EVALUATION OF INSECTICIDES AGAINST FOUR SPECIES OF ADULT MOSQUITOES IN THE PANAMA CANAL ZONE, 1967 [1]

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These tests are a continuation of a program jointly sponsored by the Armed Forces Pest Control Board and the Entomology Research Division, Agricultural Research Service, United States Department of Agriculture, to encourage Department of Defense entomologists to evaluate insecticides in various areas of the world where U. S. military personnel are deployed. The tests conducted under this program include those by Gahan *et al.*, (1965), Lofgren *et al.*, (1966) and Pennington (1966) in Okinawa and have resulted in improved mosquito control on Department of Defense installations.

During October 1962 a Curtis model nonthermal aerosol generator of the type designed and developed by the U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Virginia (Morrill and Wesley, 1955 and Edmunds *et al.*, 1958) was used to evaluate a number of insecticides against mosquitoes in the Canal Zone. The results of these tests led to the adoption of naled for adult mosquito control. The present tests were conducted to re-evaluate naled and malathion and to determine the comparative effect of fenthion.

These tests were conducted in the early evening hours on a level, open area where there were no obstructions to interfere with the fog. The standard Department of Defense nonthermal aerosol generator calibrated to deliver 40 gallons per hour, was used to disperse the insecticides. The insecticide was applied upwind from the caged insects with the truck mounted generator traveling at 5 miles per hour.

Four species of mosquitoes were used in the study. *Aedes taeniorhynchus* (Wiedemann) were reared from eggs obtained from the USDA Gainesville, Florida, colony. *Anopheles albimanus* Wiedemann were obtained as adults from the Republic of Panama, Department of Public Health, Servicio Nacional de Erradicación de la Malaria Division. *Culex pipiens quinquefasciatus* Say were reared from larvae collected near Curundu, a Canal Zone civilian housing area. *Mansonia* spp (primarily *M. titillans*) were collected daily in a horse-baited trap near the mouth of the Mandinga River which empties into the Panama Canal near Gamboa, C. Z. The *Aedes, Culex* and *Anopheles* were approximately three days old when used in the tests. The mosquitoes were immobilized in a low temperature (38° F.) room, sexed and the females placed in cylindrical test cages made of screen wire. Twenty *Culex pipiens quinquefasciatus* and *Aedes taeniorhynchus* were caged together, as were the *Anopheles albimanus* and *Mansonia* spp. Prior to and after exposure, all insects were held in insulated chests at approximately 60° F. They were provided 10 percent sucrose solution on cotton pads and held until the mortality counts were made 12 hours later.

Fenthion and naled were obtained from the USDA ARS Entomology Research Laboratory in Gainesville, Florida. The malathion used in the tests was the standard 57 percent emulsifiable concentrate purchased through Army supply channels. Each insecticide was diluted with No. 2 fuel oil to the desired concentration immediately before it was applied.

The cages of mosquitoes were placed on

[1] Mention of a proprietary product does not necessarily imply indorsement of this product by the U. S. Army.

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stakes set up in two rows 50 ft. apart at distances 150 and 300 ft. from the aerosol discharge line. Two cages containing two different species in each cage were attached to a crossbar 6 feet from the ground on each stake.

One control cage of mosquitoes was used for every ten exposed cages. These were manipulated the same as the exposed insects. A limited number were exposed to fuel oil, but this practice was discontinued after determining that it did not cause any increase in the control mortality.

Each test consisted of dispersing 6000 ml. of solution during a 2½ minute run. The aerosol generator was flushed with fuel oil immediately prior to each application. Five minutes after the generator passed the stakes, the treated cages were removed and replaced with untreated cages in readiness for the next test. Two types of cages were used. During the first series, which were conducted in December 1966, the exposed mosquitoes were immediately anesthetized with CO_2 under slight pressure in a plastic bag and transferred to ice cream cartons with clear plastic tops. Cages of the type used by Mount *et al.* (1966), were obtained from the USDA ARS laboratory in Gainesville, Florida and used for the final series of tests conducted during January 1967. In the latter tests the mosquitoes were again held in the exposure cages approximately 5 minutes before blowing them into plastic tubes lined with clean paper. There was no significant difference in the results of tests conducted with the different cages so the results were combined. However, transfer of the exposed mosquitoes was much easier with the cages obtained from the USDA.

The tests were conducted on eight different evenings between 1900 and 2100. The average air temperature was 73° F., the average wind speed 3 to 4 m.p.h. All tests were conducted during air temperature inversions. The number of replications with each concentration is indicated in the attached summary.

The mortality percentages are averages of the results obtained at 150 and 300 ft. The movement of the cloud of insecticide over the test area was closely observed and cages that were obviously missed were excluded from the tests.

The results of the tests are shown in Table 1.

On the basis of percentage concentration, fenthion was the most effective material in these tests. At the higher dosages the results of the tests with malathion, penthion and naled against *Aedes taeniorhynchus* were similar to those reported

TABLE 1.—Summary of tests with caged mosquitoes exposed to nonthermal aerosols of various insecticides.

Insecticide	Concentration %	No. reps.	Percent Mortality After 12 Hours[a]			
			Aedes taeniorhynchus	*Culex pipiens quinque.*	*Anopheles albimanus*	*Mansonia* spp
Malathion	2	7	59	59	58	72
	4	6	85	81	84	89
	6	2	96	95	96	95
	8	4	98	99	98	99
Naled	0.5	4	21	29	26	39
	1.0	5	51	64	26	60
	1.5	6	92	96	76	85
Fenthion	0.1	2	29	35	27	63
	0.25	4	69	77	66	60
	0.5	6	94	94	89	80
	1.0	5	97	100	98	96

[a] Corrected by Abbott's formula; average of mosquitoes exposed at 150 and 300 ft.

by Mount *et al.*, (1966). The relatively lower mortalities at the reduced dosage levels were possibly due to the low wind velocity which permitted the insecticide particles to fall out before reaching the cages. The percent mortality of all four mosquito species to each insecticide was similar although naled was slightly less toxic to *Anopheles albimanus* than to the other three mosquito species.

SUMMARY. In December 1966 and January 1967 two series of tests were conducted at Ft. Clayton, Canal Zone to determine the effectiveness of nonthermal aerosols of several insecticides to caged *Aedes taeniorhynchus* (Wiedemann), *Culex pipiens quinquefasciatus* Say, *Anopheles albimanus* Wiedemann and *Mansonia* spp. Based on the percentage concentration, fenthion was more effective than naled which was in turn more effective than malathion.

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