

## ARTICLES

LABORATORY SUSCEPTIBILITY TESTS OF SOME FLORIDA STRAINS OF *Aedes taeniorhynchus* (WIED.) AND *Culex nigripalpus* THEOB. TO MALATHION AND NALED, 1972-1974

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ABSTRACT. First generation larvae from field collected adults of *Aedes taeniorhynchus* (Wied.) from eight areas of Florida were found to be from 2-30 times more resistant to malathion at the LC<sub>50</sub> level than larvae from the susceptible colony maintained at the West Florida Arthropod Research Laboratory. F<sub>1</sub> adults from some areas were up to 31 times less susceptible than those of the laboratory colony. The study areas were selected on the basis of previous tests that indicated a decrease in susceptibility to malathion. No resis-

tance to naled (<2 times) was found in either the larval or adult stages. F<sub>1</sub> larvae and adults of *Culex nigripalpus* Theob. collected from five counties were shown to be as susceptible to malathion as those of the susceptible laboratory colony of this species. Larvae of this species from two counties showed no resistance (<2 times) to naled compared to the laboratory colony, while F<sub>1</sub> adults from two counties appeared to be 2½-3 times less susceptible.

Concurrent reports of resistance to malathion in 1966 by Gahan et al., and in 1967 by Rathburn and Boike revealed that populations of *A. taeniorhynchus* on some of the offshore islands of southwest Florida, in some areas of Pinellas and Hillsborough Counties, and in some locations on the East Coast were becoming increasingly less susceptible to malathion. During 1969-71, populations of *A. taeniorhynchus* from Sanibel Island exhibited malathion resistance (Boike and Rathburn, 1972), while Mount et al. (1971) reported on a malathion resistant strain of *A. taeniorhynchus* from Allenhurst in Brevard County on the East Coast. This is a report of testing Florida mosquito populations for insecticide susceptibility during 1972-74 with emphasis on areas of suspected and previously reported malathion resistance.

MATERIALS AND METHODS. Samples of wild adult mosquitoes from different areas in the state were sent to the laboratory in styrofoam cooler chests. The methods of collecting, shipping, rearing, and larval testing were the same as described by Rathburn and Boike (1967). Adult mos-

quitoes tested were 2-8 days old and were fed a 5% sugar solution on a cotton pad prior to and after testing. Tests were conducted in a wind tunnel similar to that described by Rathburn (1969), with the exception that the heater and condensation tube were not used. One-half milliliter of the insecticide solution, diluted to predetermined concentrations in acetone, was sprayed at 15 psi into the wind tunnel. A replication consisted of 1 cage of 25 female mosquitoes for each of a series of 4 insecticide dilutions plus an acetone check. Fewer mosquitoes were sometimes used if sufficient numbers were not available. The test cages used and other methods of the wind tunnel operation were essentially the same as described by Rathburn and Boike (1972).

RESULTS AND DISCUSSION. Results of tests of malathion and naled against larvae of both species are shown in Table 1 and against adults in Table 2. In the discussion of results, the statements of resistance levels are based upon the susceptibility level of the test mosquitoes as compared with the susceptibility level of the laboratory colony. It is felt that an

Table 1. Susceptibility of F<sub>1</sub> generation *Aedes taeniorhynchus* and *Culex nigripalpus* larvae from various areas of Florida to malathion and naled, 1972-74.

