in all areas sampled. Two other species of mosquito larvae that were sampled from the drains were *Cx*. *gelidus* and *Cx*. *fuscanus* but these two species were represented by very small numbers as compared to *Cx. quinquefasciatus*. In Taman Sri Nibong, 84,349 immature *Cx. quinquefasciatus* were collected from the drains. The larval stages (89%) were more dominant than the pupal stage (11%). The present study found that immature *Cx. quinquefasciatus* were highly abundant in the drains throught the year. These drains were highly polluted larval habitats which received domestic waste continuously from the surroundings (Ahmad Ramli 1996, Ngumbang 2004). These drains were clogged and the water was stagnant. In addition, decaying food and plant might have increased the source of food and nutrient for these immature *Cx. quinquefasciatus* to survive. Covell and Resh (1971) and Reisen et al. (1990) observed clogged and stagnant drains and ditches were able to accumulate organic matters and thrash for long period and encouraged the development of *Cx. quinquefasciatus* larvae in those habitats. Many areas which received nutrient rich waste water produced high density of *Culex* spp especially *Cx. quinquefasciatus* (O'Meara and Evan, 1983; Carslon et al., 1986). The number of immature collected was relatively high during periods of low rainfall. During low rainfall, the density of immature shoot up due to no flushing as occurred in high rainfall period. In general, some flushing of mosquito larvae from those concrete drains are expected.

Tables 3, 4 and 5 show the efficacies of the three insecticides against *Cx. quinquefasciatus* larvae and pupae in the drains. Baytex showed 100% reduction for 2 weeks post-treatment with Dose A (0.2ml/m^3). Higher dose (0.3 ml/m^3) produced longer period of population reduction, that is, until the 4^{th} week (Table 3). Additionally, the pupal population was also reduced by 100% even up to the three weeks post-treatment. However, Agnique MMF showed 100% pupal reduction after 24 h, one week and two weeks post-treatment but produced lower larval population reduction (Table 4). Abate 500E produced longer high population reduction than the two insecticides maintaining around 90% larval and pupal population reduction up to 6 weeks post-treatment.

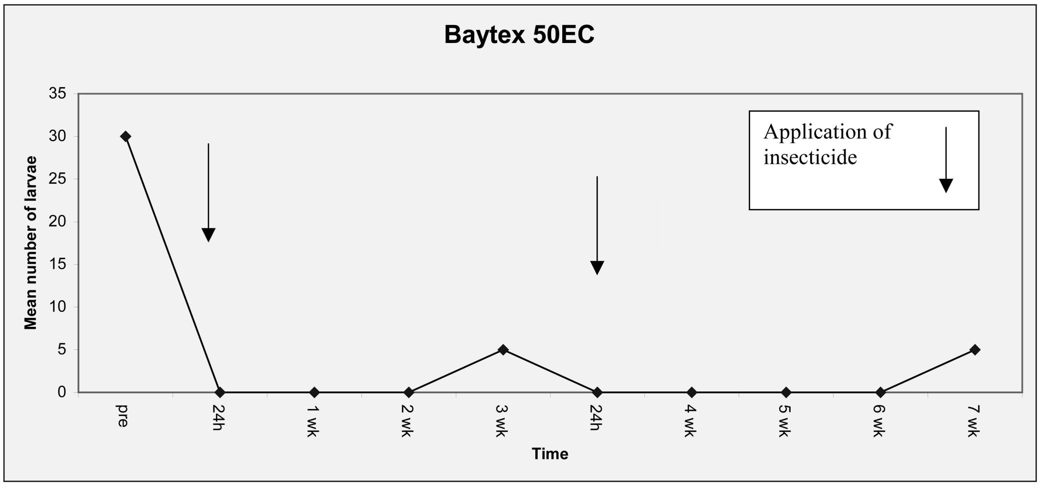

Figure 3. Field efficacy of Baytex 50EC against mosquito immature population in construction sites.

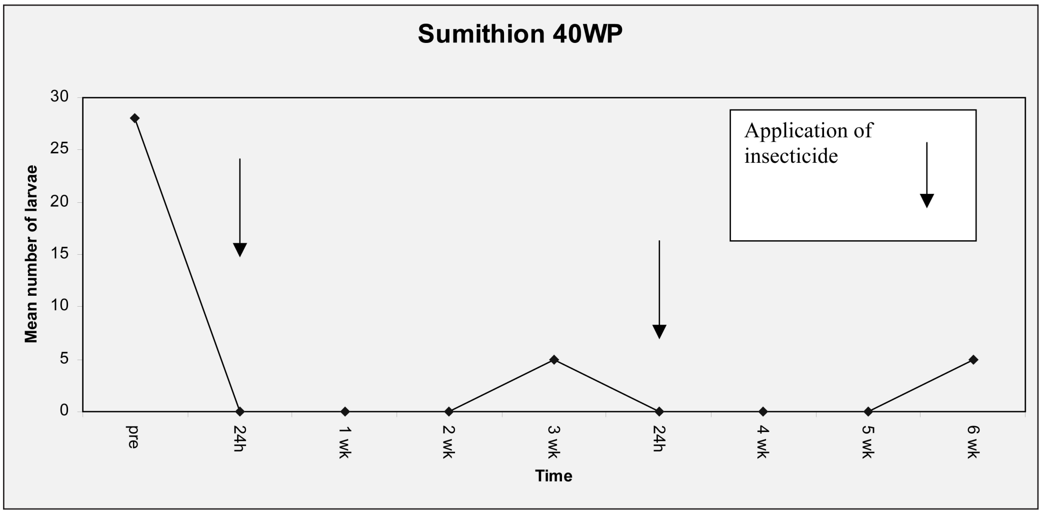

Figure 4. Field efficacy of Sumithion 40WP against mosquito immature population in construction sites.

