LARVICIDE EVALUATIONS AGAINST THE RICE FIELD MOSQUITO *PSOROPHORA COLUMBIAE*[1]

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The two most common mosquito species of importance associated with rice cultivation, *Psorophora columbiae* (Dyar and Knab) and *Anopheles quadrimaculatus* Say, require different strategies for larval control. Since the *Ps. columbiae* occurs when rice fields are either initially flooded or reflooded, a short term larvicide is applicable for control of the brood hatch. *Anopheles quadrimaculatus,* however, occurs continuously as long as the rice fields are flooded, so that control of these larvae would be better accomplished with a sustained-release larvicide formulation that would be effective during the growing season. The purpose of this study was to evaluate the efficacy of an experimental larvicide and 2 sustained-release formulations. *Psorophora columbiae* was chosen as the test organism for these materials because of the availability of field-collected specimens.

The study area was located on the University of Arkansas Agricultural Rice Research and Extension Center at Stuttgart, Arkansas. The test plots were 6.1 × 6.1 m from levee center to levee center. The rice crop was planted and grown using standard cultural practices. At the time of larvicide treatment the rice was in the preboot stage. Water was maintained at an average depth of 10 cm on a 3.6 × 3.6 m growing surface and 23 cm at the low point of the levee ditch. The volume of water treated was ca. 3 m^3. The larvicide tests were conducted from July 10 to August 12, 1981.

The larvicide tested, BAY FCR 1272 (Cyano(4-fluoro-3-phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate) was an emulsifiable concentrate (EC) containing 198 g active ingredient (AI)/liter. Plots were treated with 100, 200 or 400 mg AI (equivalent to 27, 54 or 108 g AI/ha).

Two sustained-release formulations were tested. One of the formulations was a pellet of compressed corncob grits (supplied by The Andersons, Maumee, OH) 3 mm diam and 5–10 mm length containing either 1% AI (w/w) technical chlorpyrifos or temephos. This formulation was designed to sink and disintegrate into the grit particles on the substrate, thus giving greater surface area for release of the larvicide. The second formulation was designed to float on the surface and was prepared in our laboratory using a porous polypropylene powder (supplied by Armac Company, McCook, IL) with particle sizes ranging from 100 to 400 μ. The loose powder was mixed with an EC of either chlorpyrifos or temephos in sufficient acetone to make a slurry. After the acetone evaporated, the powder was compressed in a pellet press to form a pellet 5 mm diam and 3 mm thick. Each pellet weighed 0.12 g and contained 30 mg AI. Treatment rates were 300, 600 or 900 mg AI/plot (equivalent to 81, 162 or 242 g AI/ha) for both larvicides and both types of pellets.

Temephos EC and chlorpyrifos EC were used for comparison standards applied at the label rate of 133 mg AI/plot (36 g AI/ha). Emulsifiable concentrates were mixed in 2 liters of water and sprayed uniformly over the pan and levee ditch of the test plots. The pellets were applied by hand equally distributed over the test plots.

Posttreatment bioassays were conducted in each plot at 24, 48, 96 hours, 1 week, and weekly thereafter. Mortality in the exposure containers was recorded after a 24-hr period. At the start of each bioassay, 10 field-collected larvae of *Ps. columbiae* in late 3rd or early 4th instar were placed in holding containers in each plot. The containers were made from sections of white polyvinylchloride irrigation pipe 37 cm long by 10 cm diam. A nylon cloth screen of about 35 mesh covered the bottom. Just above the bottom were three 1-cm diam screen holes on opposite sides of the container to facilitate water flow through the container. One container was attached to a stake in each plot at the junction between the rice and the open levee area. After the introduction of the larvae, cheesecloth covers were placed over the top of the containers.

The results of the larvicide study are presented in Table 1. The standard chlorpyrifos was effective for at least 7 days but was ineffective at the next check 13 days posttreatment.

[1] This paper reports the results of research only. Mention of a pesticide in this paper does not constitute a recommendation for use by the U.S. Department of Agriculture nor does it imply registration under FIFRA as amended. Also, mention of a commercial or proprietary product does not constitute an endorsement of this product by the USDA.

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Table 1. Effectiveness of larvicides against field-collected larvae of *Psorophora columbiae* in containers in 6.1 m × 6.1 m plots at Stuttgart, Arkansas, 1981.

