cause the mosquito population to be reduced or altered. It should be noted that only 16 percent of the anopheline mosquito larvae collection in the baldcypress plantations were *A. quadrimaculatus,* and 98 percent of the culicine mosquitoes were the cool water breeding *Culex territans* which are not known to feed on man or other warm-blooded animals. Even though some mosquitoes may be produced in tree plantations, the population is expected to be less than in herbaceous shoreline vegetation. This simple, and potentially economical, biological mosquito control method would eliminate the need for costly, repetitive shoreline maintenance measures and application of larvicides year after year.

CONCLUSIONS. From this study, based on extensive sampling for anopheline mosquito larvae, it is concluded that mosquito production in these special tree plantations is less than in open vegetated shorelines where repetitive maintenance and control measures have been necessary. Special plantings such as these may provide satisfactory biological, long-range, economical mosquito control for certain types of reservoir shorelines.

References Cited

BREELAND, S. G., and PICKARD, EUGENE. 1967. Field observations on twenty-eight broods of floodwater mosquitoes resulting from controlled floodings of a natural habitat in the Tennessee Valley. Mosq. News 27(3):343–358.

HINMAN, E. HAROLD, and HURLBUT, HERBERT S. 1940. The relation of shade to *Anopheles quadrimaculatus* breeding—a preliminary report. J. Parasit. 26(2):145–156.

LOW VOLUME FOG AND MIST FOR GROUND USE

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The Jefferson County Mosquito Control District started developing ground equipment for low-volume application of insecticides in 1966. Since the District had no trucks with a capacity greater than one ton, we were limited to a maximum load of 200 gallons of fog oil, and would be forced either to purchase larger trucks, or to fog less than three hours. A series of tests with Leco 120 fog applicator indicated that the amount of insecticide per acre was more important than gallons per hour of solution.

Excellent results were obtained at 30 gallons per hour. Tests at 20 gallons per hour showed that it was possible to get a fairly good kill close to the vehicle but not at several hundred feet. Field studies showed that the fog was rising from the ground, even during cool evenings, indicating small-sized particles. Attempts to lower the heat proved unsuccessful. The burner would not stay lighted at the low pressure needed to secure a low temperature. Original equipment in the fogger was a 4.5 gallon per hour burner tip. The tip was replaced with one having a capacity of 2.0 gallons per hour. The small flame provided by the new tip allowed a reduction of the temperature in the fogging chamber. The temperature was controllable at between 550 and 650 degrees. The fog generated by the lower temperature remained close to the ground.

It is our opinion that the commonly used. dilute fog formulations are based on the fact that DDT is soluble to approximately 5 percent in diesel fuel oil. This was the earliest DDT solution used by us about 1946. Field tests with the

modified equipment indicate that applications as low as 10 gallons an hour at a forward speed of 15 miles an hour will provide 100 percent mortality, under average conditions, at a distance of 600 feet or greater. Complete mortality has been observed at 1,000 feet.

A factor in the production of low-volume fog is the temperature of the air at the mixing point, i.e., the point at which the insecticide formulation is mixed with the stream of heated air. In the Leco this temperature is indicated by the thermocouple immediately up-stream from the solution-air mixing device. Temperature can be controlled to obtain the particle size most desirable for the operation. Very minor changes in temperature result in noticable changes in particle size. The air flow through the burner assembly is designed for a combustion rate using 4.5 gallons gasoline per hour. Combustion can be maintained to about 2.0 gallons per hour without reducing the amount of air. For efficient operations at low temperatures the air flow must be reduced. Too much air will extinguish the burner flame.

Tests by the District with caged *Culex quinquefasciatus,* using an uncut hay field as a testing ground, indicate that 100 percent mortalities can be obtained at 1,000 feet from the line of fog application. The District's foggers operated at approximately 13 gallons per hour and a forward speed of 15 miles an hour. Consistent results of 100 percent mortality are experienced with cages 600 feet from the line of application. Data in Table 1 give an indication of the economics of low volume fog operations. Insecticides and man power are not included.

Cages of 35 female *Culex quinquefasciatus* (Say) were placed approximately 3 feet off the ground on stakes. Distances were 400′, 500′, 600′ and in some cases 800′ and 1,000′ from the line of application. Tests were conducted after sunset. The time, temperature, wind velocity and relative humidity were recorded for each test. The mortality in each cage was checked about 1 hour after treatment. The mosquitoes were transferred to clean cages, fed and watered. Control cages were handled the same as the treated cages. The final count was made approximately 12 hours after treatment.

Field test cages were constructed of galvanized, 16-mesh screen with disposable stockinet for a top. Cages were cleaned after each use by being heated to a red heat with an acetylene torch. Clean cages were placed in new, 1-quart liquor paper bags and the bags sealed until needed. Cages containing adults were carried, each in its own bag, and returned to its own bag after field treatment. All bags were destroyed after each test. The mosquitoes used in the tests were collected as larvae and pupae from roadside ditches and reared in porcelain pans in the laboratory. The larvae were fed powdered dog biscuits. The adults were fed fluid from moistened raisins.

TABLE 1.—Comparison of data on high volume and low volume fogs.

High Volume Fog	Low Volume Fog
80 gal./hour	10 gal./hour
240 gal. in 3 hours	30 gal. in 3 hours
Diesel Oil @ 10¢=$24.00	Diesel Oil @ 10¢=$3.00
1200 series I.H. Truck	I.H. Scout
50 miles/night	50 miles/night
@ 12.8¢/mile=$6.40	@ 8.3¢/mile=$4.15
(Cost of Truck=$2,844.00)	(Cost of Scout=$2,132.00)
Cost per night for Vehicle and Fog Oil only	
$30.40	$7.15
A Difference of $23.25 per Truck per night	

Excellent results have been obtained with several insecticides at rates less than recommended by the manufacturer. An example is presented: The test was on August 14, rate of application was 0.0045 lb. Dibrom per acre, air entering the fog generating chamber was at 650° F., the wind speed was 5 to 8 miles an hour, relative humidity was 75 percent, air temperature 86°, and the unit was moving at 15 m.p.h. Mortality was 100 percent at 400 feet, 97 percent at 500 feet and 100 percent at 600 feet from the line of application of the fog.

