EFFICACY OF FENOXYCARB (PICTYL®) AGAINST *PSOROPHORA COLUMBIAE* IN ARKANSAS RICEFIELDS[1]

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ABSTRACT. The IGR, fenoxycarb was effective against mosquitoes in both small rice plots and commercial ricefields in southeast Arkansas at the rate of 10 g AI/ha. It adequately controlled *Psorophora columbiae* populations. This compound shows excellent promise as a tool in effective IPM schemes against *Ps. columbiae* larvae in Arkansas rice fields by acting as a direct control, and possibly by indirectly increasing their vulnerability to natural controls.

INTRODUCTION

Insect growth regulators (IGRs) offer effective control of mosquito larvae and are usually more specific than conventional insecticides. Fenoxycarb is an IGR compound that mimics the mode of action shown by juvenile hormones, inhibiting metamorphosis to the adult stage without inhibiting cholinesterase.

Previous research has shown that fenoxycarb affects the development of *Culex tarsalis* Coquillett, *Culex pipiens* Linn., *Culex quinquefasciatus* Say, *Aedes melanimon* Dyar and *Psorophora columbiae* (Dyar and Knab) with floodwater species being 10X more susceptible than other mosquitoes (Axtell et al. 1980, Dame et al. 1976, Mulla et al. 1974). None of the fenoxycarb formulations tested by Dorn et al. (1981) and Mulla et al. (1985) produced harmful effects against mayfly naiads (*Calibaetis pacificus* Seeman), dragonfly naiads (*Erythemis simplicicollis* Say and *Anax junius* Drury) or various predaceous diving beetle larvae (Dystiscidae and Hydrophilidae). No prior data has been published indicating the efficacy of this compound against *Ps. columbiae* in ricefields in the southern United States. Fenoxycarb was evaluated against riceland mosquito larvae in Arkansas during the summers of 1983-85. Results from tests conducted against *Ps. columbiae* larvae in both small rice plots and commercial ricefields are reported.

MATERIALS AND METHODS

Experiments were conducted in small plots at the University of Arkansas Rice Research and Extension Center near Stuttgart, AR during 1983. Three rates of fenoxycarb (10, 20 and 40 g AI/ha) were delivered in 1.89 liters of water/plot to 6.09 x 6.09 m rice plots, using a CO_2 hand-held sprayer. The three treatment rates and an untreated control were replicated three times within a completely randomized field design. One floating, cylindrical, mesh container 12 cm high x 16 cm diam (Sandoski et al. 1986), holding ten 2nd-3rd instar *Ps. columbiae* sentinel larvae was placed in each plot at the time of treatment. This was repeated 1 and 13 days posttreatment to test the residual effects of fenoxycarb. The floating containers were covered to prevent escape of emerging adults. Containers were examined daily until all individuals had died or emerged. Data collected at 1 and 4 days postintroduction and final (when all individuals were accounted for as dead or emerged) was subjected to ANOVA and treatment means were separated using DMRT (SAS 1985).

Fenoxycarb was applied in 1984 to the lower 8.1 ha of a 30.4 ha field of Bond variety rice near Stuttgart, AR. A Grumann® Ag-Wagon aircraft applied 10 g AI/ha at an altitude of 3.05 m and a swath width of 14–15 m.

One hundred *Ps. columbiae* 4th instar larvae or pupae were randomly collected from treated and 24 from the untreated area (244 m and upwind from the treated area) 1 day posttreatment. These specimens were maintained in their corresponding field water in the laboratory until all had died or emerged.

Fenoxycarb was applied in a similar experiment to 8.1 ha of Mars variety rice in a field located near Jonesboro, AR in 1985. Application was made at the rate of 24.7 g AI/ha as a mixture with 280.6 l water/ha using a Grumann® Ag Cat aircraft with a conventional spray system. One hundred and fifty 2nd-3rd instar *Ps. columbiae* were taken each time from both treated and untreated areas at 6, 12 and 24 h posttreatment. These specimens, along with their corresponding field water, were taken to the laboratory for observation and recordings of death or emergence.

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Table 1. Percentage mortality at different fenoxycarb rates against *Psorophora columbiae* introduced as 2nd-3rd instar larvae at 0, 1 and 13 days posttreatment during 1983.