		Treatment rate			Percent control ($\bar{x}$ ± S.E.) days posttreatment							
Larvicide	Formulation	mg AI/plot	g AI/ha	No. plots	1	2	4	7	13	20	27	34
BAY 1272	198 g AI/	100	27	3	67±3	77±12	10±5					
	liter EC	200	54	3	93±3	87±8	17±3					
		400	108	3	100	97±3	17±3					
chlorpyrifos	1% corncob	300	81	2	100	100	100	100	60±40			
	pellets	600	162	2	100	100	100	100	100	100	25±5	
		900	242	2	100	100	100	100	100	100	90±1	60±2
	polypropylene	300	81	2	100	90±1	45±45					
	pellets; 30 mg	600	162	2	95±5	100	95±5	100	35±35			
	AI/pellet	900	242	2	100	100	100	100	70±30			
	475 g AI/ liter EC	133	36	2	100	100	95±5	100	30±30			
temephos	1% corncob	300	81	2	85±15	85±5	60±30					
	pellets	600	162	2	85±15	35±25	70±10					
		900	242	2	95±5	95±3	90±10	65±35				
	polypropylene	300	81	2	100	95±5	15±5					
	pellets; 30 mg	600	162	2	100	100	55±5					
	AI/pellet	900	242	2	100	100	95±5	10±0				
	475 g AI/ liter EC	133	36	2	100	95±5	0					
Control				3	0	0	0	0	0	0	10	5

The second standard, temephos, was only effective for 2 days posttreatment.

The BAY 1272 formulation was not an effective larvicide in this study. A treatment rate of 3X that of the temephos rate was required for the same degree of efficacy as the standard.

In the chlorpyrifos treatment, the control periods obtained with the corncob pellets were about 3 times longer at each treatment level than those obtained with the polypropylene pellets. The control period with the corncob pellets ranged from at least 7 to 27 days at the 3 treatment rates.

In the temephos treatment, the polypropylene pellets were more effective that the corncob pellets. Complete control with the corncob pellet treatments was not obtained. The lowest treatment rate with the polypropylene pellet was as effective as the temephos standard, although the treatment rate was about 2× more than that of the standard.

The 2 types of pellets used in this study had different characteristics. The corncob pellets sank to the bottom and rapidly disintegrated into the grit particles, releasing the larvicide in the bottom substrate. The polypropylene pellets floated and did not disintegrate, thus releasing larvicide at the water surface. These characteristics possibly played a role in the effective action of the larvicides. Another factor that may have influenced the effectiveness of the 2 formulations was the treatment of the corncob grits with the technical grade of the larvicide and the treatment of the polypropylene powder with an EC formulation. In addition, rates of release from the 2 types of carrier and the sites of release may also have a role in effectiveness of the larvicides.

While control was obtained with the corncob pellets with chlorpyrifos and the polypropylene pellets with the temephos, the control periods were not extended proportionately to the increased amount of larvicide employed, compared to the standard treatment rates.

LABORATORY OBSERVATIONS ON THE BIOLOGY OF *TOXORHYNCHITES THEOBALDI*

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The larvae of *Toxorhynchites* are predaceous upon aquatic invertebrates. Among their prey are mosquitoes of medical importance. It has been suggested that *Toxorhynchites* could be used as potential biocontrol agents.

Toxorhynchites theobaldi (Dyar and Knab) is a neotropical mosquito. Little is known about its natural breeding places. In Venezuela we have found this species in artificial containers in the cemeteries of Caracas and La Guaira, D.F. where it preys upon the mosquitoes *Aedes aegypti* (Linn.) and *Culex quinquefasciatus* Say, the chironomid *Atrichopogon* sp. and the psychodid *Telmatoscopus albipunctatus* (Rubio et al. 1980, Kazana et al. in press).

Because Venezuelan populations of *Tx. theobaldi* do not mate in captivity, eggs for experiments were collected from water-containing urns and flower pots in a cemetery at La Guaira, Venezuela. Eggs were found only in the shadiest places. Individuals for observations were reared on a diet of 20 *Aedes aegypti* larvae/day of the same developmental stage as the predator larva (Rubio et al. 1980).

The behavior of *Tx. theobaldi* was filmed using two 16 mm cameras. Eggs hatching were filmed by placing eggs in a small container made with two cover slips (0.17 × 20 × 20 mm) spaced 2 mm apart to allow the eggs to float freely in front of the camera. Fourth instar larvae and pupae were filmed using a similar but larger container prepared with two optical glasses 1 × 20 × 20 mm spaced 7 mm apart. The feeding behavior of larvae and the emergence of adults were filmed in petri dishes.

Oviposition was observed in the field around 1000 hr. The flight pattern observed was similar to other *Toxorhynchites* species (Furumizo and Rudnick 1978, Steffan et al. 1980, Trimble 1979). The females were never observed

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