FIELD EVALUATION OF SOME MOSQUITO LARVICIDAL AGENTS AGAINSTANOPHELES AND CULEX MOSQITO AND ITS EFFECTS ON NON-TARGET ORGANISMS IN MALAYSIAN RICE FIELDS, PENANG, MALAYSIA

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Abstract - Under the field condition Culex spp. and Anopheles spp. were selected for small plots evaluation of Abate® 500E (0.28 mg/l), VectoBac-WDG® (AI) 3000 ITU/mg (0.48 mg/l) and monomolecular film Agnique MMF® (5 l/ha) efficacy over time in the rice fields. In fields with water pH 5.8, water temperature 28 ºC and 9.05 cm rice plant height, Abate® 500E at 0.28 mg/liter gave (75.3-100%) mortality of Anopheles spp. and (75.8-90.5%) mortality of Culex spp. 3 wk post-treatment, respectively. VectoBac-WDG® at 0.48 mg/liter yielded (55.52-100%) mortality of Anopheles spp. and (51.29-100%) mortality of Culex spp 5-7 days post-treatment, respectively. While Agnique MMF® at 5 l/ha (0.5 ml/m²) resulted in (84.9-93.7%) mortality of Anopheles spp. and (73.4-96.5%) mortality of Culex spp. 2 wk post-treatment, respectively. The three larvicides at same rates had no noticeable adverse effects on prevailing macroinvertebrate fauna such as, Corixidae, mayfly naiads, damselfly larvae and Dytiscidae.

Keywords - Anophels, Culex, Rice Fields, Larvicidal Agent, Microinvertibrats

I. INTRODUCTION

Mosquitoes are important vectors of several tropical diseases in humans; including malaria, filariasis, and numerous viral diseases, such as dengue, dengue hemorrhagic fever, yellow fever, and Japanese encephalitis (WHO, 1999). In recent years, research on the development of eco-friendly and target-specific biocontrol agents has been given much important. The microbial insecticides are selective in their action on mosquitoes and blackflies (Dominic Amalrajet al., 2000). Vector control products based on bacteria are designed to control larvae. The most widely used commercial products are VectoBac® and Teknar® which are based on Bacillus thuringiensis subsp. israelensis (B.t.i.), has come to market recently for the control of mosquito vectors offilariasis and viral diseases.The efficacy of B.t.i. and its safety to non-target organisms have been reviewed extensively (Dominic Amalrajet al.,2000;Gunasekaranet al., 2002, 2004; Gustavo et al., 2002; Federiciet al., 2003.,Brown et al., 2004;Shililuet al., 2005; and Zahiri and Mulla, 2005). Another larvicidal agent Abate, is a promising agent for control of mosquito larvae. Its low toxicity to non-target organisms and low effective dosage makes temephos the most appropriate for the control of mosquito larvae in drinking water and in areas of contact to vertebrates (Chadee, 1984; WHO, 1997). In Taiwan rice fields, Tenget al. (2005) found that the insecticide temephos was very effective at suppressing the larvae of An.Sinensis. Monomolecular surface film (Agniue® MMF) is utilized as larvicide and pupicide of mosquitoes during the 1980s. It is biodegrable and spread spontaneously over the surface of the water to form an ultra-thin film (monomolecular layer), about one molecule in thickness (Nayar and Ali, 2003). Rice fields in particular contribute to increased malaria and arthropod-borne virus infections in man (Surtees, 1977; Romiet al., 1993). The present study deals with the field evaluations to determine efficacy of Bacillus thuringiensis H-14,temephos (Abate®) and Agnique® MMF as larvicides against rice field mosquito, and impact of this larvicides on non-target organisms in the field.

II. MATERIALS AND METHODS

For field evaluation, the Bacillus thuringiensisvar. Israelensis material tested was VectoBac-WDG® water dispersible granules with 3000 ITU/mg (lot no. 72-578-PG) provided by Abbott laboratories. Emulsifiable concentrate of Abate® (Abate-500E) # 1060-122, manufactured by Agrimore Ltd., Atul. and Agnique® MMF, LOT # U 83 D 281198, Code # 242605 provided by Cognis Corporation were used during the treatments. The first two larvicides were tested in the Laboratory before their used in the fields. The applications were quantitated as parts per million (ppm) (weight/volume) depending on the results achieved in the bioassays.VectoBac-WDG® (B.t.i.) at 0.28 ppm (mg/l), Abate® at 0.48 ppm (mg/l) and Agnique® MMF at (5 l/ha) were evaluated. Larvicides were applied with a new Polyethylene (plastic), J-Jacto PJ-18 liters capacity manual sprayer equipped with lance and nozzle (JD-12P, 500mm) at 6 kg per cm² and 10 ml syringe was used to apply Agnique® MMF. The field evaluation were conducted on the rice fields in the Mardi Station, a randomized complete block design was used, which was consisted of 12 small rice plots measuring 10x10 m. Nine test plots and three control

