LOW VOLUME AERIAL SPRAYING OF MALATHION FOR CONTROL OF ADULT SALT-MARSH MOSQUITOES[1]

B. MICHAEL GLANCEY,[2] C. S. LOFGREN,[2] JACK SALMELA,[3] AND A. NELSON DAVIS[4]
Entomology Research Division, Agr. Res. Serv., U.S.D.A., Gainesville, Fla.

Aerial applications of insecticidal sprays have been used extensively to control adult mosquitoes. One of the problems associated with this method of application is the high operating costs caused by the low payload capacities of the airplanes.

During 1962 a revolutionary development in aerial application of pesticides took place. In field tests, conducted by the Plant Pest Control Division, Agr. Res. Serv., U.S.D.A., against rangeland grasshoppers, oil solutions of chlorinated hydrocarbon insecticides applied at volumes as low as 1 pint per acre produced promising results (Messenger, 1963). For these and subsequent tests, Messenger and coworkers used two types of nozzles. One type was the standard flat spray nozzle and the other a specially designed miniature rotary atomizer developed by Albert Higgins, a Plant Pest Control Division equipment specialist. These "Mini-Spin" nozzles (Fig. 1) are screen-sided cylinders fitted with propeller blades (which cause the cylinders to spin when the airplane is in flight) installed on a standard boom. The flow of insecticide to each nozzle is controlled by a standard check valve. A fine screen inside the check valve prevents clogging. The mesh of the screen wall of the cylinder and the speed of spinning control the droplet size. The speed of spinning can be controlled by adjusting the pitch of the propeller blades.

In 1963 tests with undiluted technical malathion against grasshoppers (Skoog *et al.*, in press) were so successful that the standard treatment of applying chlorinated hydrocarbon insecticides in oil at the rate of 1 gallon per acre was discontinued in favor of applying undiluted malathion at the rate of 8 fluid ounces per acre. Since that time additional tests have been conducted on boll weevils, *Anthonomus grandis* Boheman, cereal leaf beetles, *Oulema melanopa* (L.), and beet leafhoppers, *Circulifer tenellus* (Baker). In all tests, results were outstanding (Messenger 1964).

In the late summer and fall of 1964, we initiated field tests to evaluate the use of low-volume aerial sprays of undiluted technical malathion for the control of adult salt-marsh mosquitoes *Aedes taeniorhynchus* (Wiedemann), and *A. sollicitans* (Walker). We conducted these tests near Shiloh in Brevard County, Florida, and on several of the Florida Keys. We obtained four of the atomizers or "spinner" nozzles

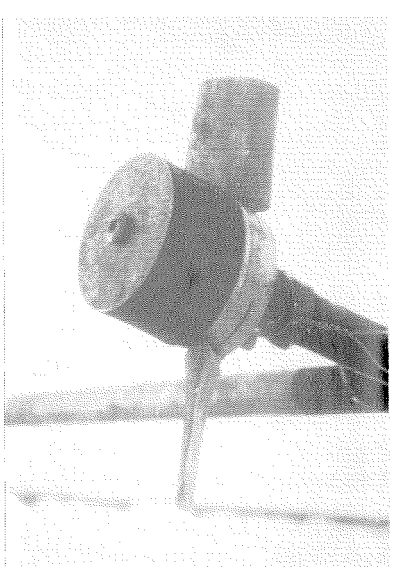

FIG. 1.—U.S.D.A. "Spinner" nozzle attached to the boom of a Stearman aircraft.

[1] The writers acknowledge the assistance of T. Hester and K. Savage of this Division; Robert Lee, Brevard Mosquito Control District; and John O'Neil, American Cyanamid Company.

[2] Entomology Research Division, Agr. Res. Serv., U.S.D.A.

[3] Director, Brevard Mosquito Control District.

[4] Director, Monroe Mosquito Control District.

from the Plant Pest Control Division and mounted the nozzles on a Stearman® (PT-17)[5] airplane belonging to the Brevard Mosquito Control District. Application rates were controlled by the number of nozzles, their orifice size, and the boom pressure.

In the first series of tests conducted near Shiloh, the plane delivered 4 fluid ounces per acre on 50-acre test plots established in citrus groves. The plane flew at 80 m.p.h. with a 100-foot swath. During flight two nozzles stopped functioning. Subsequent inspection showed they had become plugged. Although we could not determine how much malathion was actually applied, posttreatment counts showed reductions of 44 percent after 6 hours and 75 percent after 24 hours.

The following day, we cleaned the plane's spray tank and attached a new boom to the plane. We also installed a screen filter in the boom in an effort to eliminate plugging of the nozzles, and calibrated the equipment to deliver 5 fluid ounces per acre. Again we set up test plots in citrus groves and took pretreatment landing counts of mosquitoes. The plane's speed and swath width were the same as those in the first test. At 6 hours after application, landing counts showed an 85 percent reduction of mosquitoes; however, on the following day high winds dispersed the mosquito population and prevented counts at 24 hours.

