

Finally, the studies demonstrated that with average conditions of temperature and humidity, the mosquitoes made a predominantly upwind flight to the baited traps, regardless of the wind direction.

Heavy rain, high winds, or low temperature curbed activity, and a drop in temperature below 56° F reduced activity markedly. However, some activity was still evident on cool nights. For instance, on March 31, 1971, NNW winds produced temperatures of 58, 55.5 and 54.0° F at 1900, 2000, and 2100 hours, respectively, and the overnight low was 36° F. Still, 27 *C. salinarius* and one *A. crucians* were trapped. Also, there was evidence that the distribution of the catch in the ramp-traps showed some variability and slightly less correlation with wind direction when the plexiglass trap was used. With the wood trap, the distribution showed more

directed upwind flight toward the carbon dioxide source. Although not conclusive, the results indicate that factors other than olfaction may be used by mosquitoes to detect the plexiglass trap emitting carbon dioxide.

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OBSERVATIONS OF GROUND ULV APPLICATIONS IN CHATHAM COUNTY, GEORGIA

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Recent studies of mosquito adulticiding indicate that ground ultra low volume (ULV) cold aerosol applications have great promise. Mount *et al.*, (1970) obtained higher kills with ULV than with conventional high volume thermal aerosols using malathion as a toxicant. Certain nontoxic advantages make this concept even more desirable and subject for consideration. Lower cost, less traffic hazard, and less environmental contamination, which the machines contribute (Taylor and Schoof, 1971), are of vital concern to those involved in mosquito control.

The success of earlier tests led the Chatham County Mosquito Control Commission to evaluate ULV cold aerosols for use

in its program. The Commission has a continuing adult salt-marsh mosquito problem due to man-made breeding sites which permit only limited source reduction. Adulticiding applications are a very necessary part of the mosquito control program in areas affected by these salt-marsh mosquitoes. The availability of a tested production model ULV aerosol generator, coupled with the labeling of malathion for use in ground ULV work by the Environmental Protection Agency, encouraged the Commission to make final plans for ground ULV usage in 1971.

METHODS AND MATERIALS. The Chatham County Mosquito Control Commission, since its inception in 1957, has used thermal aerosol generators, employing

recommended materials and procedures, as its primary adult mosquito control. In 1970, the Commission had six, 4-wheel drive, 1-ton trucks equipped with propane fueled, Todd Insecticide Fog Applicator (TIFA), thermal aerosol generators capable of dispensing up to 80 g.p.h. of formulated insecticides with a truck speed of 10 m.p.h. The malathion formulation with an assumed 300-foot effective swath delivered approximately 0.10 pound of actual insecticide per acre. Although some thermal aerosol generators were old models, they were all inspected and given needed repairs during the winter months and were in top operating condition at the beginning of each mosquito season.

The Commission replaced four of its six trucks with nonthermal aerosol generators in 1971. Five new, compact, one-quarter ton, 4-wheel drive vehicles equipped with Lowndes Engineering Company's (LECO) H. D. Model, ULV, nonthermal aerosol generators were purchased and placed into service for the 1971 mosquito season. The five units were calibrated and operated to conform to the malathion label for ground ULV applications. The discharge rate of 90 ml/min. of 95 percent malathion at 10 m.p.h. vehicle speed delivered 0.05 pound of actual insecticide per acre with an assumed 300-foot swath. The results of the particle size determinations for the five ULV generators indicated that there was very little difference in their performance. The machines were randomly checked every 50 operational hours during the mosquito season for change in particle size, but none was detected. See Table 2. The temperature was monitored and a change in the flowmeter setting executed with every 2° F change. This differed from the Leco manufacturer's suggestion of 5° F change.

A chart was drawn and placed on the instrument panel in the cab of each truck that showed correct flowmeter settings for temperature changes from 60°-101° F. It was necessary to make several flowmeter adjustments at the beginning of each run, but after a short period of

time, the temperature stabilized at approximately 90° F, regardless of the ambient air temperature, and no further adjustments were necessary.

The Commission has Chatham County divided into 37 areas for adulticiding purposes. For comparison of fogging in 1970 with ULV treatment in 1971, 6 of these areas were chosen. The choice was based on a high incidence of adult salt-marsh mosquitoes, *Aedes sollicitans* (Walker) and *Aedes taeniorhynchus* (Wiedemann), high frequency of treatment both years, and the treatment areas' close proximity to the breeding sites. The 6 treatment areas are on Whitmarsh (2), Wilmington (2), Talahi (1), and Tybee (1) Islands, all of which are located in the eastern coastal area of Chatham County. The islands can be divided into two types based upon the accessibility of ground area. One is a high access area; subdivisions and city streets, which is treated in a grid pattern and almost all ground surface is within range of a 300-foot swath width. Second is the limited access area; suburban driveways and rural roads. The second area contains a large amount of ground surface located beyond reach of a 300-foot swath width.

Both thermal and nonthermal aerosol generators were driven at 10 m.p.h. during applications. Whenever possible wind drift was allowed to carry the insecticide downwind from the direction of travel. Thus the driver could avoid driving back through the insecticide aerosol. Driveways were treated only upon exiting, for safety reasons. Insecticide dispersal switches were turned to the off position whenever the vehicles stopped.

