LONG-TERM RESIDUAL ACTIVITY OF METHOPRENE AGAINST *PSOROPHORA COLUMBIAE* LARVAE IN RICE PLOTS[1]

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ABSTRACT. A slow-release, briquet formulation of methoprene produced long-term residual activity against *Psorophora columbiae* larvae in 37.2 m^2 (400 ft^2) rice plots. An application rate of 1 briquet/9.3 m^2 (1/100 ft^2) provided significantly ($P < 0.05$) greater reduction of adult mosquito emergence (98.2%) than did a rate of 1 briquet/18.6 m^2 (1/200 ft^2) (89.6%) during 5 insecticidal activity assessments conducted over a period of 58 days. No significant ($P > 0.05$) differences in activity were detected between treated plots which were continuously flooded and those periodically drained and reflooded.

INTRODUCTION

The ricefield mosquito, *Psorophora columbiae* (Dyar and Knab) is a major pest of man and animals in the Arkansas Grand Prairie during early to mid-summer. Cultural practices in rice, specifically water management on young rice plants, tend to facilitate development of several generations of this floodwater species during the first half of the rice growing season. Rice fields may be drained and reflooded several times for various reasons including promotion of seedling emergence, herbicide applications, rice water weevil cultural control, and control of rice plant physiological disorders.

Water management practices are not synchronized among rice farmers, rather adjacent fields differ in stages of draining or flooding and therefore harbor asynchronous larval populations of *Ps. columbiae*. Thus, the preferred form of larval mosquito control in rice, which involves the aerial application of microbial insecticides to flooded fields containing permanent water species (Sandoski et al. 1985), is difficult to administer and not economically efficient against early season floodwater species. Microbial insecticide drip applications to rice field floodwaters are used in Arkansas, but these are labor intensive and expensive relative to the benefits achieved (Finch et al. 1986).

Several reports have documented the success of residual formulations of the insect growth regulator (IGR), methoprene, against developing mosquito larvae in habitats which are less accessible and/or difficult to effectively monitor and treat (Sjogren et al. 1986, Walker 1987, Floore et al. 1990). Therefore, a long-term residual, briquet formulation of methoprene was evaluated against *Ps. columbiae* larvae developing in rice plots. A single early season application of methoprene, formulated to provide residual effectiveness under rice field conditions, could achieve adequate control of floodwater mosquito larvae when aerial applications of microbial insecticide are impracticable.

MATERIALS AND METHODS

Altosid® XR Briquets[2] (1.8% methoprene) were evaluated against *Ps. columbiae* larvae in 6.1 × 6.1 m rice plots located at the University of Arkansas Rice Research and Extension Center near Stuttgart, AR, from June 24 through August 20, 1990. Management practices for the rice plots were those commercially accepted and standard for the area.

The briquets were applied at rates of 1/9.3 m^2 (0.07 g AI/m^2) or 1/18.6 m^2 (0.035 g AI/m^2), which corresponded to either 4 or 2 briquets per plot, respectively. Each treatment rate was evaluated under 2 water management regimes—either continuously flooded or drained and reflooded between activity assessments. Water was added to the continuously flooded plots only as needed to maintain a depth of about 10 cm. Untreated control plots were subjected to the identical drain and reflood procedure. All treatments were randomly assigned to rice plots and replicated 3 times, thus a total of 15 plots were used in the study.

The briquets were uniformly applied to plots by hand on June 24. Treatments were applied in water for those plots assigned the continuous

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[2] Trademark of Zoecon Corporation.

flood regime and on dry ground for those assigned the intermittent flood. All plots were flooded to a depth of 10 cm on June 28, and the first assessment of treatment effectiveness against mosquito larvae was initiated the following day.

Initial and subsequent residual activity of treatments was assessed by placing 10 late 3rd instar *Ps. columbiae* larvae in floating cages, described by Sandoski et al. (1986), into each treated and control plot. Larvae used in the study were naturally reared in ditches bordering rice fields by flooding a section of the ditch and thus soliciting egg eclosion and larval development. Larval installations were made to the plots on June 29, July 9 and 20, and August 2 and 16. Cages were covered with a fine-mesh organdy fabric to exclude predators and prevent escape of emerged adults. The developing mosquitoes were monitored daily for mortality and stadia until no live individuals remained. Successfully emerged adults were counted and removed.