plots were used. Prior to the start of efficacy trials, the test plots were marked using numbered flags. Each plot, contained RM 220 varieties of rice, 0.46 m high. Depth of water in the rice planted area was averaged 9.05 cm. Volume of water in each plot was 61500 liters. The water temperature at midmorning was 28º C and the pH was 5.8. Larval abundance (number per dip) of mosquito genera Culex and Anopheles in both larvicides treated and untreated plots was monitored prior to the application of the larvicides(day'0) and after application days 1, 2, 3, 5, 7, 14 and 21. Measurement of mosquito larval abundance was carried out by taking 10 dip samples from each plot. Some other non-target organisms that they naturally breed on the same plots were observed and counted at the same times.The means of different larvicides were compared by computing data usingSPSS Program version 11.0. ANOVA was carried out by considering days (from 0 to 21) and experimental groups, (treated and untreated) as independent factors. The abundance of larvae was compared between larvicides treated and untreated plots for each day of observation using L.S.D.multiple comparison tests. Percentage reduction in larvae abundance in larvicides, treated plots was estimated using Mulla's formula (Mullaet al., 1971).

III. RESULTS AND DISCUSSION

The results of the field evaluation of the larvicidal effect of Abate®500E, VetoBac®WDG and Agnique®MMF at rates: 0.84ppm, 0.28ppm and 5l/ha, respectively against Anopheles and Culex larval population in Penang rice fields as shown in Table(3.1). The three larvicides differ in their effectiveness, Abate had the longest larvicidal effect (3 weeks) followed by MMF (2 Weeks) and VectoBAC (5 days) for Anopheles and (7 days) for Culex. Twenty four hours after treatment the density in the treated plots was (0.0, 0.9) ,(0.0) and (0.3) larvae/dip for Anophels and Culex, respectively against (4.3, 10.2), (4.4, 10.2) and (4.3, 10.3) larvae/dip, respectively before treatment, while in the control plots it was (4.7, 10.5) larvae/dip against (4.2, 10.7) larvae/ dip, respectively Table (3.1). Using the control plot for correction, abate showed the highest percentage reduction 100%, 100% and 100% for Anophels and 90.5%, 91.6% and 86.8% for Culex followed by VectoBac 100%, 94.8% and 90.0% for Anophels and 100%, 100% and 98.8% for Culex, respectively. The reduction of Anophels and Culex larval density in MMF treated plots were (93.7%, 91.6%, 92.3%) and (9.6.5%, 95.2%, 9.2.6%) on day first, second and third, respectively Table(3.1). Density of Anophels and Culex larvae between test and control plots was not significantly different on day 0 (L.S.D.). Larval density was significantly lower in treated plots also from day 5 on wards Table(3.1).

This result is supported by Zaim et al.(1992), Fillinger et al.(2003) and Shililu et al.(2005). Our study shown that Culex and Anophels larvae were completely reduced in the rice field plots from day 5 - 7. Previous studies (e.g. Romi et al.,1993 and Ali et al.,1994) have shown that the high mosquito larvicidal activity disappears within 2-3 days. The three larvicides at the same rates showed no appeared adverse effects on non-targetorganisms present in the plots at the time of treatment. Density of naiads of mayfly and Corixidae in treated plots increased or decreased in numbers as they did in the control plots over 21 days Table (3.2). Similary, no marked effects due to treatment were noted on Zygoptera and Dytiscidae beetles.

This result agree with Ali et al.1981,1984,Nar& Ali, 2003 andGunasekaran et al. 2004 with different rates of larvicides.

Table 3.1: Evaluation of industrially produced, commercial formulations of mosquito larvicides, temephose (Abate® 500 E), Bacillus thuringiensisserovar. israelensis[VectoBac® WDG containing 3,000 BtiInternationalToxic Units (ITU)/mg], and a monomolecular surface film (Agnique® MMF) against Anopheles spp. and Culex spp. Mosquito in rice field plots, Penang, northern Malaysia

Mosquito Larvicide	Treatment rate	Number of larvae/10 dips pre-, and posttreatment (days)							
		Pretreat[1]	1	2	3	5	7	14	21
					Anopheles spp.				
Abate® 400E	(0.48gm/l)	4.3	0.0 (100)[2]	0.0 (100)	0.0 (100)	0.3 (93.5)	0.8 (84.3)	0.7 (85.	1.2 (75.3)
VectoBac ® WDG	(0.28gm/l)	4.4	0.0 (100)	0.2 (94.8)	0.5 (90.0)	2.3 (55.5)	4.3 (16.2)	4.2 (12.8)	4.6 (12.1)
Agnique® MMF	(5 l/ha)	4.3	0.3 (93.7)	0.4 (91.6)	0.3 (92.3)	0.5 (89.6)	0.6 (87.5)	0.7 (84.9)	4.8 (6.2)
Control		4.2	4.7	4.8	5.1	5.0	4.9	4.6	5.0
					*Culex*spp.				