The Commission, as a guide to determine the success in combating mosquitoes, uses three means of measuring the adult female mosquito population. First is the number of complaints recorded from the public over a specified period of time. Second is the landing rate count made by an inspector who goes to specific sites, chosen by an entomologist, and counts the number of mosquitoes landing on his

TABLE 1.—Based on average of all slides including those for preliminary calibration as well as those for random 50-hour checks.

Unit number	ADD	MMD	MD	5-15 microns	Less than 20 microns	23-27 microns
1	10.4	11.6	25.2	60.3%	91.3%	2.5%
2	10.9	11.3	23.7	56.2%	85.0%	2.1%
3	11.9	13.4	23.4	69.5%	88.7%	2.3%
4	11.1	12.0	27.0	65.8%	95.7%	3.7%
5	11.2	10.2	26.5	63.4%	94.5%	2.8%

person within the second 60-second interval. Third is the standard New Jersey light trap, operated and examined twice weekly.

As a comparison, the landing rate data and the number of complaints on the day of treatment of the area compared with the day after treatment, were used. The light trap data were used to formulate a base line to determine, with the least amount of bias, the number of adult female mosquitoes in the area. Judged by light trap collections, there was an increase of 84.4 percent in adult female mosquitoes in 1971 over 1970. Using the complaints and landing rate data; only a 5.6 percent total increase in annoyance level was recorded in 1971 over 1970. The Commission evaluated this as a very marginal and tolerable percent increase, especially since the seasonal rainfall (April-October) for 1971 was 6.0 inches more than recorded in 1970 by the United States Weather Bureau. See Table 2.

The operating comparisons were favorable to ULV. The operating costs for

thermal aerosols (machines and vehicles) in 1970 were 15.6 cents per acre. The ULV nonthermal aerosols (machines and vehicles) in 1971 cost 4.1 cents per acre to operate, thus realizing a 73.7 percent per acre savings. Fewer repairs had to be made in 1971, and fewer truck nights were lost due to inoperative vehicles or machines. The cost per acre being considerably lower allowed for more frequent applications to suppress heavy mosquito populations.

The ULV nonthermal aerosol generators mounted on compact vehicles provided superior accessibility in most areas, offering increased aerosol coverage over the larger and heavier thermal aerosol generator units.

Visibility limitations, inherent in thermal aerosol generators, were completely eliminated by using ULV nonthermal aerosol generators. The thermal aerosols apparently offered a marginal advantage over the ULV nonthermal aerosols in areas having extremely dense ground covers.

TABLE 2.—Season comparisons (April-October) in project area.

Year	Official rainfall	3 traps total Bi-weekly collections	Truck nights	Percent reduction		Operating cost/acre
				L.C.	P.C.	
1970	33.8"	1,145 ♀	101	32.9	64.9	15.6¢
1971	39.8"	2,111 ♀	123	27.8	58.8	4.1¢
1971 % Difference	17.8+	84.4+	21.8+	5.1-	6.1-	73.7-

Explanation: L.C.=Landing Count.
P.C.=Public Complaints.

SUMMARY. The five ULV nonthermal aerosol generators operated by the Commission in 1971 provided adult mosquito control equal to that experienced with thermal aerosols in past years, except in dense ground cover sites, where thermal aerosols offered a marginal advantage. The public acceptance, safety and efficiency of operation, environmental advantages, and cost per acre, however, were markedly superior with applications of ULV nonthermal aerosol generators versus thermal aerosol generators.

ACKNOWLEDGMENTS. The authors gratefully acknowledge the assistance, guid-

ance, and encouragement of the staff at the Technical Development Laboratories, Center for Disease Control, United States Public Health Service, Oatland Island, Savannah, Georgia.

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FIELD APPLICATIONS OF ULTRA LOW VOLUME MALATHION TO THREE ANIMAL SPECIES

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ABSTRACT. Goldfish, mice and quail were exposed to ground applications of ULV malathion. The effects of two rates of malathion exposure on these animals were studied. One rate was according to label recommendations (1.5 fl. oz./min); a second rate was applied at 10 times the recom-

mended level. After 20 separate applications, within a 34-day period, all exposed animals failed to exhibit any detectable neurotoxic symptoms. Tests for red cell cholinesterase inhibition on mice and quail, 24 hours after the last exposure, were all negative.

INTRODUCTION. For over a decade Maryland has been using malathion to control adult mosquitoes. Mist sprays and thermal fogs have been effective with no apparent adverse effects on man, pets, fish and wildlife. Although ground Ultra Low Volume (ULV) aerosols offer advantages over other methods, the application of highly concentrated insecticides has been approached with caution. Despite all precautions, there is a possibility that dosages exceeding recommended rates for adult mosquito control may be applied which could create hazards to fish and wildlife. The purpose of this study was to evaluate the effects of repeated ULV malathion applications on three species of non-target animals.

METHODS AND MATERIALS. Malathion (Cythion® ULV Concentrate 95%) was applied with a truck-mounted Leco Model HD ULV cold aerosol fog generator. A remote control instrument panel was installed in the truck cab. The Leco unit was calibrated before, during and after the study at various operating temperatures.

Test animals were goldfish, white mice and bob-white quail (*Colinus virginianus*). Unsexed 2- to 3-inch goldfish were purchased from a local pet store. Sex-separated white mice and quail were obtained from local sources. Goldfish containers were 1 gallon plastic tanks equipped with aerator-filters. Five fish were placed in each of 12 tanks. Mouse and quail cages