The percentage reductions of adult mosquito emergence from treated plots during each larval installation were corrected for control mortality using Abbott's formula (Abbott 1925), transformed (arcsine), and subjected to ANOVA to test the hypotheses that mean percentage reductions between treatment rates and between water management regimes were equal (SAS Institute 1985).

RESULTS AND DISCUSSION

Excellent initial and residual activity was provided against developing *Ps. columbiae* larvae by all treatments for a period of 7 wk with the exception of the treatment consisting of rice plots subjected to the 2 briquet rate and the constant flood regime (Table 1). A substantial decline in residual activity was observed after 6 wk for this treatment, which provided only 56.7% reduction in adult emergence during the last larval installation on August 16. Although the other treatments continued to exert residual activity against exposed larvae through the last assessment (≥90%), the study was terminated due to rice harvest.

The ANOVA procedure indicated that the mean percentage reduction of adult mosquito emergence in plots treated with 4 briquets (1/9.3 m^2) was significantly ($P < 0.05$) greater than in plots treated with 2 briquets (1/18.6 m^2) during the course of the study (overall means for each rate). Mean reductions were 98.2 and 89.6% for the high and low rates, respectively. The benefit of increased mortality observed at the higher rate would likely not be justifiable on the basis of additional cost but may be necessary to obtain acceptable control in commercial rice fields.

The effect of water management on treated plots was apparently negligible as no significant ($P \geq 0.05$) effect was observed for this variable by ANOVA; however, the intermittent flood regime may have benefited treatment residual activity to some degree. Mean percent reductions for the continuous and intermittent flood regimes were 90.6 and 97.1%, respectively. The flushing action of the drain and reflood procedure may have removed sediments deposited on briquets and provided occasional movement of methoprene in those plots.

Date of larval installation was nonsignificant ($P \geq 0.05$) as were all possible interaction terms used in the ANOVA model. Therefore, no attempts were made to separate treatment means among different dates.

Table 1. Mean corrected percentage reduction ± SE of adult emergence from *Psorophora columbiae* larvae exposed to rice plots (6.1 × 6.1 m) treated with Altosid® XR briquets on June 24, 1990.

Rate/plot* (briq./m^2)	Flood** regime	Date of exposure***				
		Jun. 29	Jul. 9	Jul. 20	Aug. 2	Aug. 16
4 (1/9.3 m^2)	Constant	100.0 ± 0.0	85.2 ± 14.8	100.0 ± 0.0	96.6 ± 3.5	100.0 ± 0.0
	Drained	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0
		Mean of 4 briq./plot rate = 98.2 ± 1.5				
2 (1/18.6 m^2)	Constant	100.0 ± 0.0	85.2 ± 9.8	100.0 ± 0.0	82.8 ± 17.2	56.7 ± 23.3
	Drained	92.3 ± 7.7	100.0 ± 0.0	92.2 ± 7.8	96.6 ± 3.5	90.0 ± 5.8
		Mean of 2 briq./plot rate = 89.6 ± 3.6				
Control		13.3 ± 3.3	10.0 ± 0.0	15.0 ± 5.0	3.3 ± 3.3	0.0 ± 0.0

* The mean percentage reduction of adult emergence for the 4 briquet rate had a transformed mean which was significantly ($P < 0.05$) greater than that of the 2 briquet rate by ANOVA.

** No significant ($P \geq 0.05$) differences were observed for the effect of flood regime by ANOVA.

*** No significant ($P \geq 0.05$) differences were observed for the effect of larval installation date by ANOVA.

Our results indicate that methoprene briquets possess the residual activity needed to control this species under the conditions encountered in early to mid-season rice. The effectiveness of methoprene briquets in commercial rice remains to be tested, but it is apparent that the potential exists to control floodwater species such as *Ps. columbiae* with a single early season treatment. The large-scale application of microbial insecticide against permanent water species in mid- to late-season rice becomes feasible should the IGR lose its effectiveness.

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