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LABORATORY TESTS OF LARVICIDES FOR MOSQUITO CONTROL IN POTABLE WATERS[1]

W. L. JAKOB

Activation of an *Aedes aegypti* eradication program by the U. S. Public Health Service (Schliessmann, 1964) has intensified the search for a mosquito larvicide treatment for potable waters. In Puerto Rico and the U. S. Virgin Islands, as well as other Caribbean areas, *Ae. aegypti* frequently is found breeding in the systems and artificial containers used for collection and storage of water for drinking or other domestic purposes in and around human habitations. Mosquito control in these situations is further complicated by the resistance of *Ae. aegypti* to DDT and/or dieldrin in much of the Caribbean area (Flynn *et al.*, 1964).

Zwick (1964) reported on the evaluation of DDT, dieldrin, fenthion, malathion, and carbaryl in various breeding containers common in the Caribbean area; while Schoof and Jakob (1964) presented laboratory data on the residual effectiveness of Bayer 37342,[2] SD-8447, and dimethrin against susceptible and DDT-resistant larvae. Mulla (1963) discussed the factors that may be responsible for the disappearance or ineffectiveness of compounds in water. The present paper gives results of laboratory tests of the residual larvicide activity of 11 compounds against *Ae. aegypti.* Data are also given for selected compounds against DDT-dieldrin resistant *Culex pipiens quinquefasciatus.*

METHODS. The toxicant in 1 ml. of ethanol (95 percent) solution was mixed with 225 ml. of tap water (pH—approxi-

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[2] The use of trade names is for identification purposes only and does not constitute endorsement by the U. S. Department of Health, Education, and Welfare.

mately 8) in glass beakers, and 25 larvae (late 3rd-early 4th instar) in an additional 25 ml. of tap water were added. Following a 24-hour exposure period mortality counts were made and all larvae removed with a screen wire scoop. The treated water was then stored under ventilated conditions until the next test, usually every 2 weeks. Prior to each succeeding test the water volume of each container was restored to its original 225 ml. level, after which the test procedure was repeated. Mortality counts given include moribund and dead larvae. Effectiveness was based on the number of weeks of 95 percent or higher mortalities.

With dichlorvos only the tests were made on 4 consecutive days each week. Larvae were added in only 10 ml. of tap water to prevent excessive dilution of the toxicant that might arise from the daily addition of the test specimens.

The chemical formulae and acute oral toxicity to rats of the compounds tested are given in Table 1.

RESULTS. The five most promising compounds—Bayer 41831, OMS-711, SD-7438, AC-52160, and fenthion—gave effective larval mortalities for 6 or more weeks against the two test species (Table 2).

On the basis of the concentration required for prolonged residual activity, AC-52160 and fenthion were the most effective materials; each required 0.5 p.p.m. or less for >10 weeks activity. Bayer 41831 and OMS-711 at 1 p.p.m. gave 6–>8 weeks of activity. SD-7438

TABLE 1.—Chemical composition and acute oral toxicity of experimental compounds tested.

Designation	Chemical Composition	Acute oral LD-50—rats mg./kg.
AC-52160	0,0,0′,0′-tetramethyl 0,0′-thiodi-*p*-phenylene phosphorothioate	440 [1]
Bayer 41831	0,0-dimethyl 0-4-nitro-*m*-tolyl phosphorothioate	400–530
Bayer 38800	*o*-cyclopentenyl-N-methyl-phenyl-carbamate	1000–2500
DDT	2,2-*bis*(p-chlorophenyl)-1,1,1-trichloroethane	113–118
dichlorvos(DDVP)	0,0-dimethyl-0-2,2 dichloro-vinyl phosphate	56–80
fenthion	0,0-dimethyl 0-3-methyl-4-methyl-thiophenyl phosphorothionate	215–245
malathion	S-(1,2-dicarbethoxyethyl)-0,0-dimethyldithiophosphate	1000–1375
OMS-315	0,0-dimethyl-S-(4-chlorophenyl)-dithiophosphate	>2500
OMS-711	2-chloro-1-(2,5-dichlorophenyl) vinyl dimethylphosphate	3680
trichlorfon	0,0-dimethyl-2,2,2-trichloro-1-hydroxyethyl phosphonate	500
SD-7438	toluene-*a,a*-dithiol-*bis*(o,o-dimethyl phosphorodithioate)	280

[1] Data for later sample indicate a value greater than 1000.

gave satisfactory kills at 2.5 p.p.m. for 8–>10 weeks but was effective for only 2–4 weeks at 1 p.p.m.

