TESTS WITH ESTERS OF CHRYSANTHEMUMIC ACID AGAINST LARVAE OF THE MOSQUITO *CULEX TARSALIS*

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The resistance of the mosquito *Culex tarsalis* Coq. to DDT was first indicated by Smith (1949) in California. During the last few years malathion has been applied as a substitute larvicide in many areas of California, and now resistance has also developed to this compound (Gjullin & Isaak 1957). The search for substitute larvicides has therefore been continued. Particularly promising have been various esters of chrysanthemumic acid (Gjullin & Lewallen 1958).

Thirty-nine esters of chrysanthemumic acid were tested against fourth instar *tarsalis* larvae of a nonresistant strain. A few of these esters were also tested against certain insecticide-resistant strains. Most of them had shown promise as larvicides when subjected to tests against *Anopheles quadrimaculatus* Say by Gahan and coworkers at Orlando, Fla.

Tests for each compound were run in duplicate and replicated twice. The toxicant in acetone was added to 250 ml. of distilled water contained in 400-ml. beakers. The amount of acetone was held constant at 0.08 percent of the water volume. Twenty-five fourth instar larvae were used in each test, and the mortality was recorded after 24 hours. The tests were conducted at 78°–80° F.

Twelve of the esters tested caused mortalities of 95 percent or above at 1 p.p.m. As shown in table 1, the 6–chloropiperonyl and 6–bromopiperonyl esters caused 100 percent kill at 0.05 p.p.m., and were therefore the two most effective larvicides.

Results with the other 27 esters, which

TABLE 1—Percent mortality of fourth instar larvae of a non-resistant strain of *Culex tarsalis* 24 hours after treatment with various esters of chrysanthemumic acid

Ester	1.0 p.p.m.	0.5 p.p.m.	0.1 p.p.m.	0.05 p.p.m.	0.025 p.p.m.
6–Chloropiperonyl	—	—	100	100	97
6–Bromopiperonyl	—	—	100	100	88
Piperonyl	100	100	97	90	78
6–Propenylpiperonyl	100	97	68	23	—
alpha–tert–Butylpiperonyl	100	95	79	17	—
alpha–(1, 1–Dimethylpropyl)	100	96	65	10	—
Allethrin	100	96	37	26	—
alpha–Methylpiperonyl	100	89	22	—	—
o–Chlorobenzyl	98	86	13	—	—
o–Allyloxybenzyl	98	40	16	—	—
3, 4–Dimethylbenzyl	95	95	21	—	—
p–Chlorobenzyl	95	71	37	—	—

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caused less than 95 percent mortality at 1 p.p.m. are shown:

p–Ethylbenzyl	94
2, 3–Dimethoxybenzyl	93
6–Propylpiperonyl	89
Benzyl	87
m–Ethoxybenzyl	86
m–Allyloxybenzyl	86
6–Allylpiperonyl	85
Alpha–Amylpiperonyl	81
m–Methoxybenzyl	80
3, 4–Dichlorobenzyl	74
Alpha–Propylpiperonyl	67
Cuminyl	63
m–Isopropoxybenzyl	62
p–Methoxybenzyl	44
Alpha–(2–methylallyl) piperonyl	19
Alpha–allylpiperonyl	17
1–Piperonylethanol	16
Alpha–ethylpiperonyl	15
Alpha–(p–methylphenyl) piperonyl	9
P–ethoxybenzyl	8
Cinnamyl	8
Alpha–butylpiperonyl	7
3, 4–Methylenedioxyphenethyl	6
3–(3', 4'–Methylene–diozophenyl) propyl...	3
m–Proproxybenzyl	2
4–Hydroxy–4–methyl–2–pentatone	2
Alpha–methyl–p–methoxybenzyl	1

Tests were also conducted to determine the effectiveness of the 6–chloropiperonyl, 6–bromopiperonyl, and piperonyl esters against larvae from malathion-DDT-resistant and DDT-resistant colonies. These tests have already been briefly discussed (Eddy 1958, Eddy *et al.*, 1958).

The resistance of the malathion-DDT colony was about 75 to 100 times to malathion but only about 5 times to DDT whereas the resistance of the DDT colony was several hundredfold. As indicated in table 2, these strains showed only about a twofold resistance to the chrysanthemumic acid esters.

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TABLE 2—Percent mortality of fourth instar larvae of nonresistant and resistant strains of *Culex tarsalis* treated with three esters of chysanthemumic acid

Strain	0.2 p.p.m.	0.1 p.p.m.	0.05 p.p.m.	0.025 p.p.m.	0.01 p.p.m.
		6–Chloropiperonyl			
Nonresistant	—	100	99	90	26
Malathion–DDT–resistant	100	96	86	67	8
DDT–resistant	—	96	90	64	10
		6–Bromopiperonyl			
Nonresistant	—	100	100	79	7
Malathion–DDT–resistant	100	94	85	67	7
DDT–resistant	—	96	90	64	4
		Piperonyl			
Nonresistant	—	87	37	30	0
Malathion–DDT–resistant	89	61	6	1	1
DDT–resistant	—	76	32	2	4