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A NEW ULV HAND APPLICATOR FOR USE IN INSECT VECTOR CONTROL

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MALATHION[2] Low-Volume Concentrate Insecticide (LVC) has been highly successful in the control of adult mosquitoes when applied by aircraft and specialized ground equipment. Motorized knapsack mistblowers are also being employed in adult mosquito control programs using the ULV technique (Buzicky, 1967).

The present method of controlling adult malaria mosquitoes, by residual wall spraying of wettable powder formulations, has been successful in eradicating malaria from many, but not all, countries of the world. However, in recent years the cost of malaria control and eradication programs has increased drastically. Labor, transportation, and overall operational costs are now limiting factors in obtaining eradication of malaria.

The idea of adapting the ULV technique for residual wall spraying inside houses for mosquito control and eradication is recent, but as Lofgren (1970) has stated, the main limiting factor up to now has been the lack of suitable or commercially available equipment for application.

At the Inter-American Malaria Research Symposium, San Salvador, El Salvador, in November, 1971, interest was expressed by the participants in experimenting with the ULV technique for residual wall spraying in malaria eradication.

This paper describes a potential new applicator of LVC insecticides for use in malaria eradication and insect vector control programs.

METHODS AND MATERIALS. At the request of the Cyanamid International Research and Development Department, the Beeco Products Company developed a hand ULV applicator (Figure 1). The prototype Beecomist Applicator has the following specifications: (1) nickel-cadmium rechargeable battery with an average operation time before recharging of 8 hours, (2) 500-cc liquid insecticide capacity, (3) 20,000 RPM electric motor with fan, (4) controllable air flow 0–65 RPM, (5) micrometer needle valve to control flow rate, (6) sintered-metal spray heads (sleeves of 10, 20 and 40 micron pore size).

The air pressure from the fan maintains approximately 2 psi within the 500-cc insecticide tank. The spray heads are 1″ long x 1½″ in diameter. The flow rates were determined for each spray head and needle valve setting, using MALATHION LV Concentrate. The needle valve used to regulate the flow rate is a JN 1 Alkon[3]

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[2] Trademark of American Cyanamid Company for o,o-dimethyl phosphorodithioate of diethyl mercaptosuccinate.

[3] Trademark—Alkon Company.

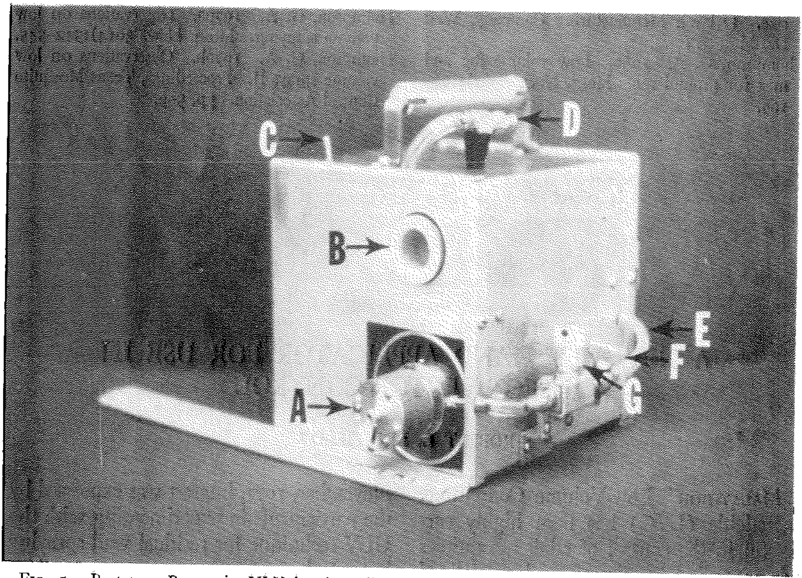

FIG. 1.—Prototype Beecomist ULV hand applicator showing (A) Beecomist spray head; (B) 500-cc insecticide tank; (C) On-off switch; (D) Insecticide tank positive pressure line; (E) Insecticide line; (F) Insecticide stopcock valve and (G) Flow-rate needle valve.

needle valve with vitron seals. There are six turns from shutoff. The orifice sizes in inches, mm and approximate twist drill (wire drill) size for each opening are presented in Table 1.

A 1-gallon glass jar was weighed in grams, and then the jar opening was placed over the spray head. The unit was turned on and the motor allowed to reach operating RPM (about 30 seconds). The stopcock was then opened, and the MALATHION LV Concentrate allowed to accumulate in the jar for 5 minutes. The

TABLE 1.—Needle valve orifice size for each setting including approximate twist drill (wire drill) number.

Needle valve settings	Inches	MM	Approximate drill size #
0	closed	.....	..
1	0.008	0.203	..
2	0.030	0.762	68
3	0.090	2.286	43
4	0.110	2.794	35
5	0.125	3.175	31
6	unseated	.....	..

unit was turned off and the glass jar was again weighed. The difference in weight was the amount of MALATHION LV Concentrate Insecticide in gm/5 minutes (later converted to gm/minute) discharged through the nozzle at the specific needle valve setting. Before each test the jar was rinsed with acetone and allowed to dry.

To convert gm/minute to ml/minute, the gm/minute figure is divided by 1.23, which is the specific gravity (sp. gr.) of MALTHION LV Concentrate.

Oil-sensitive 4″ x 5″ red-dye cards [4] were used to determine the number of droplets per cm^2 (in^2) applied with each spray head and needle valve setting. In each test, two cards were taped on a wall 6 feet from the point of application. The unit was turned on and the fan allowed to reach operating RPM (about 30 seconds) before the stopcock was opened. Application was made for 10 seconds.

