AERIAL INSECTICIDAL SPRAYS AGAINST RESISTANT SALT-MARSH MOSQUITOES *AEDES TAENIORHYNCHUS* (WIEDEMANN) AND *AEDES SOLLICITANS* (WALKER)

B. MICHAEL GLANCEY, C. S. LOFGREN AND G. A. MOUNT

Entomology Research Division, Agr. Res. Serv., U.S.D.A., Gainesville, Florida 32601

After 8 years of extensive use of malathion in Florida for control of adult mosquitoes, resistance to this compound has begun to appear in salt-marsh mosquitoes, *Aedes taeniorhynchus* (Wiedemann), in several areas (Glancey *et al.*, 1966; Gahan *et al.*, 1966; Lofgren *et al.*, 1967; Glancey and Lofgren, 1967; Rathburn and Boike, 1967). This resistance has been evident in our field tests in the Shiloh area of Brevard County. Our data for the years 1959, 1963, 1964, and 1966 show that the tolerance of *A. taeniorhynchus* to malathion has slowly increased with the 90 percent control dosage changing from 0.062 pound per acre in 1959 to 0.68 pound per acre in 1966 (Fig. 1). *Aedes sollicitans* (Walker) were present in these field populations and are probably resistant also since general observations during the field tests did not show any change in the relative abundance of the two species before and after malathion applications. Recent tests by Mount (unpublished data) showed that *A. sollicitans* from Langley AFB, Virginia were resistant to malathion.

During the past few years, we have been making laboratory and field tests to find materials that could be substituted for malathion as aerial sprays. This paper reports the results obtained from 1963 to 1967 in the Shiloh, Florida area with aerial

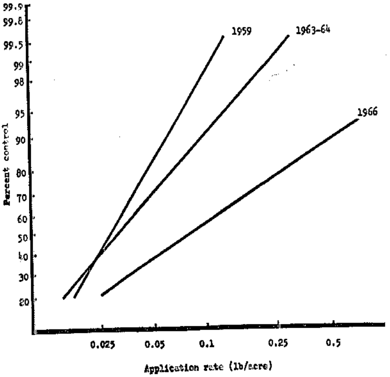

FIGURE 1.—Results of tests in Brevard County, Florida with malathion sprays against *Aedes taeniorhynchus*.

application of seven compounds that had proved highly toxic in wind-tunnel tests to adult *A. taeniorhynchus* from our susceptible (to malathion) laboratory colony. During this period of time, the mosquitoes were becoming increasingly resistant to malathion as indicated in Figure 1.

The following insecticides were tested as either water emulsions or fuel oil solutions: Bay 41831 (Accothion, Sumithion®) (*O,O*-dimethyl *O*-4-nitro-*m*-tolyl phosphorothioate); Bay 39007 (*o*-isopropoxyphenyl methylcarbamate); dimethoate; Dursban® (*O,O*-diethyl *O*-3,5,6-trichloro-2-pyridyl phosphorothioate); fenthion; naled; Shell SD-8211 (2-chloro-1-(2,5-dichlorophenyl)vinyl dimethyl phosphate); and malathion.

The tests were made in 10- to 50-acre plots in citrus groves bordering salt marshes. Spray was applied with a Stearman (PT-17) airplane owned by the Brevard Mosquito Control District that was equipped with an underwing spray boom and calibrated to disperse 2 or 3 quarts of spray per acre in swaths of 100 feet wide. All applications were made during the early morning hours when the wind was

TABLE 1.—Control of adult salt-marsh mosquitoes with aerial sprays.

Insecticide[a]	Dose (lb/acre)[b]	No. of replicates	Pretreatment count (avg./man/minute)	% Reduction at indicated no. of hours: 6	24
Bay 41831					
Emulsion	0.05 d	2	25	80	29
	.1 acd	3	29	85	14
Fuel oil	.1 c	1	156	99	44
Bay 39007					
Emulsion	.025 cde	6	37	64	15
	.05 ace	5	110	95	54
	.1 ac	4	181	96	89
Dimethoate					
Emulsion	.1 c	3	154	59	64
Dursban					
Fuel oil	.025 e	3	464	94	41
	.05 e	3	252	90	57
	.1 e	1	56	96	68
Fenthion					
Emulsion	.05 d	2	26	97	57
	.1 d	2	33	98	64
	.2 d	2	38	95	96
Naled					
Emulsion	.05 d	4	18	79	24
	.1 d	2	25	82	44
	.2 d	2	381	99	73
Shell SD-8211					
Fuel oil[c]	.1 c	1	81	97	37
Malathion					
Emulsion	.05 ab	4	82	57	23
	.1 ac	4	148	90	60
	.2 d	2	35	74	88
	.4 d	2	187	84	70
Fuel oil	.05 b	3	132	76	24
	.1 ac	5	133	86	37
Fog oil[d]	.05 b	3	123	81	35

[a] All except Dursban applied at 3 quarts liquid per acre; Dursban applied in 2 quarts liquid per acre.
[b] Letters following dose indicate year of test. 1963=a; 1964=b; 1965=c; 1966=d; 1967=e.
[c] Insecticide dissolved in 1 gallon of methylene chloride and added to 36 gallons of fuel oil.
[d] An oil (Sun X-Light) used in aerial fogging formulations (sp. gr. 0.92; mw. 300).

favorable (1–8 miles per hour). Flagmen carrying brightly colored flags mounted on 25- to 30-foot magnesium or bamboo poles marked the swath at each end of the flight line.

The percentage reduction in the population was determined by counting the rates of landing of adult mosquitoes 1 day pretreatment and 6 and 24 hours posttreatment. A total of 10 counts was made in each plot (Table 1).

The maximum reduction usually occurred at 6 hours posttreatment; at 24 hours, infiltration from untreated areas was apparent. On the basis of the results obtained 6 hours after treatment, satisfactory control (>89 percent) was obtained with fuel oil formulations of Dursban at rates of 0.025–0.1 pound per acre and Shell SD-8211 and Bay 41831 at rates of 0.1 pound per acre. Also, Bay 39007 (0.05 and 0.1 pound per acre), fenthion (0.05–0.2 pound per acre), and naled (0.2 pound per acre) gave more than 94 percent control in water emulsifiable formulations. Surprisingly, dimethoate was not effective at 0.1 pound per acre, though in our laboratory tests it was as toxic as malathion to susceptible mosquitoes.

Our concurrent laboratory tests with mosquitoes collected in the test area showed no cross resistance to naled, fenthion, Bay 41831, or Bay 39007 (Lofgren *et al.*, 1967). (Dimethoate was not tested for cross resistance.) Because of resistance, control with malathion varied considerably; a rate of 0.4 pound per acre gave only 84 percent control in 1966.

SUMMARY. Conventional aerial sprays were tested in citrus groves in Florida from 1963 to 1967 against adult salt-marsh mosquitoes that were showing a gradually increasing resistance to malathion. Six hours posttreatment, fuel oil solutions of Dursban (0.025–0.1 pound per acre), Shell SD-8211 and Bay 41831 (at 0.1 pound per acre), and fenthion (at 0.05–0.2 pound per acre) gave >89 percent control; water emulsifiable formulations of Bay 39007 (0.05 and 0.1 pound per acre) and naled (0.2 pound per acre) gave more than 94 percent control.

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