	Larvae plus pupae		
	Means by days postintroduction*,**		
Rate (g AI/ha)	1	4	Final***
	0 day		
0	23.3a	36.7b	36.7b
10	30.0a	73.3ab	73.3ab
20	73.3a	100.0a	100.0a
40	60.0a	93.3ab	93.3ab
	1 day		
0	3.3a	16.7b	33.3b
10	33.3a	90.0a	96.7a
20	10.0a	66.7a	93.3a
40	56.7a	86.7a	100.0a
	13 days		
0	0.0a	3.3b	6.7b
10	0.0a	15.0ab	25.0b
20	6.7a	26.7ab	60.0a
40	0.0a	50.0a	80.0a

* Analysis of variance performed on transformed data (arcsin) for each postintroduction time separately (N = 30).

** Means in the same column followed by the same lower case letter are not significantly different ($P \geq 0.05$) by DMRT.

*** When all individuals are finally accounted for as dead or emerged as adults.

RESULTS AND DISCUSSION

Analysis of the final mortalities of *Ps. columbiae* larvae plus pupae exposed as early instars to different fenoxycarb rates at time 0 indicated a significantly ($P \leq 0.05$) higher mortality at 20 g AI/ha as opposed to the control during the 1983 study (Table 1).

Analysis of the final mortalities of *Ps. columbiae* larvae plus pupae exposed as early instars 1 day posttreatment indicated significantly lower mortalities in the controls than in the treated plots, but no significant differences were detected among treatment levels.

Analysis of final mortalities of *Ps. columbiae* larvae plus pupae exposed as early instars to different fenoxycarb rates 13 days posttreatment indicated significantly lower mortalities in controls and the 10 g AI/ha treatment than in the 20 and 40 g AI/ha treatments.

Determination of the residual efficacy of fenoxycarb was achieved through comparative observations of the data. Final mortality readings for larvae plus pupae introduced respectively at 0, 1 and 13 days posttreatment and exposed to fenoxycarb rates of 10, 20 and 40 g AI/ha resulted in 73.3, 100 and 93.3%; 96.7, 93.3 and 100%; and 25, 60 and 80% mortalities, respectively. Effective control was achieved by all treatment rates for larval introductions at 0 and 1 day posttreatment. Some residual activity occurred at the highest rate (40 g AI/ha), evidenced by 80% mortality of larvae introduced 13 days posttreatment.

Higher treatment levels caused more rapid mortality than lower levels in many instances. This was particularly true when observing differences in mortality of larvae plus pupae on different days postintroduction.

Specimens collected at random from the treated area of the field died over a period of 2 days never emerging as adults, whereas all of those collected from the untreated area successfully emerged within 1 day. The results of the experiment (100% mortality) on uncaged larvae from the treated area demonstrated that the compound was highly efficaceous.

Larvae exposed to fenoxycarb tended to remain close to the water surface, rarely being induced to express escape movements when disturbed by shadows or taps on the container. They appeared cream-colored and distended in form. Affected pupae rested off-center with paddles extended. Furthermore, treated larvae progressed through instars at a slower rate than untreated larvae, independent of mortality.

Larvae collected 6 hr posttreatment from the treated area exhibited 100% mortality after 18 hr posttreatment in the 1985 field test; however, control contamination precluded comparisons. Larvae collected 12 hr posttreatment from the treated and untreated areas were observed 1, 2 and 5 days posttreatment and exhibited 8.7, 95.4 and 100% and 1.5, 1.5 and 1.5% mortality, respectively. Larvae collected 24 hr posttreatment from the treated and untreated areas exhibited 100% and 0% mortality, respectively.

It is evident from the 1983 small plot test that adequate control was achieved when *Ps. columbiae* larvae were introduced at 0 and 1 day posttreatment as 2nd-3rd instars at treatment levels of 10, 20 and 40 g AI/ha. Though larvae appeared to die more slowly when exposed to lower treatment levels as opposed to high levels, it was of no consequence since lack of emergence is considered effective control of this pest.

The lowest treatment level tested (10 g AI/ha) provided adequate control of 2nd-3rd instar larvae exposed at 1 day posttreatment. Considering this species can progress through its larval instars in a relatively short time (less than 4 days), it is conceivable that one application soon after ricefield flooding could effectively control the population even if a range of instars existed at that time.

Behavioral changes in the mosquito larvae may result in reduced capacity to avoid predation. Fenoxycarb also may enhance natural control by extending instars, thus subjecting larvae to adverse conditions over a longer period.

The 1984 and 1985 field tests support the findings of the 1983 small plot test by demonstrating high mortality in *Ps. columbiae* larvae exposed to fenoxycarb. Observations of behavioral effects and physical appearance of the treated larvae as well as lengthening of instars were similar in all tests.

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