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1268 9

A NEW AEROSOL GENERATOR NOZZLE SYSTEM: ESTIMATES OF DROPLET SIZE AND KILL OF CAGED ADULT MOSQUITOES¹

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ABSTRACT. A new aerosol generator nozzle system (London Aire®) offered for use in mosquito control programs was compared with a standard nozzle system (Leco®). Estimates of droplet size and assays with caged female *Aedes*

taeniorhynchus (Wiedemann) and *Anopheles quadrimaculatus* Say indicated that the new system provided adequate aerosolization of technical malathion.

A new aerosol generator nozzle system, an integral component of a London Aire® Model XW generator (London Fog Co., Crystal Bay, Minnesota), is being offered for use in mosquito control programs. This nozzle is a pneumatic type that requires relatively high air pressures (70-90 psi). It also requires a liquid pressure of at least 12 psi for dispersal of liquid mosquito adulticides. The nozzle system on the Leco® Model HD (Lowndes Engineering Co., Valdosta, GA) was compared with the new system in regard to estimated droplet size and kill of caged adult mosquitoes with technical malathion.

DROPLET SIZE ESTIMATES. The hand wave method of droplet collection used was that reported in detail by Mount and Pierce (1972). Glass microscope slides

coated with silicone (General Electric SC-87 Dri Film®) were used for the droplet collections. Samples of 100 droplets were measured at random on each of three glass slides for each of the applications. Volume distribution of the aerosol droplets and volume median diameters were estimated on the basis of corrected droplet diameters. The spread factor used for diameter corrections (0.5) was determined according to direct measurement method described by Mount and Pierce (1972).

The results (Table 1) indicate that the London Aire nozzle system gave efficient aerosolization of technical malathion. Volume distributions and volume median diameters obtained at 80 and 90 psi were similar to those obtained when the Leco standard was operated at 4 psi. Aerosolization was inadequate ($>17 \mu$ VMD) when the London Aire nozzle was pressurized at 70 psi. Results obtained with the Leco nozzle system were essentially

¹ This paper reflects the results of research only. Mention of a pesticide or a commercial or proprietary product in this paper does not constitute a recommendation or an endorsement of this product by the USDA.

Table 1. Droplet size of ULV ground aerosols of technical malathion dispersed at 4.3 fl. oz. (130 ml)/minute from two nozzle systems.

Air pressure (psi)	No. droplets sampled	Percent of total volume in indicated size range (μ)			VMD (μ)
		<5	5-20	>20	
London Aire Model XW					
70	300	1	49	50	20
80	900	3	68	29	16
90	900	3	77	20	14
Leco Model HD					
4	900	8	61	31	15

the same as those obtained in previous studies (Mount et al. 1975).

CAGED MOSQUITO ASSAYS. The efficacies of aerosols of malathion dispersed by the prototype and standard nozzle systems were determined in 13 paired simulated field tests with caged adult female mosquitoes.

The test site was a pasture near Gainesville, FL, characterized by uneven elevation and a moderate stand of pine. Aerosol applications were made between 0900 and 1000 hr on 5 mornings during April and May of 1975. Air temperatures near ground level ranged from 74 to 77° F and average ca. 75° F. Wind velocities at 5 ft above the ground ranged from 2 to 8 mph and were usually ca. 3 mph.

For the mosquito assays, the London Aire XW nozzle was pressurized at 80 psi and the Leco nozzle was pressurized at 4 psi. Both aerosol generators were operated alternately with the same instrument panel (needle valve, flowmeter, liquid temperature gauge, and liquid flow solenoid valve). The instrument panel was mounted in the cab of the dispersal truck so that each application could be monitored.

The dose of malathion was varied by changing dispersal speeds. The liquid flow rate was maintained at 4.3 fl. oz. (127 ml)/minute, and dispersal speeds were 2.5, 5, and 10 mph.

Adult female *Aedes taeniorhynchus* (Wiedemann) and *Anopheles quadrimaculatus* Say (2 to 5 days old) were

exposed in 16-mesh galvanized screen wire cages (4.5 cm diam. x 15 cm long) containing 25 specimens/cage. A total of 16 cages was suspended 4 ft above the ground on stakes at 150, 300, 450, and 600 ft downwind in 2 rows perpendicular to the line of travel of the generator. Immediately after each application had drifted through the test plot the mosquitoes were blown into plastic holding tubes (4.5 cm diam. x 14 cm long) lined with clean paper. Except during exposure to the aerosols, the cages of mosquitoes were held in insulated chests containing ice and moist cotton. Absorbent cotton pads moistened with 10% (v/v) sugar water solution were placed on the holding tubes as soon as they were returned to the laboratory. Mortality counts were made 24 hr after the mosquitoes were exposed to the aerosols. Four cages of mosquitoes not exposed to the aerosols but handled in an identical manner showed 10 and 15% mortality for *Ae. taeniorhynchus* and *An. quadrimaculatus*, respectively.

Table 2 shows the results of the caged mosquito assays of the aerosols dispersed by the prototype and standard nozzle systems. Fiducial limits obtained by probit analysis of these results indicated no statistically significant differences between the doses of aerosolized malathion estimated to produce 90% mortality (ED_{90}).

DISCUSSION. We should point out that the estimated ED_{90} 's obtained in the study were higher than those that have been obtained previously in similar tests (Mount

Table 2. Comparison of two ULV nozzle systems dispersing aerosols of technical malathion (4.3 fl. oz./min) against caged female mosquitoes during April and May of 1975.

Dose (lb. AI/acre) for indicated swath		Dispersal speed (mph)	Percentage kill of <i>Ae. taeniorhynchus</i> for indicated swath		Percentage kill of <i>An. quadrimaculatus</i> for indicated swath	
300 ft	600 ft		300 ft	600 ft	300 ft	600 ft
London Aire Model XW—80 psi						
0.05	0.025	10	73	52	68	52
.1	.05	5	84	60	80	65
.2	.1	2.5	91	85	100	99
ED ₉₀ ^a	0.16(0.1-0.4)	0.18(0.1-0.4)	0.13(0.1-0.25)	0.09(0.07-0.13)
Leco Model HD—4 psi						
.05	0.25	10	72	56	71	57
.1	.05	5	89	76	82	65
.2	.1	2.5	91	87	100	99
ED ₉₀ ^a	0.14(0.1-0.3)	0.12(0.1-0.2)	0.12(0.1-0.25)	0.1(0.08-0.16)

^a Effective dose estimated by probit analysis to produce 90% kill and fiducial limits at the 95% level of probability.

et al. 1975b). However, both visual observations of aerosol clouds and variations in mortalities of mosquitoes exposed at equal distances suggested poor coverage. The cause may have been the uneven terrain of the experimental plot and its close proximity to heavily wooded areas on three sides. Furthermore, these tests were conducted during morning hours when micrometeorology is usually less favorable than at night.

Our estimates of droplet size showed that the London Aire XW nozzle system pressurized at 80 and 90 psi provided adequate aerosolization of technical malathion. Therefore, we believe that this new nozzle system should be capable of

efficient adult mosquito control when applications of insecticides are made over more favorable terrain and during periods of optimum micrometeorology.

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NOTICE TO CONTRIBUTORS

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