CONTROL OF ADULT MOSQUITOES IN ALASKA WITH MALATHION [1]

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Mosquito control with DDT was demonstrated in Alaska by Travis (1949), Travis *et al.* (1949), and Blanton *et al.* (1950). However, no experimental work has been done with any of the newer insecticides in Alaska. Therefore, during May and June 1967, we evaluated malathion as a mosquito adulticide when applied from the ground as an aerosol with the military nonthermal aerosol generator and from the air as an ultra-low volume (ULV) aerial spray from aircraft. ULV is used to refer to any spray in which total volume applied is less than ½ gallon per acre. The tests were conducted at Eielson Air Force Base near Fairbanks, Alaska as a cooperative effort by the Armed Forces Pest Control Board, the Alaska Air Command, the Air Force Special Aerial Spray Flight, and the U. S. Department of Agriculture.

METHODS AND MATERIALS. In the ground-level tests, the malathion was dispersed from a truck-mounted nonthermal aerosol generator developed by the U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Virginia. The C-123 aircraft used to apply the ULV spray was provided and operated by the 4500th Special Aerial Spray Flight, U. S. Air Force, Langley Air Force Base, Virginia.

Two series of tests were conducted with the nonthermal aerosols. In the first series, malathion was compared with DDT against caged adult females (about 10 per cage) of *Culiseta alaskaensis* (Ludlow). The generator was calibrated to deliver 40 gallons of liquid per hour and was moved at a speed of 5 miles per hour. The insecticides were tested as emulsifiable concentrates diluted in water (w/v). The tests were made on an open, level field between 6 and 9 p.m. The cages were placed 5 feet above the ground on stakes located 150 and 300 feet downwind from the path of the generator. Four tests were made with three concentrations of each insecticide. After each passage of the aerosol generator, the exposed mosquitoes were transferred from the screen-wire cages to plastic tubes lined with clean paper. After the tubes were returned to a holding room, absorbent cotton pads dipped in a 10 percent solution of sugar and water were placed on the tubes. Counts of mortality were made 18 hours after the exposure.

In the second series of tests with the nonthermal aerosols, malathion only was evaluated against natural populations of adult mosquitoes (predominantly *Aedes* sp.). Since there are about 25 miles of road on Eielson Air Force Base, the aerosol generator was moved along these roads at a speed of 10 miles per hour so the entire application could be completed during a time when favorable winds prevailed (about 6:30 to 8 p.m.). Previous observations indicated that the wind velocity later in the evening was insufficient to disperse the aerosols satisfactorily. By using this method, the entire base was treated three consecutive evenings with 8 percent (v/v) malathion and three evenings with 12 percent (v/v) malathion

[1] Mention of a proprietary product does not necessarily imply endorsement by the U. S. Department of Agriculture or the Department of Defense.

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(only two of the 12 percent treatments were on consecutive evenings) diluted in diesel oil and dispersed at the rate of 40 gallons per hour. The average swath width on the base was estimated to be about 600 feet.

Effectiveness of the aerosols was based on the number of mosquitoes landing on two men at each of 12 counting stations on the base before the applications began and each night about 3 hours after the applications. Also, three counting stations were located about one mile from the base to check the fluctuations in the natural population.

In the ULV aerial-spray test, a C-123 aircraft was equipped with 38 D2-13 hollow-cone tips and flown at a speed of 150 miles per hour and an altitude of 150 feet; the swath width was 500 feet. Output was 3.14 ounces (0.2 pound) technical malathion per acre. Application was made between 8 and 10 p.m.

Droplets of malathion deposited on 20 oil-red dye cards placed on the ground 0.1 mile apart in a single row perpendicular to the swaths of the aircraft were evaluated by eye and estimated to range from 8 to 31 per square inch and to average 19.5 per square inch.

The effectiveness of ULV aerial spraying against adult mosquitoes was measured by taking pre- and posttreatment landing rate counts of adult mosquitoes on two men at 30 stations located within the treated area (24 square miles), and at six check stations located 6 miles away from the treated area. Larval control was evaluated by dipping for larvae in three locations in the treated area and at one location 6 miles away before and after treatment.

RESULTS AND DISCUSSION. The data presented in Table 1 indicate that the LC_{90} of malathion was 2.1 percent; thus, malathion was about seven times more effective as a nonthermal aerosol against caged mosquitoes than DDT which had an LC_{90} of 15 percent.

In the tests with nonthermal aerosols against natural populations of mosquitoes (Table 2), the average pretreatment count was about nine mosquitoes per man per one-half minute. The average control obtained was 65 percent with 8 percent malathion and 83 percent with 12 percent malathion. Also, except for the third treatment with 8 percent malathion, control improved slightly on each consecutive night. The lower degree of control the third night indicated that substantial reinfestation had occurred.

The ULV aerial spray of malathion produced excellent control of adult mosquitoes as long as 4 days after application (Table 3), but dipping counts indicated that the reduction of larvae after 1 day was only 37 percent. The adult reinfestation that occurred after 4 days could thus have resulted because new adults were emerging within the treated area and/or because adults were migrating from adjacent untreated areas. Travis (1949) demonstrated that in Alaska plots of 24 to 30 square miles treated already with DDT had to be retreated every 7 to 10 days to control adult mosquitoes. The earlier reinfestation in the present test may therefore reflect emergence of new adults from pupae after the treatment

TABLE 1.—Comparison of DDT and malathion as nonthermal aerosols against caged females of *C. alaskaensis*.

Insecticide	Percent mortality after 18 hours at indicated concentration[1]					LC_{90} (%)
	1	2	4	8	16	
DDT	..	..	24	55	92	15
Malathion	78	86	98	..	..	2.1

[1] Average mortality at exposure distances of 150 and 300 feet; average check mortality was 12 percent.

TABLE 2.—Control of natural populations of adult mosquitoes (predominantly *Aedes* sp.) with nonthermal aerosols of malathion.

Percent (v/v) malathion	Pretreatment count (mosq./man/one-half min.)	Percent control [1]			
		Night			
		1	2	3	Average
8	10	64	88	44	65
12	8	76	84	89	83

[1] Computed by Abbott's formula.

TABLE 3.—Control of natural populations of adult mosquitoes (predominantly *Aedes* sp.) with ULV aerial spraying of malathion.

Pretreatment count (mosq./man/one-half min.)	Percent control at indicated interval after spraying [1]					
	Hours	Days				
	6	1	2	3	4	6
33	91	95	96	94	82	55

[1] Computed by Abbott's formula.

with malathion and the poor control of larvae obtained with this compound.

SUMMARY. Malathion was evaluated as a nonthermal aerosol applied from equipment mounted on a truck and as an ultra-low volume (ULV) aerial spray against adult mosquitoes at Eielson Air Force Base, Alaska. As a nonthermal aerosol, malathion was seven times more effective than DDT against caged *Culiseta alaskaensis* (Ludlow) and also gave satisfactory control of natural infestations of adult mosquitoes (predominantly *Aedes* sp.). ULV aerial spraying at 3.14 ounces per acre of technical malathion gave over 80 percent control of natural populations of adult mosquitoes (predominantly *Aedes* sp.) for 4 days.

ACKNOWLEDGMENT. The authors acknowledge the assistance of Mr. R. W. Probert, Foreman, Sanitation Services Section, and A1/c T. L. Stevens, Sanitation Services Section, Eielson Air Force Base, Alaska.

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