effective in the field also, the use of floating baits compounded with water-insoluble, organic insecticides would provide a new technique for anopheline control which would be highly advantageous in terms of low insecticide cost and reduced environmental contamination.

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EFFECTIVENESS OF GROUND ULV AEROSOLS AGAINST LARVAE OF *PSOROPHORA CONFINNIS* (LYNCH-ARRIBÁLZAGA)

L. E. COOMBES, J. T. LEE and M. V. MEISCH [1]

The ULV ground aerosol technique of applying insecticides has recently become widely accepted for mosquito control. Considerable research has been performed with this method of application, primarily against caged adult mosquitoes. However, little has been reported on the effectiveness against mosquito larvae. Lofgren (1970) stated that ULV spraying works well against adult mosquitoes, but is limited for larval breeding areas because vegetation reduces its effectiveness. Also, larval breeding is limited to relatively small, distinct areas, and the main objective is to deposit insecticide at these sites.

There is much concern regarding mosquito resistance to insecticides, and it would appear useful to understand the effect of ULV ground application upon larvae as well as adults since larvae are often present in areas where adulticides are used. The objectives of this research were to ascertain the effectiveness of ULV application of insecticides against dark ricefield mosquito larvae, *Psorophora confinnis* (Lynch-Arribálzaga). No tests have been reported against larvae of this species using ground ULV aerosols.

Most ULV larviciding has been accomplished by aerial spraying. Mount *et al.* (1970) applied aerial sprays of malathion and fenthion against larvae contained in

[1] L. E. Coombes is graduate assistant, J. T. Lee was formerly graduate assistant. M. V. Meisch is Assistant Entomologist and Extension Specialist, University of Arkansas, Fayetteville, Arkansas 72701.

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cups and obtained 63 percent and 100 percent control, respectively. Knapp and Pass (1966) Lembright (1968) and Mulhern *et al.* (1965) also tested aerial ULV sprays against larvae. Womeldorf and Whitesell (1972) studied ricefield mosquito control with low volume sprays in California. Burgoyne and Akesson (1968) and Womeldorf and Gillies (1968) tested chemicals against mosquito larvae with a helicopter.

McNeil and Ludwig (1970) using a truck-mounted modified Leco 120 unit reported that chlorpyrifos was effective against *Culex quinquefasciatus* Say mosquito larvae while malathion was found to be ineffective.

METHODS AND MATERIAL. During the summers of 1971–72 experiments were conducted against *P. confinnis* larvae using a truck-mounted, standard model Leco cold aerosol generator. All tests were conducted at a ground speed of 10 mph, and at 2 psi. An instrument panel was mounted in the cab so that insecticide flow could be adjusted. Air temperatures varied from 70° to 95° F. and averaged approximately 80° F. Wind velocity varied from 1 to 10 mph and averaged about 7.5 mph.

Field-collected late third and early fourth instars of dark ricefield mosquito larvae were tested at Lonoke, Arkansas. Ten-oz. paper cups, each containing 10 larvae in approximately 8 oz. of H_2O, were placed in an open field in approximately 5 in. of grass at distances of 50, 100, 200 and 300 ft downwind and perpendicular from the path of the generator and in the center of the sprayed area. Approximately 5 minutes post-treatment, the larvae were transported to the laboratory. Mortalities were recorded 24 hr following treatment. The larvae remained in the treated cups throughout the test. Cups of mosquitoes were also placed in an adjacent untreated area, then transported to the laboratory to serve as checks. All tests were replicated a minimum of 3 times.

Insecticides tested and AI lbs/gal were as follows: fenthion (4.7) E.C. and (9.3) ULV conc; chlorpyrifos (6); malathion (9.7); chlormethylfos (6); Abate® (4) (o, o, o′, o′ - tetramethyl o, o′ - thiodi-p-phenylene phosphorothioate); and Plant Protection PP-511 (5) (o - (2- (diethylamine)- 6-methyl-4-pyrimidinyl) o, o - dimethyl phosphorothioate).

RESULTS AND DISCUSSION. Mean mortality at various dosages of six insecticides are shown in Table 1. Percentage mortality for all tests was corrected by Abbott's formula. At the 1 percent level of probability (Duncan's Multiple Range Test) mortality at the 50-ft swath width for all insecticides was significantly greater than at the other distances, with mortality at 50 ft averaging 96.1 for all compounds. All insecticides tested, with the exception of Plant Protection PP-511, killed 80 percent or more of the larvae at 50 ft. Mortalities at the 100 and 200 ft distances were comparable with mean kills of 75.73 and 62.66 percent respectively. However, the mean mortality at 100 and 200 ft was significantly greater than at 300 ft where mean mortality was 47.66 percent.

Mean mortality for all swath widths, insecticides, and dosages are presented in Table 1. Chlorpyrifos at .0310 and .0232 lbs AI/acre, fenthion (4.7 lb/gal EC)at .0182 lb AI/acre, and fenthion (9.3 lb/gal) at all rates tested were significantly more effective at the 5 percent level of probability than were all other insecticides. Fenthion (9.3 lb/gal) .0179 lb AI/acre averaged 88.5 percent control whereas the same formulation at .0089 lb AI/acre was 96.3 percent. No explanation is given for this irregularity; however, there was no significant difference in performance. Chlormethylfos at .0153 and .0077 AI/acre along with Plant Protection PP-511 at .0128 AI/acre were the least effective insecticides at the dosages tested.

The results of this experiment show that ULV ground aerosol applications of certain insecticides will kill mosquito larvae contained in paper cups. Routine applications by mosquito control workers against adult mosquitoes may also have

Table 1.—Effectiveness of ULV ground aerosols against *Psorophora confinnis* larvae contained in paper cups at various swath widths and dosages.[1]

Insecticide	AI lb/acre	Flow rate Fluid Oz/Min.	50 Ft	100 Ft	200 Ft	300 Ft	Mean [3] all swath widths
			P. confinnis				
Chlorpyrifos	.0310	4.0	100	100	100	96	99.0a
Chlorpyrifos	.0232	3.0	100	100	100	73	93.3ab
Chlorpyrifos	.0153	2.0	100	80	67	57	76.0bcd
Chlorpyrifos	.0077	1.0	100	60	63	33	64.0cde
Chlormethylfos	.0232	3.0	100	90	40	0	76.0cde
Chlormethylfos	.0153	2.0	80	20	5	5	32.5f
Chlormethylfos	.0077	1.0	100	35	0	0	33.8f
Fenthion (EC)	.0182	3.0	100	89	93	48	82.5abc
Fenthion (EC)	.0091	1.5	100	71	50	5	56.5cde
Fenthion	.0359	3.0	100	100	100	87	96.8a
Fenthion	.0179	1.5	100	100	67	87	88.5abcd
Fenthion	.0089	0.75	100	95	90	100	96.3ab
Abate ®	.0206	4.0	100	53	65	50	67.0bcd
Plant Protection PP-511	.0128	2.0	67	50	30	14	40.3cdef
Malathion	.0375	3.0	94	84	70	12	65.0cde
		Mean [4]	96.1a	75.7b	62.7b	47.6c	

[1] Percentages corrected by Abbott's formula.
[2] Swath widths are perpendicular distances in feet downwind from application.
[3] Means followed by the same letter are not significantly different at the 5% level.
[4] Means followed by the same letter are not significantly different at the 1% level.

an effect against the larvae. It might be feasible under certain conditions, especially open areas, to use ground ULV aerosols as larvicides. Additional tests against naturally occurring populations of larvae are needed to explore the effectiveness of ground ULV aerosols as a larviciding tool.

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