COMPARATIVE THERMAL AEROSOL TESTS WITH DIBROM AND MALATHION AGAINST *AEDES TAENIORHYNCHUS* (WIED.) AND *CULEX NIGRIPALPUS* THEOB.[1]

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In the summer of 1962, the Tampa Bay region of Florida was the center of an outbreak of St. Louis encephalitis. *Culex nigripalpus* was implicated as a major vector of the virus in the epidemic area (Chamberlain, 1963) and mosquito control operations were intensified, especially the application of malathion and Dibrom with thermal aerosol generators for the control of adult mosquitoes.

Prior to 1963 dosage recommendations for ground fogging in Florida were based upon test results against *Aedes taeniorhynchus,* the species of principal interest. However, in tests conducted by the authors in the spring of 1963 with aerial fogs against caged adults of *Aedes taeniorhynchus* and *Culex nigripalpus,* the kills of *Aedes* were significantly higher than for *Culex* where both species were exposed in the same tests (Unpublished data). The U.S.D.A. laboratory at Orlando, Florida also demonstrated that *Culex nigripalpus* adults are less susceptible to malathion sprays than the adults of salt-marsh *Aedes* (personal communication). Therefore, because of the special interest in controlling *Culex nigripalpus,* malathion and Dibrom were tested against this species in ground-dispersed thermal aerosols in the spring and early summer of 1963. Adults of *Aedes taeniorhynchus* were included in each test for comparison. This is a report of the results of these tests.

METHODS. The methods used were similar to those reported by Rogers, *et al.* (1957). All tests were conducted in the early evening hours on level, open areas having little or no underbush. Four cages of mosquitoes, two of each species, containing approximately 25 female mosquitoes per cage were attached to stakes. One cage of each species was placed at six feet and another at two feet above the ground. The stakes were placed at intervals of 165 and 330 feet downwind from and perpendicular to the line of travel of the fogging vehicle. Each test or replicate consisted of the cages of each species from three sets of stakes placed a block (approximately 300 feet) apart or a total of 12 cages.

All mosquitoes used in the tests were between 2 and 8 days old and had been fed only sugar water. After exposure to the fog, the mosquitoes were transferred to clean cages and a fresh pad of cotton saturated with sugar water was placed on the top of each cage. Mortality counts, of female mosquitoes only, were made 12 hours after treatment.

All tests were conducted with either a Leco 80[2] or a TIFA 40[3] thermal aerosol generator calibrated to deliver 40 gallons per hour. The Leco was operated at a burner temperature of 850° F. and at a formulation pressure required to give the desired output of 40 gallons per hour or approximately 13 p.s.i. The TIFA was operated at a burner temperature of 1000° F. and a formulation pressure of 25 p.s.i. The fogging vehicle was driven at 5 miles per hour. The operation of the machines was checked constantly during the tests, and the volume discharged was measured accurately for each test. Tests in which the output varied more than six percent were discarded. Wind velocities during the tests at six feet elevation were

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[2] Lowndes Engineering Co.

[3] Todd Shipyards Corp.

between 1 and 5 miles per hour and the temperature betwen 67° and 81° F. It has been determined previously that there is no difference in mosquito kill with these two machines when used within the conditions of atmospheric temperatures and wind velocities at which these tests were conducted (unpublished data). The fog coverage at each station was visually checked and if poor coverage was noted the test was discarded.

Both malathion and Dibrom were formulated in No. 2 diesel oil from malathion 90 and Dibrom 14 respectively. Due to the formation of precipitates with these insecticides when formulated in diesel oil, appropriate inhibitors were used. Thiosperse[4] was used at 0.25 percent by volume in malathion formulations and Ortho Additive 10–20[5] at 0.5 percent in Dibrom formulations.

RESULTS. It is evident from data in Table 1 that either of the previously recommended dosages of 6 oz. of malathion or 1½ oz. of Dibrom per gallon (Rathburn and Rogers, 1963) produce a satisfactory kill of *Aedes taeniorhynchus*. However, the ranges and average kills of *Culex nigripalpus* obtained at these dosage levels is considered unsatisfactory. For satisfactory kill of this species, the higher dosage of 8 oz. of malathion or 1¾ oz. of Dibrom is required.

The unusually wide ranges of mortality for both species with Dibrom at 1½ ounces per gallon were due to poor kills at 330 feet in separate tests. In each instance fog coverage of all cages appeared to be normal and satisfactory kill of the other species was obtained in each of the tests. Therefore, in the absence of an acceptable explanation for these aberrant results, data from these tests are included.

