AG-CAT ULV SPRAY SYSTEM DEVELOPMENT, CALIBRATION, AND FIELD TESTS USING NALED

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ABSTRACT. An aerial ULV spray system was developed for use with a Grumman Ag-Cat using Dibrom® 14 (1,2-dibromo-2,2-dichloroethyl dimethyl phosphate). The entire system utilizes a 26 volt electric motor directly coupled to a brass gear pump. The design affords simplified attachment and changeover from the conventional system, an incorporated flushing system, pressure gauges located at the nozzles, disposable insecticide tank, and safety for the pilot from insecticide exposure. The system was calibrated and field tested to determine flow rate, swath width, particle size, and its ability to kill mosquitoes. The system has proven to be a valuable tool in combating *Culex salinarius* (Say) and *Aedes sollicitans* (Walker).

INTRODUCTION

The advent of ULV aerial treatment has brought about a decrease in cost and an increase in effectiveness of mosquito adulticiding. The Douglas DC-3 ULV spray system, developed and calibrated at New Orleans Mosquito Control (NOMC) has proven to be an effective tool for large areas over 4,000 ha (Machado et al. 1969a, Machado et al. 1969b). Using this aircraft for short periods on small areas increases the cost per hectare of treatment considerably.

A single-engine aircraft is desirable for treatment of areas less than 2,000 ha. NOMC equipped a Grumman Ag-Cat with an electrical pump-driven ULV system for use with Dibrom® 14 (naled). After installation, the system was calibrated in accordance with label recommendations. The optimum swath width of the system, its effectiveness and limitations under field conditions were then determined.

SYSTEM DESCRIPTION

The nozzles are located on a small boom on each lower-wing tip. The total number of nozzels can vary using 2, 3, or 4. The pressure gauge is located on one wing tip just forward of the nozzles. The hoses are routed through the wings (inside a plastic tube) to a brass gear pump with a diaphragm by-pass. The insecticide tank is a 57 liter Dibrom can and liner, mounted in the hopper by cargo straps. The tank can be replaced after treatment or refilled from larger Dibrom containers. Also mounted in the hopper is a 23 liter polyethylene can containing isopropanol for flushing the system. The gear pump is driven by a 26 volt electric motor powered by the aircraft's electrical system.

MATERIALS

a) Motor- EEMCO 26 volt, D-709
b) Gear pump- Brass Oberdorfer #4000
c) By-pass valve- Spray Systems type 9840
d) Nylon hose- Synflex® #3130-06, ⅜" i.d.
e) Teejet nozzles- Spray Systems #8001
f) Brass swivel and pipe
g) Tube- Polyethylene- 1" i.d.
h) Insecticide tank- 57 liter (15 gal) Dibrom can and liner
i) Flushing tank- 23 liter (6 gal) polyethylene can
j) Solenoid- 24 volt and wires
k) Plastic clamps- Thomas and Betts Ty-527-M
l) Tank harness- Aircraft cargo type
m) Ball valves- (2)- Hayward ⅜" PVC
n) Tank cradle- Plywood insulated with foam rubber
o) Strainer- Spray Systems "T" type, 100 mesh
p) Pressure gauge- 5.9 cm diam, 0-160 psi, Ashcroft

INSTALLATION AND USE

Changeover from the conventional system is simple, and requires 2 man-hours of work. Once the spray booms and nozzles are mounted on the wing tips, they need never be taken off aside from maintenance. All hoses are permanently mounted through the wing and connected with swivel type couples. The pump is attached by 4 bolts and receives power from the electrical system with one wire. The cost of the entire system is less than $1,000.

The system is adjusted on the ground before takeoff with no in-flight pressure or flowrate adjustments needed. The pilot operates the entire system with an on-off toggle switch.

DETERMINATION OF SWATH WIDTH. An unused road in NOMC area W-20 was selected for swath width determination. Dibrom dye cards (Koundahjian 1965) were numbered and placed on the ground every 3 m for 366 m downwind and 9 m upwind of the flight path. The Ag-Cat was flown at 145 kph, perpendicular to the wind, at an altitude of 7.6 m spraying Dibrom at 1200 ml/min. The droplet-exposed cards were collected after 15 min. Cards with droplet densities of less than 3 spots/cm^2 were considered to be beyond the effective swath.

With wind speeds up to 8 kph, the swath width was 100 m, displaced downwind up to 100 m. With wind speeds above 8 kph, the swath width was very dispersed and difficult to determine.

CALIBRATION OF FLOW RATE. A dosage rate of between 36.5 ml and 73.0 ml/ha (0.5 to 1.0 oz/acre by label) of Dibrom was used for all treatments. It was calculated that a flow rate of 800 ml/min is necessary to produce a dosage rate of 36.5 ml/ha with a 100 m swath width.

The spray system was operated with the Ag-Cat stationary with an engine speed of 2000 rpm. The Dibrom sprayed from each of the two nozzles for 2 min was collected through plastic tubes into buckets and the volume measured. The pressure of the system was adjusted to obtain the desired flow rates (Table 1).

