EFFICACY OF GROUND ULV AEROSOLS OF THREE PYRETHROIDS AGAINST TWO MOSQUITO SPECIES[1, 2]

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ABSTRACT. Three pyrethroids, fenvalerate (Cyano (3-phenoxyphenyl)methyl 4-chloro-*a*-(1-methylethyl) benzeneacetate), American Cyanamid 222705 (±-cyano(3-phenoxyphenyl) methyl (+)-4-(difluoromethoxy)-*a*-(1-methylethyl) benzeneacetate), and NRDC-161 ((S)-[cyano(3-phenoxyphenyl) methyl]cis(+)-3-(2,2-dibromoethenyl)-2,2dimethycyclopropane carboxylate) were tested as ULV ground aerosols against caged females of *Anopheles quadrimaculatus* and *Aedes taeniorhynchus*. The three adulticides were more effective than the standard, malathion (*0,0*-dimethyl phosphorodithioate of diethyl mercaptosuccinate) applied at its recommended label rate of 27 g/ha. Fenvalerate, American Cyanamid 222705, and NRDC-161 were 3X, 7X, and 39X, respectively, more effective against *Ae. taeniorhynchus* and 12X, 17X, and 628X, respectively, more effective against *An. quadrimaculatus*.

INTRODUCTION

In our continuing program of testing new chemicals as mosquito adulticides, those compounds that are equivalent or more effective than the malathion (*0,0*-dimethyl phosphorodithioate of diethyl mercapto-succinate) standard in laboratory assays and are available in sufficient quantity are selected for the next stage of testing. This consists of evaluation as ULV ground aerosols against caged *Anopheles quadrimaculatus* Say and *Aedes taeniorhynchus* (Wiedemann) under field conditions. The present paper reports results obtained with 3 pyrethroids selected from the screening program where they ranged from 2X to 48X more effective than the standard.

MATERIALS AND METHODS

The 3 pyrethroids tested were fenvalerate (Cyano (3-phenoxyphenyl) methyl 4-chloro-*a*-(1-methylethyl) benzeneacetate) supplied as a 2.4 lb/gal EC; American Cyanamid 222705 (±cyano(3-phenoxyphenyl) methyl (+)-4-difluoromethoxy)-*a*-(1-methylethyl) benzeneacetate) supplied as 300 gm/liter EC; and NRDC-161 ((S)-[cyano(3-phenoxyphenyl) methyl]cis-(+)-3-(2,2-dibro-

[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 and endorsement of this product by the USDA.

[2] This study was conducted, in part, under the auspices of the USDA/CSRS and ARS Southern Regional Project S-122 (Biology, Ecology and Management of Mosquitoes in the Southern Region of the United States) sponsored by the Association of Southern Experiment Station Directors.

moethenyl)-2,2-dimethylcyclopropane carboxylate) supplied as a 20 gm/liter oil solution.

The tests were conducted in a fairly level open field near Gainesville, Florida during April, May and June 1980. Temperatures at elevations of 1.8 m and 9.1 m and wind speed at 1.8 m were measured during these tests and application were made in the evening between 7 and 10 p.m. during favorable weather. Tests were not conducted when wind velocity was less than 3.2 km/h, greater than 16 km/h or wind direction varied more than 30° from perpendicular to the spray line.

A Leco Model HD cold aerosol generator with a blower pressure of 0.28 kg/cm² was used to disperse the adulticide, which was delivered to the nozzle by a positive displacement pump (Micro-Gen Digital Flow Control) at 60 ml/min. The test adulticides were formulated in Klearol at the concentrations necessary for treatment at the desired rate of Ai/ha based on a 91 m swath and a truck speed of 16 km/h. Malathion ULV concentrate applied at the label recommended rate of 60 ml (2 oz)/min and a vehicle speed of 16 km (10 mi)/h was used as the standard for comparison.

Insecticide susceptible strains of *Ae. taeniorhynchus* and *An. quadrimaculatus* reared in the laboratory were used; test insects were immobilized on a cold table (Berry et al. 1978) for handling and counting. Adult female mosquitoes (4- to 6-days-old) were placed in groups of 25 in 16-mesh screen wire cages of the type used by the World Health Organization (4.5 cm diam. × 15 cm long). The screen wire cages and companion plastic holding tubes were mounted on a slide unit by means of a screw-cap on either side (World Health Organization test kit). The plastic divider is provided with a 20 mm opening which can be positioned between cage and tube to facilitate a rapid transfer of exposed mosquitoes into the clean holding tube without the necessity of additional immobilization stress.

Four cages of each species were suspended 1.2 m above ground on stakes 46 m and 91 m downwind in two rows 30.5 m apart perpendicular to the line of travel of the truck-mounted ULV aerosol generator. Immediately after each aerosol had drifted through the test plot (5 to 15 min) the insects were transferred to the plastic holding tubes lined with clean paper. The cages containing the test insects were held in chilled, insulated chests containing moist cotton for transportation between the laboratory and the test site. During the 12 hr holding period prior to mortality counts the test insects were held at room temperature (24°C) and supplied with 10% sugar water on cotton pads. Cages of test insects not exposed to the insecticide but handled in the same manner were used as controls.

Effective dosages (ED) for 90 and 95% control were calculated with a probit analysis program written for a Hewlitt-Packard Model 9810A programmable calculator following procedures given by Finney (1971).

RESULTS AND DISCUSSION

Over the period from mid-April to mid-June temperatures recorded at the test site ranged from 19° C to 28° C. The overall mean for the 1.8 m temperature was 23.3° C and for 9.1 m was 23.4° C. Wind velocity ranged from 3.2 to 13 km/h with an overall average of 8.7 km/h.