It is the policy of this District to use insecticides at different rates per acre depending upon ambient temperatures. A "1 X" rate is used during the summer, when temperatures are in excess of 75° F. from sunset until midnight. A "2 X" rate is used in the temperature range at 70–75°. A "3 X" rate is used when it is "cool," 68–72° F. A "4 X" rate is used when "chilly," 65–70° F. The "5 X" rate is used when "cold," below 65° F.

During the developmental work with low-volume fogging, literature investigations also provided information relative to cold fog and mist applicators. After discontinuing the work with B.H.C., the District had a considerable stock of Buffalo Turbine parts available. A machine using the Buffalo Turbine axial flow blower to provide an aid blast to direct the atomized spray was designed. A solution pressure pump, a small air compressor and the Buffalo Turbine were arranged so that all could be driven by a single 9-½ hp. B & S Engine. A series of controls was designed to regulate the flow of compressed air and solution into an atomizing nozzle. An atomizing drying-nozzle, manufactured by Delavan, was used in the mist applicator. The "Mister" is capable of producing 100 percent mortality at distances up to 1,000 feet at manufacturer's recommended rates for U.L.V. application by aircraft.

The particle size would probably cause the fog to be classified as an "aerosol," as defined by Brown in AMCA Bulletin 2, Revised. Observations of the behavior of the insecticide cloud under field conditions indicate that the cloud settles at a very slow rate. Tests show the cloud to be insecticidally active 2 feet above ground level at a distance of at least 1,000 feet from the point of liberation. It seems probable that the particle size is less than 50 microns, possibly about 20 microns. The test area was the same uncut hay field mentioned above. The rate of application was that recommended for ultra low-volume application from airplanes for the different chemicals used. The dosage rate is calculated for a 600-foot swath with a forward speed of 15 m.p.h. As an example: on July 16th, the wind was 8 m.p.h., relative humidity 68 percent, temperature 85° F. Mortality was 100 percent at 400 feet, 500 feet and 600 feet using Dibrom at the rate of 0.025 lb. per acre with the District's "Mister." Complete mortality has been observed at 1,000 feet. Other insecticides have been found effective at the manufacturer's prescribed rates. Under local operating conditions, 30 miles of roadside coverage of an evening required approximately 5 gallons of solution. The District field tested the "Mister" during 1968. There will be three such units in operation in 1969, in competition with the foggers.

There are two critical areas of operation: First, accurate control of rates of flow; and, second, constant flow of materials. "Conoflow" produces a series of pressure regulators that will control line pressures to less than a 1 percent error. Equally important, the regulators will "reset" to less than 1 percent error. In an early model "Mister," without adequate controls, we found it necessary to readjust the pressure control each time the misting operation was interrupted.

Brooks Flow Meters provide the final control of the rate of application. The flow meters installed on our "Misters" are calibrated so that each full division of the scale indicates 1/180 gallon per hour. Each division is subdivided into ten parts. The

supply of solution and air must be delivered within the up-stream and down-stream limits of the regulating devices. Quincy Compressors equipped with automatic unloading and low oil pressure cut-off have proved satisfactory.

Viking pumps designed to move liquefied petroleum gases have proved satisfactory. Standard pumps are available in ratings down to 2–3 gallons per hour.

CONCLUSIONS. Sufficient data have been assembled to indicate that low-volume application of insecticides by ground equipment is practicable. The rate of application of insecticides is essentially that recommended for U.L.V. application by airplane. The most effective rate of application of insecticide should be determined at a local level for the different existing habitats.

A MOSQUITO CONTROL DISTRICT'S PUBLIC INFORMATION AND EDUCATION PROGRAM

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There is a crying need for better public understanding of mosquito control work. This presents an especially acute problem to the individual Mosquito Control Districts. For it is upon the basis of public understanding that the Mosquito Control District is *founded, funded,* and *supported.*

Experience has shown time and again that public opinion, informed or otherwise, is often served regardless of true public interest. Public opinion does not depend on accurate or true information. And in the absence of facts, misinformation can form public opinion. Accordingly it is crucial that the Mosquito Control District inform its public by providing accurate information through a planned educational program. And if we do not, it is likely that no one else will. And who can better supply this information than the Mosquito Control District? After all, we know or ought to know more about mosquitoes and mosquito control than anyone else.

The remainder of this paper will be devoted to discussing ways of communicating with the public and specifics of how the Jefferson Parish (Louisiana) Mosquito Control District does this.

A good starting point is to create a good public image through your routine workday operations. Important factors in this regard are: (1) a clean, neat office and headquarters; (2) an efficient office, including the courteous answering of the telephone, welcoming visitors at office, and even the receipt of deliveries of supplies and materials; (3) cleancut, courteous, well-informed, uniformed employees; and (4) clean, safe, well-marked equipment and vehicles.

In order to carry out an effective public information and education program one must have a systematic approach. And there must be an overall plan. This plan should be comprehensive, reaching everyone—that is, every individual from 4 or 5 years old on up, and every segment of the population, as well, to include all special interest groups.

Obviously a broad, comprehensive plan cannot be implemented all at once. I hasten to point out that Mosquito Control Districts are formed to control mosquitoes. And they are held accountable by the voters and taxpayers of their District for the control results which they achieve. All of the other operations which every Mos-