DETERMINATION OF PARTICLE SIZE. Eight spinners (modified from Rathburn 1970) with Teflon® coated slides were placed 15 m apart downwind of the flight path, 1 m above the surface, beginning directly below the flight path.

The Ag-Cat sprayed Dibrom from two #8001 Teejet nozzles mounted at a 45° forward angle, slightly aft of the wing tips, at 800 ml/min and 4.8 atm (70 psi) pressure. The particles were allowed to impinge on the Teflon slides for 15 min. The average number median diameter (NMD) (Yeomans 1949) was 20 μm. Ninety-five percent of the particles were below 80 μm, and 87% below 30 μm.

The procedure was repeated under the same conditions using two #8002 Teejet nozzles. The NMD was 53 μm, with 95% of the particles below 80 μm, and 65% below 30 μm. From the data collected, it was decided that the standard spray configuration for all treatments would be as in Table 1, column a.

Table 1. Calibrated flow rates of Dibrom 14 through an Ag-Cat ULV system.

	a.	b.
Teejet #	(2) #8001	(2) #8002
Pressure	4.8 atm (70 psi)	4.8 atm (70 psi)
Flow Rate	804 ml/min	1495 ml/min
Dosage*	36.5 ml/ha (0.50 oz/acre)	68.6 ml/ha (0.94 oz/acre)
Droplet Size (Number Median Diameter)	20.2 μm	53.4 μm

* at 145 kph with a 100 m swath width and 7.6 m altitude.

KILL TESTS ON CAGED MOSQUITOES

Mosquitoes from natural populations of *Aedes sollicitans* (Walker) and *Culex salinarius* (Say) were placed in screen cages 7 cm in diam by 18 cm long, and kept in ice chests with moistened paper towels.

Eight cages, each containing 10 to 15 female mosquitoes of each species were placed atop 1 m poles in the center of the treatment area. These were placed at 15 m intervals, parallel to the wind direction, starting below the flight path. The treatment area, approximately 125 ha, was treated using the standard Ag-Cat configuration. Cage and spinner placements were on one of two unused cross-roads in a *Spartina patens* marsh. The cages remained in position for 15 min after treatment and were returned to the ice chests until they were examined for mosquito mortality. Controls were employed outside the treatment area, and handled in the same manner as the treated cages. In all cases, 100% of the treated mosquitoes died after 1.5 hr, while only 2% of the control mosquitoes died after 10 hr.

FIELD TESTS ON THE MOSQUITOES OF THE NATURAL POPULATION

A large population of *Ae. sollicitans* and *Cx. salinarius* afforded a good opportunity to test the operational aspects of the system. The population was sampled 1 night pre-treatment, treatment night, and 1 night post-treatment.

The mosquitoes were monitored before and after the treatment using CO_2 enhanced 3 min landing rates, and truck trap collections from a 4.8 km route. All landing rates were taken by two groups of observers, at the same 14 stations, over a 2 hr period starting at sunset. Truck trap collections were made 30 min after sunset.

By using the standard Ag-Cat spray configuration with four #8001 Teejet nozzles (this doubles the dosage rate while keeping the pressure and particle size the same), the 800 ha area was treated 1 hr before sunset.

Based on landing rate and truck trap data from two trials, *Ae. sollicitans* were reduced an average of 71% and *Cx. salinarius* were reduced an average of 88%. The amount of reinfestation which occurred can only be estimated, but due to the small size of the test area, it is believed that some did occur.

CONCLUSIONS

All tests indicate the system works well at 145 kph, 7.6 m altitude, with a 100 m swath width, spraying Technical Grade Dibrom 14 (at label recommendations) from #8001 Teejet nozzles at 4.8 atm. The only operational limitation is wind condition. Wind speeds in excess of 8 kph displace the swath too far downwind. The system, in operation for 3 years, has performed almost flawlessly.

The Ag-Cat spray system is proving to be an effective tool in situations where use of large aircraft is not feasible. With 57 liters of Dibrom 14, it can treat 810 ha in about 1 hr with 73 ml/ha (1 oz/acre). This is very effective against both *Cx. salinarius* and *Ae. sollicitans,* since the system can treat a relatively large infested area in a short time just before the dusk or after the dawn activity period.

Literature Cited

Koundakjian, T. H. 1965. The detection and measurement of Dibrom LV concentrate aerospray droplets. Calif. Chem. Co., Ortho Div., Res. and Devel. Dept., Richmond, Calif. (File no. 721:101):6pp.

Machado, W. C., Blake, A. J., Bordes, E. S. Jr. and Carmichael, G. T. 1969a. Evaluation of a multi-engine aircraft in the ULV application of Dibrom. Mosquito News 29(1):47–52.

Machado, W. C., Bordes, E. S. Jr., Blake, A. J. and Carmichael, G. T. 1969b. A technique for ULV insecticide application from high altitudes. Mosquito News 29(3):353–360.

Rathburn, C. B. 1970. Methods of assessing droplet size of insecticidal sprays and fogs. Mosquito News 30(4):501–513

Yeomans, A. H. 1949. Directions for determining particle size of aerosols and fine sprays. USDA Bur. Entomol. Pl. Quar. ET-267:7pp.