Abate®	(0.48gm/	10.2	0.9	0.8	1.4	1.3	1.5	2.2	2.4
400E			(90.5)	(91.6)	(86.8)	(86.8	(85.3)	(78.9)	(75.8)
VectoBac®	(0.28gm/	10.2	0.0	0.0	0.5	2.5	4.8	9.7	9.6
WDG			(100)	(100)	(94.8)	(73.4)	(51.2)	(3.1)	(0.3)
Agnique®	(5 l/ha)	10.3	0.3	0.5	0.8	1.1	1.4	1.8	9.2
MMF			(96.5)	(95.2)	(92.6)	(88.9)	(81.6)	(73.4)	(5.3)
Control		10.7	10.5	10.7	11.1	10.0	10.4	10.5	10.1

[1] Average of the two pretreatment sample counts

[2]Percent reduction in parentheses

Table 3.2: Evaluation of industrially produced, commercial formulations of mosquito larvicides, temephose (Abate® 500E), Bacillus thuringiensisserovar.israelensis [VectoBac® WDG containing 3,000 Bti International Toxic Units (ITU)/mg], and a monomolecular surface film (Agnique® MMF) against Anopheles spp. and Culex spp. Mosquito in rice field plots, Penang, northern Malaysia.

Treatment Material	Treatment rate	Number of invertebrates/ 10 dips pre-, and posttreatment (days)							
		Pretreat[1]	1	2	3	5	7	14	21
					Corixidae				
Abate®	(0.48gm/l)	9.5	10	9.0	8.9	9.0	10	10	10
400E			(0)[2]	(<1)	(0)	(0)	(0)	(0)	(0)
VectoBac®	(0.28gm/l)	8.3	10	10	7.4	7.9	9.3	6.8	10
WDG			(0)	(0)	(10.8)	(0)	(0)	(18)	(0)
Agnique®	(5 l/ha)	9.4	9.0	8.0	7.5	6.8	5.8	6.0	8.0
MMF			(4.3)	(10.4)	(20.2)	(18.7)	(31.4)	(36.2)	(14.9)
Control		10	10	9.5	10	8.9	9.0	10	10
					Mayfly naiads				
Abate®	(0.48gm/l)	2.9	4.1	3.4	2.5	2.2	2.7	3.2	3.4
400E			(0)	(0)	(11.2)	(26.3)	(1.1)	(0)	(0)
VectoBac®	(0.28gm/l)	3.0	3.6	4.1	3.0	3.0	3.0	2.8	3.9
WDG			(11.3)	(0)	(0)	(2.9)	(0)	(0)	(0)
Agnique®	(5 l/ha)	4.0	4.4	4.0	2.4	2.7	3.2	3.0	4.2
MMF			(18.7)	(15.0)	(38.2)	(34.4)	(15.0)	(0)	(10.8)
Control		3.4	4.6	4.0	3.3	3.5	3.2	2.3	4.0
					Damselfly larvae				
Abate®	(0.48gm/l)	2.9	1.7	2.8	2.0	1.1	1.3	2.0	2.9
400E			(17.9)	(36.6)	(0)	(0)	(37.2)	(37.0)	(0)
VectoBac®	(0.28gm/l)	3.0	2.2	3.0	1.8	0.8	1.5	3.0	1.4
WDG			(0)	(34.4)	(0)	(6.7)	(30.0)	(8.7)	(34.7)
Agnique®	(5 l/ha)	2.0	2.0	2.6	2.0	1.0	1.0	1.7	1.5
MMF			(0)	(14.7)	(0)	(0)	(30.0)	(22.4)	(0)
Control		2.1	1.5	3.2	1.1	0.6	1.5	2.3	1.5
					Dytiscidae				
Abate®	(0.48gm/l)	1.6	1.0	1.0	0.8	1.6	1.5	1.7	1.0
400E			(0)	(0)	(4.0)	(0)	(0)	(0)	(0)
VectoBac®	(0.28gm/l)	2.0	1.0	0.6	1.0	1.8	2.0	1.2	1.1
WDG			(0)	(13.8)	(4.2)	(0)	(0)	(8.0)	(0)
Agnique®	(5 l/ha)	1.8	0.8	1.3	1.0	2.0	2.2	1.6	1.0
MMF			(7.1)	(0)	(0)	(0)	(0)	(0)	(0)
Control		2.3	1.1	0.8	1.2	2.0	2.1	1.5	1.2

[1]Average of the two pretreatment sample counts

[2]Percent reduction in parentheses

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