County	Area	Year	Reps	Lethal concentration in ppm.	
				LC <sub>50</sub>	LC <sub>90</sub>
<i>Aedes taeniorhynchus</i> —malathion					
Lab colony	Panama City	1972	40	0.018	0.034
Lab colony	Panama City	1973	18	0.018	0.035
Bay	P. C. Beach	1972	4	0.024	...
Brevard	Shiloh	1972	11	0.135	0.650
Monroe	Marathon	1973	10	0.210	0.910
Monroe	Little Duck Key	1973	4	0.300	1.040
Lee	Sanibel Is.	1973	16	0.086	0.370
Sarasota	Longboat Key	1973	20	0.036	0.220
Hillsborough	MacDill AFB	1973	8	0.380	0.970
Hillsborough	Ruskin	1973	4	0.021	0.074
Martin	Jensen Bch.	1973	2	0.048	0.380
Dade	Miami	1974	14	0.132	0.504
<i>Culex nigripalpus</i> —malathion					
Lab colony	Panama City	1972	28	0.027	0.046
Lab colony	Panama City	1973	28	0.029	0.045
Bay	P. C. Beach	1972	8	0.048	0.064
Bay	State Park	1972	4	0.026	0.048
Pinellas	L. Maggiore	1973	16	0.040	0.062
Manatee	Bradenton	1973	12	0.038	0.071
Martin	Jensen Bch.	1973	8	0.048	0.079
Martin	Salerno	1973	16	0.045	0.075
Palm Beach	Boynton Bch.	1973	17	0.055	0.077
<i>Aedes taeniorhynchus</i> —naled					
Lab colony	Panama City	1972	28	0.064	0.118
Lab colony	Panama City	1973	14	0.063	0.134
Monroe	Marathon	1973	4	0.085	0.240
Sarasota	Longboat Key	1973	4	0.074	0.180
Hillsborough	MacDill AFB	1973	2	0.098	0.148
Dade	Miami	1974	7	0.060	0.130
<i>Culex nigripalpus</i> —naled					
Lab colony	Panama City	1972	22	0.042	0.056
Lab colony	Panama City	1973	12	0.040	0.060
Manatee	Bradenton	1973	12	0.046	0.064
Martin	Jensen Bch.	1973	5	0.075	0.101
Martin	Salerno	1973	12	0.053	0.084

increase in the LC<sub>50</sub> and LC<sub>90</sub> of approximately 2 times or less as compared to the laboratory colony does not indicate a significant degree of resistance and may be due to a natural tolerance of some field strains to these insecticides.

**MALATHION vs *Aedes taeniorhynchus*.** In these tests, larvae from Marathon and Little Duck Key in Monroe County were 11.7 and 16.7 times respectively more resistant at the LC<sub>50</sub> level than the laboratory colony, and 26.0 and 29.7 times re-

spectively at the LC<sub>90</sub> level. In extreme north Brevard County a population of *A. taeniorhynchus* was 7.5 times more resistant at the LC<sub>50</sub> level and 18.6 times at the LC<sub>90</sub> level. This substantiates reports of Rathburn and Boike (1967), Boike and Rathburn (1969, 1972) and Mount, et al. (1971) of a high degree of tolerance to malathion in populations of *A. taeniorhynchus* in that part of Brevard County. Larvae from MacDill AFB in Hillsborough County were 21.1 times more resistant at



the LC<sub>50</sub> level and 27.7 times at the LC<sub>90</sub> level. These values indicate that a high level of resistance has continued in *A. taeniorhynchus* in this area since it was first found in 1965 (Rathburn and Boike, 1967).

Larvae from Sanibel Island in Lee County were 4.8 and 10.6 times more resistant at the LC<sub>50</sub> and LC<sub>90</sub> levels than the laboratory colony while F<sub>1</sub> adults were approximately 10 and 18 times resistant at these levels. A fairly high level of resistance was found in a population of *A. taeniorhynchus* from Dade County; the LC<sub>50</sub> and LC<sub>90</sub> values being 7.3 and 14.4 times the laboratory colony. Adults from this same area were 23 times less susceptible to malathion than the laboratory colony at the LC<sub>50</sub> level. Larvae from Longboat Key in Sarasota County were 2.0 and 6.3 times more resistant to malathion at the LC<sub>50</sub> and LC<sub>90</sub> levels; however, adults from this area showed approximately 9-fold tolerance at the LC<sub>50</sub> level and about

30 times at the LC<sub>90</sub>. A lower level of resistance was found in larvae from Jensen Beach in Martin County where the LC<sub>50</sub> and LC<sub>90</sub> values were 2.7 and 10.9 times that of the laboratory colony. Two of the areas sampled showed no resistance, Ruskin, located across Tampa Bay from MacDill AFB in Hillsborough County and Panama City Beach in Bay County. Similar results were reported from Ruskin in 1965 (Rathburn and Boike, 1967) and from Panama City Beach in 1967 and 1968 (Boike and Rathburn, 1968, 1969).

**MALATHION vs *Culex nigripalpus*.** LC<sub>50</sub> and LC<sub>90</sub> values for larvae from seven areas in five counties were all less than two times that of the laboratory colony, indicating no resistance to malathion. F<sub>1</sub> adults from Salerno, Lake Maggiore and Bradenton were approximately two times less susceptible at both the LC<sub>50</sub> and LC<sub>90</sub> levels.

