UNITED STATES AIR FORCE AERIAL SPRAY ACTIVITIES IN OPERATION COMBAT VEE[1]

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ABSTRACT. From July 8 through August 8, 1971, U.S. Air Force aircraft specially equipped for the dispersal of insecticides battled against the spread of Venezuelan equine encephalitis (VEE) in South Texas. Over 3.5 million acres, total, were sprayed by U.S. Air Force aircraft using the ultra low volume (ULV) technique and two insecticides, malathion and naled (Dibrom), for the control of adult mosquito vectors of VEE.

Early in July 1971 communications from the U.S. Public Health Service (USPHS) and the U.S. Department of Agriculture (USDA) requested assistance from the U.S. Air Force (USAF) in combating an outbreak of Venezuelan equine encephalitis (VEE) in South Texas. On July 6 operations personnel from the Special Aerial Spray Flight (SASF) based at Langley AFB, Virginia, and the Special Operations Forces (SOF) located at Hurlburt Field, Florida, and a SASF medical entomologist met with USDA and USPHS officials in Harlingen, Texas, to discuss the VEE situation. The need for aerial spray efforts to control the spread of VEE in Texas was established. On July 7 SASF was directed by Headquarters USAF to participate in Operation Combat VEE. Two UC–123K Provider aircraft specially equipped for ultra low volume (ULV) insecticide spraying were in place in Brownsville, Texas, in the lower Rio Grande Valley on July 8. Rain delayed the first aerial spray flights until July 11.

The aerial application of insecticide was aimed at the direct control of adult mosquitoes carrying the sleeping sickness virus across the Rio Grande River from Mexico into Texas and at indigenously infected mosquitoes. Target mosquito vectors included some 12 species from which VEE virus was isolated, with *Aedes sollicitans* (Walker), *Psorophora confinnis* (Lynch-Arribálzaga) and *Psorophora discolor* (Coquillett) yielding the greatest number of VEE-like isolates (Sudia and Newhouse, 1971). As designated by USPHS officials, population centers along the Rio Grande within 10 to 30 miles from the international border were the initial spray target areas.

Malathion (95 percent) supplied to the aircraft in bulk tankers was disseminated as a mosquito adulticide at 2.6 fl oz/acre from an altitude of 200 feet for an effective 1,000-foot swath. Aircraft speed was 130 knots (150 mph). Twenty-two TeeJet® nozzles with 8003 flat fan tips were used with a system pressure of 40 psi to achieve the necessary flow rate.

An appropriate flow of insecticide was achieved by an initial calibration and maintained by periodic recalibration. During each calibration run insecticide was sprayed for a 30- or 60-second interval through 6-foot lengths of plastic hose which were attached to each spray boom nozzle and which exited into 13-liter plastic buckets. The amount of chemical delivered was measured using a clear plastic, 1-liter, graduated cylinder, and system pressure was adjusted on subsequent calibration trials to achieve a desired, calculated volume of flow. Clear plastic hose sections used for nozzle attachment allowed viewing of each nozzle orifice and facilitated detection of clogged or leaking nozzles.

The initial two SASF planes were joined between July 12 and 17 by five additional UC–123K aircraft, modified for aerial spraying, from Hurlburt Field, Florida. Each of these aircraft was equipped

[1] Mention of a pesticide or a proprietary product in this paper does not constitute a recommendation or an endorsement of the item by the author or the U.S. Air Force.

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with 14 nozzles with 8004 tips and operated with a spray system pressure of 45 psi. The nozzles on the Hurlburt aircraft were positioned downward at a 45 degree angle into the forward line of thrust of the aircraft as in the SASF arrangement to achieve maximum particle breakup. The deposition droplet spectra of all aircraft were checked by flying each plane with its spray system operating over red oil dye indicator cards. The following conditions were desired, and were obtained, as indicated by tests with silicone-coated slides and dye cards: (1) droplets with a mass median diameter of 30–50 microns; (2) few if any droplets of the 100-micron, or greater, range; (3) droplet coverage at least 10 drops per sq. in. All aircraft dispersal systems were monitored continuously to insure appropriate insecticide flow rates and most effective droplet sizes.

Between the 11th and 20th of July morning missions of approximately 2 hours' duration were accomplished, with each aircraft covering close to 30,000 acres while meteorological conditions were favorable. Increasing wind velocity (considered out of limits over 8 knots) and temperature (upper boundary: 80–85° F) each day limited morning sprays to 2 hours. In addition to frequently unfavorable wind conditions, crew duty day restrictions ruled out late afternoon-early evening flights. While operating out of Brownsville, USAF aircraft sprayed 19,620 gallons of technical malathion over 982,000 acres in Cameron and Hidalgo counties.