During the first week in November, we conducted further tests on the Florida Keys using the same plane, calibrated to deliver 2, 4, or 9.6 fluid ounces per acre. We set up test plots of 400 to 750 acres on Long Key, Duck Key, Little Duck Key, Conch Key, Big Pine Key, and West Summerland Key. The vegetation on the test plots consisted primarily of low-growing palmetto and scrub oak with a scattering of tall pine trees. Mosquito counting stations were located in spots where the vegetation varied from dense to light. The tests were conducted between 6:30 and 11 a.m. in wind speeds of 10 to 14 m.p.h. and air temperatures of 72° to 82° F, with three replications of each concentration. We counted the numbers of mosquitoes landing before and at 6 and 24 hours after treatment. Results of these tests are presented in table 1.

Six hours after application, mosquito control was 61 per cent with the 2-ounce, 50 percent with the 4-ounce, and 94 percent with the 9.6-ounce per acre dosages. After 24 hours, control had increased with all three dosage rates to 91 percent, 94 percent, and 99.9 percent, respectively. There was less vegetation on the plots treated at the 2-ounce rate than at the 4-ounce, which was probably responsible for the better control obtained with the lower dosage of insecticide after 6 hours. The increase in kill observed between the 6th and 24th hour contrasts with the results usually obtained by using water or fuel oil sprays of malathion against mosquitoes. With these treatments, the greatest control is noted about 6 hours after treatment.

In these tests we took no landing counts beyond 24 hours. However, the data obtained so far suggest that with this method

TABLE 1.—Control of adult salt-marsh mosquitoes with low-volume applications of undiluted technical malathion from a Stearman airplane equipped with U.S.D.A.-designed "spinner" nozzles. *Aedes taeniorhynchus* predominating; plane speed 80 m.p.h.; 100-foot swaths, 50–75 feet altitude.

Application rate (oz./acre)	Pre-treatment count (Avg./man./min.)	Percent reduction after—	
		6 hours	24 hours
2	23	61	91
4	32	50	94
9.6	31	94	99.9

[5] Mention of a trade name does not necessarily imply endorsement of this product by the U.S.D.A.

of application residual control may extend to several days. This possibility will be evaluated in future tests.

As with any mechanical system, persons attempting to use this method of application are bound to encounter certain problems. Because of the small orifices, the nozzles likely will become plugged. Any residues inside the tank, pump or booms will be loosened by the undiluted malathion and possibly by certain other insecticides used in their undiluted form. We overcame the problem of clogged nozzles by constructing a new boom and installing a special screen between the pump and the boom. Because some of the insecticides presently being used are corrosive, we recommend that booms be made of aluminum or possibly plastic. One other modification we recommend is that the insecticide be recycled through the pump rather than returned to the tank. The Plant Pest Control Division tests showed that when the malathion was returned to the tank, aerating and foaming occurred.

Should this method of application prove feasible, the area that can be covered by an airplane in a single flight will be limited only by its fuel capacity, not the payload that it can carry.

Literature Cited

ANONYMOUS. 1964. Low volume spraying can cut costs in half. American Aviation, Sept. pp. 34–35.

MESSENGER, KENNETH. 1963. Low volume aerial spraying will be boon to applicator. Agri. Chem. 18(12):63–66.

———, 1964. Low volume aerial spraying. Agri. Chem. 19(9):61–64.

SKOOG, F. E., COWAN, F. T., and MESSENGER, K. Ultra-low volume aerial spraying of dieldrin and malathion for rangeland grasshopper control. J. Econ. Entomol. (In press).

DISTRIBUTION IN ALTITUDE OF MOSQUITOES IN NORTHERN THAILAND

JOHN E. SCANLON[1] AND SAHEM ESAH

U. S. Army Component—SEATO Medical Research Laboratory, Bangkok, Thailand

INTRODUCTION. The land mass of Southeast Asia has a particularly rich mosquito fauna, which has received relatively little attention in recent years. Earlier works by Barraud (1934) and Christophers (1933) were devoted largely to the fauna of the Indian subcontinent, and the work of Borel (1930) in the area then known as French Indochina was not completed due to his untimely death. More recently, excellent studies of the Malaysian mosquitoes have been published by Mattingly (1957 *et seq.*), Macdonald (1957) and others. Of particular significance to the present report is the work by Thurman (1959) on the mosquitoes of Northern Thailand. Many of Thurman's records are from the same mountain area discussed in the present report. Unfortunately, Thurman's studies of the mosquitoes of Northern Thailand have not been completed. Detailed taxonomic or biological studies of the important manbiting genera have not been published, although she did publish lists of the species found in Thailand.

The present study is part of a large scale research program on mosquito-borne diseases begun at the Southeast Asia Treaty Organization (SEATO) Medical Research Laboratory in Bangkok in 1961. Part of this program, a taxonomic and ecological

[1] Present address: Department of Entomology, Walter Reed Army Institute of Research, Washington, D. C. 20012.