**NALED vs *Aedes taeniorhynchus*.** Larvae from Marathon, Longboat Key, MacDill

Table 2. Susceptibility of F<sub>1</sub> generation *Aedes taeniorhynchus* and *Culex nigripalpus* adults from various areas in Florida to malathion and naled, 1972-74.

County	Area	Year	Reps	Milligrams a.i. per Milliliter	
				LC <sub>50</sub>	LC <sub>90</sub>
<i>Aedes taeniorhynchus</i> —malathion					
Lab colony	Panama City	1973	10	0.013	0.33
Sarasota	Longboat Key	1973	8	1.15	10.30
Lee	Sanibel Is.	1973	11	1.19	6.00
Dade	Miami	1974	5	3.20	....
<i>Culex nigripalpus</i> —malathion					
Lab colony	Panama City	1973	20	0.64	2.80
Martin	Salerno	1973	5	1.36	3.90
Palm Beach	Boynton Bch.	1973	12	1.03	4.50
Pinellas	L. Maggiore	1973	9	1.26	4.50
Manatee	Bradenton	1973	10	1.41	5.80
<i>Aedes taeniorhynchus</i> —naled					
Lab colony	Panama City	1972	10	0.100	0.256
Lab colony	Panama City	1973	10	0.083	0.255
Sarasota	Longboat Key	1973	4	0.155	0.222
Lee	Sanibel Is.	1973	4	0.110	0.235
<i>Culex nigripalpus</i> —naled					
Lab colony	Panama City	1972	10	0.076	0.196
Lab colony	Panama City	1973	14	0.063	0.131
Martin	Salerno	1973	4	0.114	0.278
Martin	Jensen Bch.	1973	2	0.190	0.400
Palm Beach	Boynton Bch.	1973	2	0.177	0.321

AFB, and Miami showed no resistance to naled. Both LC<sub>50</sub> and LC<sub>90</sub> values were less than twice that of the laboratory colony. Similarly, F<sub>1</sub> adults from Longboat Key and Sanibel Island showed no resistance.

**NALED vs *Culex nigripalpus*.** Larvae from Jensen Beach in Martin County were approximately twice as tolerant to naled as the laboratory colony while F<sub>1</sub> adults were 3 times. Larvae from Bradenton and Salerno and F<sub>1</sub> adults from Salerno were not resistant, and adults from Boynton Beach and Jensen Beach were only 2½-3 times less susceptible than the laboratory colony.

In general, the above tests indicate malathion resistant populations of *A. taeniorhynchus* were confined mainly to coastal areas of Florida and the Keys, and no resistance to naled was found. Populations of *C. nigripalpus* from these same areas were generally susceptible to both malathion and naled.

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#### References Cited

- Boike, A. H., Jr. and C. B. Rathburn, Jr. 1968. Tests of the susceptibility of Florida mosquitoes to insecticides, 1967. *Mosq. News* 28(3):313-316.
- Boike, A. H., Jr. and C. B. Rathburn, Jr. 1969. Laboratory tests of the susceptibility of mosquito larvae to insecticides in Florida, 1968. *Mosq. News* 29(3):392-395.
- Boike, A. H., Jr. and C. B. Rathburn, Jr. 1972. The susceptibility of mosquito larvae to insecticides in Florida, 1969-1971. *Mosq. News* 32(3):328-331.
- Gahan, J. B., C. N. Smith and B. M. Glancy. 1966. Resistance in Florida and countermeasures involving chemicals. *Mosq. News* 26(3):330-337.
- Mount, G. A., D. A. Dame and C. S. Lofgren. 1971. Susceptibility of a Florida strain of *Aedes taeniorhynchus* (Wiedemann) to insecticides. *Mosq. News* 31(3):438-440.
- Rathburn, C. B., Jr. and A. H. Boike, Jr. 1967. Studies of insecticide resistance in Florida mosquitoes. *Mosq. News* 27(3):377-382.
- Rathburn, C. B., Jr. 1969. A laboratory thermal aerosol generator for the testing of insecticidal aerosols. *Mosq. News* 29(1):1-6.
- Rathburn, C. B., Jr. and A. H. Boike, Jr. 1972. Laboratory thermal aerosol tests of new insecticides for the control of adult mosquitoes. *Mosq. News* 32(2):179-183.

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