The results of the aerosol tests with the 3 adulticides are presented in Table 1. The estimated ED for each species is presented in Table 2. Overall control mortality averaged 6.2% for *Ae. taeniorhynchus* and 3.8% for *An. quadrimaculatus*.

The most effective adulticide tested was NRDC-161. The calculated ED for 90% control was 400 mg/ha against *Ae. taeniorhynchus* and 29 mg/ha against *An. quadrimaculatus*. The second most effective adulticide tested was American Cyanamid 222705. The calculated ED 90 for this adulticide was 2.0 g/ha against *Ae. taeniorhynchus* and 0.9 g/ha against *An. quadrimaculatus*. The least effective of the

Table 1. Efficacy of ULV ground aerosols discharged at 60 ml/min at a dispersal speed of 16 km/hr against adult female mosquitoes at 1.2 m elevation 46 and 91 m downwind (number of replications in parentheses).

Treatment rate (g/ha)	Avg. 12 hr mortality (%) *Aedes taeniorhynchus*	*Anopheles quadrimaculatus*
	Fenvalerate (SD-43775, AI3-29235) 2.4 lb AI/gal EC	
3.4	83 (7)	
1.7	79 (7)	93 (7)
0.8	57 (6)	84 (6)
.4	40 (6)	64 (9)
.2		67 (8)
.1		22 (3)
	American Cyanamid 222705 (AI3-29391) 300 g AI/liter EC	
1.8	92 (6)	
0.9	80 (5)	88 (6)
.45	66 (6)	85 (6)
.22	50 (9)	65 (7)
.11	46 (7)	53 (8)
.05		29 (3)
	NRDC-161 (RU-22974, AI3-29279) 20 g AI/liter ULV	
.448	80 (5)	
.224	79 (5)	
.112	60 (5)	100 (2)
.056	42 (7)	98 (6)
.028	11 (3)	86 (7)
.014		78 (6)
.007		42 (6)
	Malathion (standard) (AI3-17034)	
27.	96 (7)	100 (7)

Table 2. Calculated effective dosage (ED) for 90 and 95% control of caged adult female mosquitoes with ULV ground aerosols (fiducial limits at 95% level of probability in parentheses).

Insecticide	ED-90 (g/ha)	ED-95 (g/ha)	Reciprocal ED-95 ratio to malathion at 27 g/ha
	Aedes taeniorhynchus		
Fenvalerate	5.1 (3.8–7.6)	9.3 (6.4–16.0)	3
American Cyanamid 222705	2.0 (1.5–2.9)	4.0 (2.8–6.5)	7
NRDC-161	0.4 (0.35–0.57)	0.7 (0.53–0.98)	39
	Anopheles quadrimaculatus		
Fenvalerate	1.3 (1.1–1.7)	2.3 (1.8–3.3)	12
American Cyanamid 222705	0.9 (0.7–1.2)	1.6 (1.2–2.4)	17
NRDC-161	.029 (0.026–0.035)	0.043 (0.036–0.054)	628

3 adulticides, fenvalerate, had a calculated ED 90 of 5.1 g/ha against *Ae. taeniorhynchus* and 1.3 g/ha against *An. quadrimaculatus*.

The 3 adulticides were each more effective than malathion applied at the recommended label rate of 27 g/ha. Fenvalerate, American Cyanamid 222705, and NRDC-161 were 3X, 7X, and 39X, respectively, more effective against *Ae. taeniorhynchus* and 12X, 17X, and 628X, respectively, more effective against *An. quadricmaculatus*.

The ED 95 level of these materials, while valuable for comparisons of efficacy, would be insufficient for practical field application. Compared to resmethrin presently labeled at 7.8 g/ha (0.007 lb/acre) and pyrethrins labeled at 2.2 to 8.9 g/ha (0.002 to 0.008 lb/acre) the pyrethroids tested in the present study are sufficiently effective to warrant additional studies against natural mosquito populations.

References Cited

Berry, I. L., J. A. Miller and R. L. Harris. 1978. A chilling table for immobilizing insects. Ann. Entomol. Soc. Am. 71:126–128.

Finney, D. J. 1971. Probit analysis, 3rd ed., Cambridge Univ. Press, 333 pp.

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The scientific name of a species should be spelled out in its entirety the first time it is used in a title, abstract or the text. Thereafter, the appropriate generic abbreviation may be used after the initial citation of a species. The one exception is that sentences should commence with the complete generic name. Subgeneric names do not need to be mentioned unless an author wishes to make significant comparisons between different subgenera.

Names of authors of species are not used in either the title or the abstract. In the text, they should only be mentioned the first time a species is cited. The names of well-known authors may be abbreviated as follows: Coquillett = Coq., Fabricius = Fabr., Linnaeus = Linn. and Wiedemann = Wied.

Current nomenclature for mosquitoes of North America, north of Mexico can be found in the Darsie–Ward key (1981). For other areas, consult the Knight–Stone mosquito catalog (1977) and its supplement (Knight 1978).

Abbreviations for genera of Culicidae commonly mentioned in *Mosquito News* follows [the complete list may be found in *Mosquito News* 40:431 (1980)]:

Aedes = *Ae.*
Anopheles = *An.*
Armigeres = *Ar.*
Coquillettidia = *Cq.*
Culex = *Cx.*
Culiseta = *Cs.*
Deinocerites = *De.*
Limatus = *Li.*
Mansonia = *Ma.*
Orthopodomyia = *Or.*
Psorophora = *Ps.*
Sabethes = *Sa.*
Toxorhynchites = *Tx.*
Trichoprosopon = *Tr.*
Tripteroides = *Tp.*
Uranotaenia = *Ur.*
Wyeomyia = *Wy.*

It is not necessary to use 'Diptera: Culicidae' in the title or a footnote. However, it may be useful to use 'Diptera: Ceratopogonidae', etc. for other families of biting flies.