DISCUSSION. The data in Table 1 are comparative since both *Aedes taeniorhynchus* and *Culex nigripalpus* were included in each test. However, due to changes in weather during the testing period, availability of test mosquitoes and other causes, it was not always possible to conduct a test with each formulation on the same night. It has been previously determined, however, that comparable results could be expected under conditions where the temperature is greater than 65° F. and the wind velocity is below 5 miles per hour. Since all tests were conducted within these conditions, they may be assumed to be comparable.

A principal reason for publishing the results of these tests is to call attention to the difference in species susceptibility to insecticides among mosquitoes and the desirability of establishing effective dosage levels for each important species to a particular insecticide.

Fortunately, Dibrom was used at the effective dosage rate of 1¾ oz. per gallon for control of *Culex nigripalpus* during

TABLE 1.—Results of tests conducted in 1963 with malathion and Dibrom applied as thermal aerosols against caged adults of *Aedes taeniorhynchus* (Weid.) and *Culex nigripalpus* Theob.

Insecticide	Ounces[1] per gallon	Mosquito species	No. of tests	Percent mortality	
				Average	Range
Malathion	8	*Aedes taeniorhynchus*	8	98	94–100
		Culex nigripalpus	8	93	84–100
Malathion	6	*Aedes taeniorhynchus*	7	98	93–100
		Culex nigripalpus	7	85	78–93
Dibrom	1.75	*Aedes taeniorhynchus*	9	96	85–100
		Culex nigripalpus	9	93	73–99
Dibrom	1.50	*Aedes taeniorhynchus*	6	90	55–100
		Culex nigripalpus	6	86	49–100

[1] Ounces of actual toxicant per gallon in No. 2 diesel oil.

[4] American Cyanamid Co.
[5] California Chemical Co.

the 1962 outbreak of encephalitis in Florida, even prior to its incrimination as a vector. This was because Dibrom had only been tested against *Aedes taeniorhynchus* at the 1 oz. and 1¾ oz. levels prior to 1962 (Rathburn and Rogers, 1961) and the only known effective dosage at the start of the 1962 encephalitis outbreak was 1¾ oz. per gallon. The recommended dosage rate of 1½ oz. of Dibrom per gallon for *Aedes taeniorhynchus* (Rathburn and Rogers, 1963) was not established until November of 1962.

References

CHAMBERLAIN, ROY W. 1963. Transmission of St. Louis encephalitis, with special reference to *Culex nigripalpus* Theobold. Rpt. 34th Ann. Mtg., Fla. Anti-Mosq. Assn. pp. 31–34.

RATHBURN, CARLISLE B., JR., and ROGERS, ANDREW J. 1961. Tests of insecticides for the control of adult mosquitoes, 1959–60. Rpt. 32nd Ann. Mtg., Fla. Anti-Mosq. Assn. pp. 36–40.

———, and ROGERS, ANDREW J. 1963. Thermal aerosol insecticide tests for the control of adult mosquitoes, 1961–62. Mosquito News 23 (3):218–220.

ROGERS, ANDREW J., BEIDLER, E. J., and RATHBURN, CARLISLE B., JR. 1957. A cage test for evaluating mosquito adulticides under field conditions. Mosquito News 17(3):194–198.

RECENT INVESTIGATIONS ON THE USE OF BHC AND EPN TO CONTROL CHIRONOMID MIDGES IN CENTRAL FLORIDA

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Chironomid midges are a serious nuisance in certain areas of Florida. The principal species, *Glyptotendipes paripes,* becomes so numerous at times that almost all outside activity is prohibited. In the Winter Haven area, several of the lakes that are widely used for recreational purposes produce large numbers of adult midges almost daily from March through November. Many of the lakes have a larval density of 500 or more per square foot in the sandy areas, but usually more than half the lake bottom is covered by muck. Few of the important species of chironomids inhabit this muck area, but *Chaoborus* midges do breed in muck-bottom lakes and appear to be increasing in numbers in several lakes in central Florida.

Of the many compounds tested, only two, BHC and EPN, have been used extensively as midge larvicides. Although each of these chemicals was very successful at the beginning, within a year of their initial applications there were definite indications according to Lieux (1955) that they were no longer effective in certain lakes. Resistance was suspected as reported by Lieux and Mulrennan (1956) but was not substantiated since there is no known method of rearing this species of chironomid or keeping them alive in the laboratory for the time required to establish tolerance levels. Therefore, most of the previous evidence of resistance against these compounds was based on observations of adult midge populations following the application of the insecticide.

BHC was first widely used as a midge larvicide in 1953 but was generally discontinued by 1955 because it was not giving adequate control in certain lakes. However, in a few areas of the state it has been used almost continually with apparent success. This apparent prolonged success of BHC is, however, based purely on observations made by laymen, and is not supported by scientific evaluation of the treatments. EPN was used extensively in lakes at Winter Haven in 1954 but was judged ineffective after 1955 and has been used only sporadically in recent years.

The 1963 investigations were conducted