The present study found that three different insecticides showed different effectiveness against immature stages of *Cx. quinquefasciatus* in highly polluted drains in residential areas of Penang. In summary, temephos had the longest larvicidal effect (7 weeks) against immature stages of *Cx. quinquefasciatus* followed by fenthion and monomolecular surface film for 3 weeks. Many works on temephos produced high percentage reduction of immature mosquito population up to 6 weeks post-treatment (Sutherland et al., 1974; Chadee 1984; Ali et al., 1995). Agnique MMF has been shown to be relatively safe to non-target organisms and has an extremely low mammalian toxicity (Nayar and Ali 2003). Furthermore, film-induced mortality of immature mosquitoes is thought to be produced by physical factor, i.e., habitat surface tension reduction with subsequent wetting of tracheal structures and anoxia, and therefore resistance to Agnique MMF is not expected to develop. These factors as well as the ease of application, susceptibility of *Cx. quinquefasciatus* at a surface dosage as low as 0.4 ml/m^2 make this surface film an excellent candidate for practical mosquito control in highly polluted water of concrete drains such as in Penang. The study also confirmed that construction sites provided breeding habitats for *Aedes* mosquitoes. Temephos showed the longest insecticidal activity (6-7 weeks) against the *Aedes* immatures in the construction sites.

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Table 3. Post treatment reduction (%) of immature *Cx. quinquefasciatus* with Dose A (0.2ml/m^3) and Dose B (0.3ml/m^3) of Baytex EC50 in concrete drain 1.

Dose	Post-treatment	% reduction	
		Larvae	Pupae
Dose A (0.2 ml/m^3) 1st run	24 hour	100	97.6
	1 week	100	100
	2 weeks	100	100
	3 weeks	73.8	79.3
	4 weeks	21.1	42.1
Dose A (0.2 ml/m^3) 2nd run	24 hour	100	97.8
	1 week	100	100
	2 weeks	100	100
	3 weeks	75.5	79.0
	4 weeks	8.8	26.8
Dose B (0.3 ml/m^3) 1st run	24 hour	100	100
	1 week	100	100
	2 weeks	100	100
	3 weeks	94.5	93.5
	4 weeks	73.9	68.5
Dose B (0.3 ml/m^3) 2nd run	24 hour	100	100
	1 week	100	100
	2 weeks	100	100
	3 weeks	100	100
	4 weeks	93.7	90.7

Table 4. Post treatment reduction (%) of immature *Cx. quinquefasciatus* with Dose A (0.4 ml/m^2) and Dose B (0.5ml/m^2) of Agnique MMF in concrete drain 2.

Dose	Post-treatment	% reduction	
		Larvae	Pupae
Dose A (0.4 ml/m^2) 1st run	24 hour	84.5	100
	1 week	96.3	100
	2 weeks	94.1	90.0
	3 weeks	71.6	75.9
	4 weeks	34.4	42.4
Dose A (0.4 ml/m^2) 2nd run	24 hour	81.0	100
	1 week	94.8	100
	2 weeks	91.1	86.6
	3 weeks	64.6	59.8
	4 weeks	24.4	25.0
Dose B (0.5 ml/m^2) 1st run	24 hour	91.3	100
	1 week	99.1	100
	2 weeks	97.0	100
	3 weeks	77.2	76.5
	4 weeks	32.8	34.7
Dose B (0.5 ml/m^2) 2nd run	24 hour	94.8	100
	1 week	98.0	100
	2 weeks	96.0	100
	3 weeks	100	95.2
	4 weeks	74.2	72.6

Table 5. Post treatment reduction (%) of immature *Cx. quinquefasciatus* with Dose A (0.0125 ml/m^2) and Dose B (0.02ml/m^2) of Abate 500E in concrete drain 3.

Dose	**Post-treatment**	**% reduction**	
		Larvae	**Pupae**
Dose A (0.0125 ml/m^2) 1st run	24 hour	100	71.6
	1 week	100	97.2
	2 weeks	100	95.6
	3 weeks	100	94.6
	4 weeks	100	92.7
	5 weeks	98.4	98.8
	6 weeks	91.0	87.7
	7 weeks	20.1	55.5
Dose A (0.0125 ml/m^2) 2nd run	24 hour	100	77.6
	1 week	100	97.0
	2 weeks	100	96.0
	3 weeks	100	94.4
	4 weeks	100	92.4
	5 weeks	98.5	97.0
	6 weeks	92.0	90.4
	7 weeks	33.7	48.2
Dose B (0.02 ml/m^2) 1st run	24 hour	100	69.1
	1 week	100	97.3
	2 weeks	100	94.5
	3 weeks	100	92.7
	4 weeks	100	91.8
	5 weeks	98.8	97.3
	6 weeks	95.6	87.3
	7 weeks	46.2	52.7
Dose B (0.02 ml/m^2) 2nd run	24 hour	100	57.8
	1 week	100	95.3
	2 weeks	100	93.8
	3 weeks	100	93.8
	4 weeks	100	89.1
	5 weeks	95.8	909
	6 weeks	95.8	89.1
	7 weeks	72.9	58.7

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