RESPONSES OF *AEDES AEGYPTI* (L.) FROM ALABAMA, GEORGIA AND SOUTH CAROLINA TO DDT, DIELDRIN, AND MALATHION[1,2]

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One essential element in the current Aedes aegypti Eradication Program is constant surveillance of the susceptibility levels of *aegypti* populations to the toxicants employed in the operations. In earlier studies larvae and adults of 17 strains of *Ae. aegypti* from Puerto Rico (with one exception) and the Virgin Islands showed varying degrees of lesser susceptibility to DDT and dieldrin than did a susceptible CD strain (Flynn *et al.*, 1964). Strains from St. Thomas and St. Croix were highly resistant to DDT and dieldrin. Larvae and adults of all strains were susceptible to malathion. Studies on strains from seven localities in Florida indicated resistance of the adults to DDT as well as a lowered response of the larvae to both DDT and dieldrin (Flynn and Schoof, 1965). Larvae and adults from these localities were susceptible to malathion. In eight areas in Texas the larvae and adults showed less resistance to DDT than did the Florida strains. Against dieldrin, the strains from San Antonio displayed the highest level of resistance of the strains tested. All Texas strains were susceptible to malathion. This report gives the results of tests to determine baseline susceptibility levels to DDT, dieldrin and malathion of larvae and adults of *Ae. aegypti* from three locations each in Alabama and Georgia and from one location in South Carolina.

METHODS. In the summer of 1965, larvae were collected from various locations in Alabama, Georgia and South Carolina. These specimens were placed in 4-quart plastic freezer bags with approximately 1 liter of water. As much air as possible was trapped in each bag, the end folded over, twisted and secured with a rubber band. Each bag was then labeled according to city and zone from which the larvae were collected. The plastic bags were then placed in a styrofoam ice chest containing a 1-inch layer of crushed ice covered with old newspapers or similar material. Movement of the bags was prevented by adding newspaper packing to the chest. A maximum-minimum thermometer was also placed inside the chest. The lid was taped on and the chest placed inside a cardboard carton, which was sealed and shipped air express to the Technical Development Laboratories, Savannah, Georgia.

In the laboratory these larvae were used to establish colonies. As soon as enough specimens were produced in the F-1 generation the larvae and adults were tested for susceptibility to DDT, dieldrin and malathion by the standard procedures established by the World Health Organization (Anon., 1960). Three test series were conducted for each locality represented, each test series consisting of three replicates per concentration. Twenty-five specimens were exposed in each replication, or a total of 225 for the three test series. Specimens of a susceptible strain (CD) were included as a treated check in each test along with untreated specimens of each field strain.

The strains were from Birmingham, Mobile and Montgomery, Alabama; Albany, Columbus and Macon (three localities), Georgia; and Columbia, South Carolina.

[1] Presented May 9, 1966, at the 37th Annual Meeting, Florida Anti-Mosquito Association, Daytona Beach, Florida.

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TABLE 1.—Susceptibility to DDT of *Aedes aegypti* (L.) from Alabama, Georgia and South Carolina.

Strain	Percent Mortality					
	Larvae (ppm)				Adults (%)	
	0.02	0.1	0.5	2.5	2.0	4.0
Alabama						
Birmingham	75	97	100	100	12	80
Mobile	45	89	100	100	7	42
Montgomery	23	86	99	100	7	58
Susceptible [a]	76	99	100	..	36	93
Georgia						
Albany	12	81	100	100	4	45
Columbus	46	90	>99	100	9	58
Macon						
Zone I	31	87	100	100	6	39
Zone III	30	89	>99	100	4	50
Zones III & IV	44	93	100	100	16	64
Susceptible (CD) [b]	81	>99	100	..	41	87
South Carolina						
Columbia	60	96	100	100	40	80
Susceptible (CD) [c]	79	100	100	..	22	85

[a] Average of nine replicates.
[b] Average of 15 replicates.
[c] Average of three replicates.

RESULTS

RESPONSE TO DDT. Data on the larvae from the three locations in Alabama indicated them to be susceptible to DDT (Table 1). The data from the adults from these three locations showed the Birmingham strain to be susceptible to DDT but the Mobile and Montgomery strains were much less so, giving only 42 and 58 percent kills, respectively, at the 4 percent level as compared to 93 percent for the CD strain.

Larvae of the Georgia strains were susceptible to DDT (Table 1). Adults from Albany, Columbus and Macon showed less response to DDT.

Both larvae and adults from South Carolina were susceptible to DDT (Table 1).

RESPONSE TO DIELDRIN. The larvae of the Alabama strains were susceptible to dieldrin (Table 2). The adults from Birmingham and Mobile gave a response similar to the susceptible strains but those from Montgomery gave a plateau-like response to 1.6 and 4.0 percent dieldrin.

Data on the strains from Georgia (Table 2) indicate susceptibility in all localities except Albany. The adults from Albany showed only 64 percent kill at 0.8 percent, the larvae 56 percent kill at 0.1 ppm. Both stages exhibited a plateau type of response at dosages and concentrations above these levels.

The South Carolina strain showed susceptibility to dieldrin in both larvae and adults (Table 2).

RESPONSE TO MALATHION. Results of the tests with malathion showed larvae and adults of all strains from Alabama, Georgia and South Carolina to be susceptible to malathion (Table 3). At the 0.1 ppm dosage level, larvae from all locations responded less to this toxicant than did the susceptible CD strain. However, when the dosage was increased to 0.5 ppm the mortality of all strains was essentially 100 percent. With the adults, a sharp rise in mortality also was noted when the concentration was increased (Table 3).