OMS-315 at 20 p.p.m., Bayer 38800 at 10 p.p.m., malathion and trichlorfon, each at 5 p.p.m., were effective for 4 weeks or less against susceptible and DDT-resistant *Ae. aegypti* and against *C. p. quinquefasciatus*. DDT at 1 and 2.5 p.p.m. produced good kills against susceptible *Ae. aegypti* for 4 and >10 weeks, respectively, but was ineffective beyond week 3 against the DDT- or dieldrin-resistant strains.

Results with dichlorvos showed that concentrations of 0.5 and 1 p.p.m. remain effective for 7 to 12 days against susceptible and DDT-resistant *Ae. aegypti*. At 2.5 p.p.m. it gave satisfactory mortalities for 15 days against both strains. Previous tests showed the LC-95 of dichlorvos against these strains to be 0.1 p.p.m. (unpublished data).

DISCUSSION. Although five compounds offer promise as residual mosquito larvicides, AC-52160 and fenthion were the most effective, providing satisfactory kills of *Ae. aegypti* and *C. p. quinquefasciatus* at lower concentrations than were required for Bayer 41831, OMS-711 and SD-7438. The effectiveness of dichlorvos in water was shown to be more prolonged than previously suspected.

With the exception of dichlorvos, each of the compounds was effective for longer periods against the susceptible strain of *Ae. aegypti* than against the DDT-resistant strain. Certain compounds (fenthion, AC-52160, and OMS-711) gave greater kills of the resistant *C. p. quinquefasciatus* than of the resistant *Ae. aegypti*. The reverse was true for SD-7438.

While toxicants with a low order of mammalian toxicity should be those of first consideration for the treatment of drinking water (Schoof and Jakob, 1964), it is possible that compounds with greater toxicity to mammals would require correspondingly lower concentrations for mosquito control. However, the margin of safety is decreased greatly with the use of the more toxic materials.

ACKNOWLEDGMENTS. The author is indebted to Mrs. Mary Crawford and Mrs.

TABLE 2.—Number of weeks of effective kills of mosquito larvae.

Compound	Conc. (p.p.m.)	*Aedes aegypti*		
		Susceptible	DDT-resistant	*C.p. quinq.*
Bayer 41831	2.5	>8	>8	>8
	1.0	>8	7	7
	0.5	>8	4	4
	0.1	4	<2	4
OMS-711	10.0	>10	>10	>10
	5.0	>10	8	>10
	1.0	8	6	6
SD-7438	5.0	>10	>10	>10
	2.5	>10	>10	8
	1.0	4	2	2
AC-52160	0.5	>10	>10	>10
	0.25	8	8	>10
	0.1	8	4	>10
fenthion	1.0	>10	>10	>10
	0.5	>10	>6<10	>10
	0.1	4	2	>10
	0.05	4	2	4

Theresa Blue for their technical assistance in performing the tests described.

These studies were funded in part by a contractual agreement between the Communicable Disease Center and the World Health Organization, and in part by the Aedes aegypti Eradication Branch of the Communicable Disease Center.

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TWO USEFUL VEHICLES

THOMAS D. MULHERN AND E. CHESTER ROBINSON [1]

INTRODUCTION. Mosquito control agencies perform a variety of operations which frequently require nonstandard vehicles. This is so when the usage demands alternate off-the-road operation over rough land, and high speed operation on the highway and through urban areas. This also occurs where the same vehicle must be used alternately as a mobile base for spray equipment and as an inspection or transport vehicle. This report describes two such vehicles which have been developed by the Alameda County Mosquito Abatement District, using information gleaned from a number of sources, including commercial suppliers, other mosquito control organizations, and the ingenuity of the personnel of the District.

FLAT PROFILE TRACTION TIRE. To provide the extra flotation necessary for off-the-road operation over agricultural or sandy land, various devices have been em-

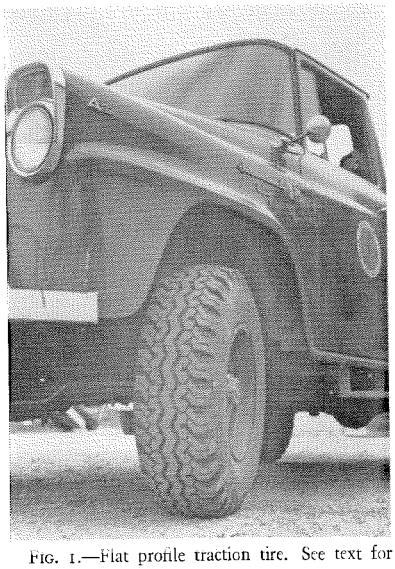

FIG. 1.—Flat profile traction tire. See text for data.

[1] This report was prepared by Thomas D. Mulhern, Technical Consultant, Mosquito Control, Bureau of Vector Control, California State Department of Public Health, from data provided by E. Chester Robinson, Manager, Alameda County Mosquito Abatement District, Oakland, California.