In the laboratory, five 1-cm^2 boxes were

[4] Obtained from the Home and Farm Chemical Company, Charlotte, North Carolina.

TABLE 2.—Discharge of MALATHION LV Concentrate Insecticide in Gm/Min, Ml/Min and Fl Oz/Min, using three different Beecomist Spray Heads at six needle valve settings.

Needle valve setting	10μ Sleeve			20μ Sleeve			40μ Sleeve		
	Gm	Ml	Fl oz	Gm	Ml	Fl oz	Gm	Ml	Fl oz
1	0.06	0.05	0.002	0.08	0.07	0.002	0.54	0.44	0.02
2	1.36	1.11	0.04	1.26	1.02	0.03	1.64	1.33	0.05
3	4.92	4.00	0.14	5.46	4.44	0.15	5.60	4.55	0.15
4	6.50	5.29	0.18	8.00	6.50	0.22	7.40	6.02	0.20
5	8.80	7.16	0.24	9.60	7.81	0.26	8.40	6.83	0.23
6	8.00	6.50	0.22	8.00	6.50	0.22	6.40	5.20	0.18

drawn in random places on each card. The number of droplets within each box was counted under a microscope. The average number of droplets per cm² was determined by dividing by 10 the number of droplets counted on both dye cards.

This process was repeated with each spray head and needle valve setting to a total of 36 dye cards.

Ordinary 3″ x 1″ glass slides were coated with silicone (General Electric SC–87 Dri-Film) prior to sampling. The slides were dipped into a solution of 1 part silicone to 9 parts of toluene, allowed to dry, and stored in a tight slide box. Before use, the slides were lightly polished with a soft, lint-free tissue to remove foreign particles.

With the sprayer in operation, the silicone-coated slide was waved once, perpendicularly, through the spray at a distance of 6 feet from the nozzle, and then stored in a tight slide box.

A microscope with mechanical stage and eyepiece micrometer was used to determine the individual droplet sizes. Two hundred droplets were measured, and their size converted into microns using the conversion factor of 2.85μ for each eyepiece division. The spread factor of MALATHION LV Concentrate for silicone-coated slides is 0.5 (Anderson and Schulte, 1971).

The average droplet diameter was determined by dividing by N the sum of the products of D x N, and multiplying by the conversion factor 2.85μ.

The mean mass diameter (MMD) was determined by plotting the accumulative percentages on the X-axis against the eyepiece divisions on the Y-axis, using arithmetic probability paper.

RESULTS AND DISCUSSION. The test results of flow rates, number of droplets per cm² (in²) and droplet size are presented in Tables 2, 3 and 4.

Discharge of MALATHION LV Concentrate through needle valve setting number six was reduced in all tests (Table 2). This is probably due to a turbulence caused by the needle being withdrawn from the flow line.

TABLE 3.—The average number of MALATHION LV Concentrate Insecticide droplets per CM² and In² produced with the Beecomist 10μ, 20μ and 40μ spray heads, using six needle valve settings.

Needle valve setting	Number of droplets per cm²			Number of droplets per in²		
	Sleeve pore size			Sleeve pore size		
	10μ	20μ	40μ	10μ	20μ	40μ
1	1.20	0.20	0.80	7.74	1.29	5.16
2	1.00	1.00	1.80	6.45	6.45	11.61
3	149.40	48.80	12.80	963.93	314.86	82.59
4	214.10	48.40	46.90	1,381.37	312.28	302.60
5	147.10	31.60	29.30	949.09	203.88	189.04
6	114.30	24.80	30.20	737.46	160.00	194.85

TABLE 4.—The droplet size of MALATHION LV Concentrate insecticide produced with the Beecomist 10μ, 20μ and 40μ spray heads, using needle valve settings 3, 4 and 5.

Needle valve setting	10μ sleeve MMD (μ)	10μ sleeve Average diameter (μ)	10μ sleeve Maximum diameter (μ)	20μ sleeve MMD (μ)	20μ sleeve Average diameter (μ)	20μ sleeve Maximum diameter (μ)	40μ sleeve MMD (μ)	40μ sleeve Average diameter (μ)	40μ sleeve Maximum diameter (μ)
3	17	20	66	61	47	97	28	30	88
4	14	17	60	28	31	97	29	30	91
5	14	17	54	27	28	94	26	27	94

In determining the droplet sizes, needle valve settings 3, 4 and 5 were tested because (1) high flow rates were obtained (Table 2), and (2) the number of droplets per cm^2 (in^2) was greater at these settings (Table 3).

The smallest droplet measured using the 10μ sleeve was 6μ, while the smallest droplets with the 20μ and 40μ sleeves measured 11μ.

CONCLUSION. Aside from refining the mechanical operations, the next step is to relate these data to residual efficacy.

The Beecomist ULV hand applicator is being developed primarily as a tool for applying LVC residual insecticides in malaria eradication and control programs. The data presented here are preliminary, but they do indicate that the potential uses of this unit are many, and that it could be adapted for other insect vector control programs.

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THE SUSCEPTIBILITY OF MOSQUITO LARVAE TO INSECTICIDES IN FLORIDA, 1969–1971

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Since 1964 mosquito larvae from different areas of Florida have been tested for their susceptibility to various insecticides in order to determine any possible resistance build-up. Previous papers dealt mainly with two-year comparative results, while this paper covers the period 1969–1971.

METHODS. The methods for mosquito collection, shipments, and larval testing were essentially the same as described by Rathburn and Boike (1967) and Boike and Rathburn (1969). Since water temperature and kind of testing vessel were found to be important factors affecting test results (Rathburn and Boike, 1969),