DISCUSSION. The larvae from Alabama, South Carolina and Georgia were susceptible to DDT, dieldrin, and malathion with the exception of specimens from Albany, Georgia, which were resistant to dieldrin. In all instances the response to malathion at 0.1 ppm was somewhat lower than that of the susceptible laboratory

TABLE 2.—Susceptibility to dieldrin of *Aedes aegypti* (L.) from Alabama, Georgia and South Carolina.

	Percent Mortality								
	Larvae (ppm)					Adults (%)			
Strain	0.004	0.02	0.1	0.5	2.5	0.4	0.8	1.6	4.0
Alabama									
Birmingham	2	88	>99	100	100	19	79	99	98
Mobile	31	99	100	100	100	19	99	100	100
Montgomery	5	90	92	100	100	13	84	90	93
Susceptible (CD) [a]	43	>99	100	..	..	51	100	100	..
Georgia									
Albany	3	49	56	94	99	18	64	69	73
Columbus	4	89	99	100	100	12	95	99	100
Macon									
Zone I	13	95	100	100	100	14	94	100	100
Zone III	25	96	99	100	100	25	83	99	99
Zones III & IV	17	99	100	100	100	34	96	98	99
Susceptible (CD) [b]	70	>99	100	..	..	43	98	100	..
South Carolina									
Columbia	8	98	97	>99	100	61	99	98	99
Susceptible (CD) [c]	62	100	100	..	..	5	92	100	..

[a] Average of nine replicates.
[b] Average of 15 replicates.
[c] Average of three replicates.

strain. This type of response to malathion at the lower dosages has been observed with samples from Puerto Rico, Texas and Florida (Flynn *et al.*, 1964; Flynn and Schoof, 1965).

The response of the adults to DDT was not as clear cut as that of the larvae since strains from localities in Alabama and Georgia gave much lower kills than did the susceptible strains. In the absence of

TABLE 3.—Susceptibility to malathion of *Aedes aegypti* (L.) from Alabama, Georgia and South Carolina.

	Percent Mortality								
	Larvae (ppm)					Adults (%)			
Strain	0.004	0.02	0.1	0.5	2.5	0.8	1.6	3.2	6.4
Alabama									
Birmingham	2	2	62	100	100	62	86	100	..
Mobile	2	4	57	100	100	42	70	100	..
Montgomery	1	3	57	100	100	15	70	100	..
Susceptible (CD) [a]	0	10	97	100	..	33	65	100	..
Georgia									
Albany	0	2	63	100	100	34	90	99	100
Columbus	1	2	53	100	100	26	95	94	100
Macon									
Zone I	0	13	88	100	100	52	99	100	..
Zone III	2	14	80	>99	100	62	95	92	100
Zones III & IV	2	10	92	100	100	12	76	100	..
Susceptible (CD) [b]	2	16	>99	100	..	50	81	98	..
South Carolina									
Columbus	<1	2	70	100	100	90	99	100	..
Susceptible (CD) [c]	3	9	100	100	..	56	97	96	..

[a] Average of nine replicates.
[b] Average of 15 replicates.
[c] Average of three replicates.

concentrations of DDT above 4 percent, it is difficult to determine the significance of such mortalities. When kills are 50 percent or less at 4.0 percent DDT, a strain is considered as resistant to DDT (*e.g.*, Albany, Macon—Zones I and III, and Mobile, Alabama). Whether such strains should be so classed without including in the same category those from Columbus, Macon—Zones III and IV, Georgia, and from Montgomery, Alabama, which gave kills of 58 to 64 percent may be open to question but, based on the above criterion, at this time they are not in the resistant category.

The data for the adult response to dieldrin or malathion indicate susceptibility of all strains except for the Albany strain, which displayed resistance to dieldrin as evidenced by the low kills and plateau response. The adults from Montgomery, Alabama, also showed a plateau response to dieldrin in the range of 84 to 93 percent that suggests a loss of susceptibility to this compound.

These data suggest the need for continued susceptibility surveillance in any of these areas where DDT is employed as an operational measure. Although no resistance to malathion was apparent in the previous tests, periodic assessment of the response of the *aegypti* population to that compound also should be made in areas where it is used for eradication purposes.

SUMMARY. Using the standard WHO test methods, studies were conducted to determine baseline susceptibility levels for DDT, dieldrin, and malathion against larval and adult stages of *Ae. aegypti* (L.) from Alabama, Georgia, and South Carolina along with a laboratory susceptible (CD) strain. Of the strains from Alabama, two were resistant to DDT (adults), one slightly resistant to dieldrin (adults), and none resistant to malathion. From Georgia, all strains of the adult stage were resistant to DDT, one strain (Albany, adult and larval stages) to dieldrin, and none to malathion. Strains from South Carolina were susceptible to all of these toxicants.

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References

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ARRANGEMENTS HAVE BEEN MADE FOR THE RECEPTION AND THE BANQUET on Tuesday, April 2, at New Orleans in separate rooms to avoid possible delays in handling the anticipated large crowd. The reception will be from 6:30 to 7:30 in the Tulane Room; the banquet will be held in the Grand Ballroom from 7:30 to 10:30. Entertainment will be provided, following the banquet, by Mr. Bud Fletcher, a noted humorist and Cajun story teller.