Suspected cases of VEE reported north of the Brownsville area prompted relocation of the USAF aerial spray force to Ellington AFB, near Houston, Texas. USDA officials designated a spray target area approaching 3 million acres in size for USAF Combat VEE aircraft. The spray area included Wharton, Fort Bend, Harris, Brazoria, Matagorda, Liberty, Chambers, and Galveston counties which surround the city of Houston. A USDA official was designated as liaison officer between the Combat VEE force and USDA planners in coordinating primary and secondary target area information. USAF information personnel arranged news releases on Combat VEE activities and notified civilian communities through public communications media of upcoming spray missions in their local areas.

From Ellington AFB the two SASF planes disseminated 85 percent naled (Dibrom® 14), another mosquito adulticide, at .75 fl oz/acre. Other aircraft involved in the USAF aerial spray effort around Houston dispersed malathion. These aircraft included the six UC–123K planes from Hurlburt Field, a single UC–123K from USAF Southern Command, Panama, and nine C–47 aircraft deployed from England AFB, Louisiana, to Texas. The C–47's employed a newly developed, short boom (T-bar) spray system which required significant on-site modification prior to becoming operational.

Personnel safety was a foremost concern. The SASF entomologist briefed all crews on the nature of the chemicals being sprayed, symptoms of organophosphate poisoning, and emergency safety procedures. Copies of the SASF Pesticide Information and Safety Pamphlet were distributed. A flight surgeon was available to the Combat VEE task force to handle routine sick call matters and emergencies. Each aircraft was equipped with a medical kit containing items for the treatment of minor skin and eye irritations as well as major pesticide overexposure. Five-gallon capacity, plastic water containers were provided for emergency washdown purposes. Protective equipment provided for personnel included chemical resistant rubber overalls, boots, and gloves and face shields for the insecticide loading crew, surgical rubber gloves for all personnel working on the spray systems, and respirators for flight engineers.

A total of 3,436 gallons of naled were disseminated over 586,287 acres and 40,335 gallons of malathion were applied to 2,016,060 acres by USAF aircraft in the Houston area. In this region as also in the majority of areas covered in the lower Rio Grande Valley significant reduction of most adult mosquito populations was

achieved. Landing rate counts indicated 94 percent to 98 percent or better control in most spray target areas. An exception occurred near Brownsville where coastal wind conditions were less favorable for aircraft spraying and rapid mosquito reinfestations were encountered.

In view of the excellent initial adult mosquito kills, limited and isolated larval reinfestation areas, and increasing civilian aerial spraying involvement an anticipated second treatment of the target area by USAF aircraft was not made. During this South Texas campaign 3,584,347 acres were sprayed by USAF aircraft. A total of 59,955 gallons of malathion and 3,436 gallons of naled were disseminated. It is felt that aerial mosquito adulticiding combined with equine vaccination and quarantine programs did much to control the spread of VEE during the summer of 1971.

Literature Cited

Sudia, W. D. and Newhouse, V. F. 1971. Venezuelan equine encephalitis in Texas, 1971 Information Report. Mosq. News 31(3):350–351.

ULTRA LOW VOLUME TESTS OF SBP-1382 APPLIED BY GROUND EQUIPMENT FOR THE CONTROL OF ADULT MOSQUITOES

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The authors previously reported on the use of ULV malathion by ground equipment for the control of adult *Aedes taeniorhynchus* and *Culex nigripalpus* (Rathburn and Boike, 1972a). This research showed that *C. nigripalpus* required approximately twice the dosage necessary to give satisfactory kill of *A. taeniorhynchus*. Because of the high dosage of malathion required and the importance of *C. nigripalpus* as a vector of St. Louis encephalitis in Florida, other suitable insecticides were investigated for possible use against this species. Laboratory tests (Rathburn and Boike, 1972b) showed that SBP-1382,[1] a synthetic pyrethrin, was highly toxic to *C. nigripalpus*. The following tests were made to establish effective field dosages of this insecticide applied at ultra low volume by ground equipment.

[1] (5-benzyl-3-furyl) methyl 2,2-dimethyl-3-(2 methylpropenyl) cyclopropanecarboxylate. S. B. Penick and Company, New York, New York.

METHODS. All tests were made in the early evening hours after sunset. The temperatures at 6 feet ranged from 69 to 85° F and averaged 78° F. The wind velocities at 6 feet ranged from 1 to 11 miles per hour (mph) and averaged 6 mph. The test plot was in a fairly open beach residential area with a few houses and large pine trees but with sparse ground vegetation.

Four cages of mosquitoes, two of *A. taeniorhynchus* and two of *C. nigripalpus*, each containing 25 females, were attached to a metal pole. One cage of each species was hung at 6 feet and another at 2 feet above ground. The poles with the cages of mosquitoes attached were placed at 165 and 330 feet downwind and perpendicular to the line of travel of the first swath of the aerosol generator. The second and third swaths were applied at one and two blocks (300 and 600 feet) upwind of the first swath. Each test or replicate con-