old 1.5 m by 0.6 m bathtubs containing a volume of 0.3 cubic meters at a depth of 0.3 m. Approximately 500 fish were held in each bathtub for 2 to 3 months without any noticeable amount of mortality. The size range of the fish in the tubs ranged from 2 to 4 cm, with the majority of the fish being about 3 cm long. An air pump, commonly used in home aquariums, supplied oxygen to the fish. One pump, in continuous use, serviced 2 tubs adequately. Commercial fish food was fed to the minnows. During the mosquito breeding season, the fish were fed mosquito larvae, whenever possible, instead of the artificial diet.

A barrier of aquatic weeds, such as watermilfoil (*Ceratophyllum demersum* L.) woven into a plastic rack or lattice-type frame arrangement, was submerged in the water to provide protection from cannibalism and predation. This frame could be easily lifted out of the tub for removal of the fish which were then transferred to 9.5 liter buckets and transported to the field for stocking.

Wood (1976) found that exposure of these fish to daylight increases swimming activity and results in greater oxygen consumption and fish bruising. Since this may have a significant impact on the culture of the mosquito fish, a flat plywood cover was placed over the tops of the tubs. Two 2.5 cm wooden slats were placed, width-wise under the cover to provide an air space. Each cover was left on continuously. This tended to minimize algae production in the water and stopped fish predation by vertebrates such as raccoons. More fish could probably be held in the tubs if they are used within a couple of weeks. Several tubs can be used to obtain quite a large holding population of mosquito fish for stocking purposes.

The technique of using bathtubs as holding tanks was an economical and efficient way to have fish available throughout the year for the suppression of natural mosquito populations.

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DIFFERENCE IN FLOW RATES OF MALATHION USING THREE TYPES OF HOUR METERS COMPARED TO A CONSTANT VOLUME FLOW CONTROL PANEL[1]

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At the present time ULV cold aerosol generators are widely used for ground adulticiding operations. This type of equipment has been shown to be effective against rice field mosquitoes in Arkansas (Mount et al. 1972). Tachometers are used to maintain a constant speed (16 kph), and an hour meter hooked to the on-off switch of the cold aerosol generator records the number of minutes the machine is in operation each night. This number is then divided into the amount of chemical used which gives the rate at which the chemical is dispersed per minute.

A constant volume flow control panel was purchased in order to improve the consistency of our flow rates. The hour meter was retained on the unit to indicate the performance of the C. V. (constant volume) panel. The flow rates calculated using the hour meter were consistently from 14.8 to 44.4 ml/minute lower than the rate the C.V. panel was set to deliver. Thus, a test was conducted to determine the ability of

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3 types of hour meters and the C.V. panel to accurately measure the actual insecticide flow rate during operation.

MATERIALS AND METHODS

A LECO® ULV Model HD cold aerosel generator with LECO's C.V. flow control panel mounted on a short wheel base, flat bed Ford-100 pickup truck was used for the tests. Three types of hour meters were connected to the ULV on-off switch: 1) Hobbs part #15002-3 (our original hour meter), 2) Marine with instant on-off and 3) Hobbs instant on-off #24963-2 hour meter[3]. The rate of insecticide application during our actual adulticiding operations was measured and/or calculated from a 0.5 hr after sunset and continued until the entire spray area was treated or until the temperature dropped below 15.5°C.

When this test was initiated the spray vehicle was calibrated to apply malathion at 118.4 ml/minute, which was within the rates recommended by Rathburn (1977). The calibrations were determined by allowing the chemical to flow into a 200 ml cylinder and emptying it into a 50 ml cylinder that was graduated in tenths of a ml. This chemical was collected and returned to the insecticide tanks at the conclusion of each test. Flow rates for all tests were determined at 0.5 hr intervals by disconnecting the insecticide line from the spray nozzle and allowing the chemical to flow into a graduated cylinder for 1.0 minute. This procedure was replicated 3 times, and the average taken at each time interval. At this time, the readings on all 3 hour meters, the amount of insecticide in the tanks, the calibrated reading on the C.V. flow control panel and the ambient temperature were recorded. To limit variation the same equipment and personnel were used during the entire test.

The data obtained from the study were statistically analyzed as a randomized block design with the number of collection dates as the replication source.

RESULTS AND DISCUSSION

Table 1 shows results of the comparison between the 3 types of hour meters and the actual measured flow rates taken during adulticiding operations. No significant difference (P>0.05) existed between the Hobbs instant on-off #24963-2 and the actual measured rates, which indicated that this type of hour meter would be satisfactory to calibrate flow rates. Both the Marine with instant on-off and the Hobbs part #15002-3 were significantly different (P<0.05), 145.76 and 84.21 ml/min, from the measured flow rates, 115.81 ml/min.

Table 1. Comparison of calculated flow rates from 3 hour meters and a C.V. (constant volume) flow control panel to measured flow rates from a LECO® ULV Model HD cold aerosol generator.

	Hour Meters (ml/min)				
Date	Hobbs (1) #15002-3	Marine (2) instant on-off	Hobbs (3) #24963-2	C.V. Read-outs (ml/min)	Measured Flow Rates (ml/min)
8/20	79.03	160.73	115.74	116.92	116.30
9/5	97.68	140.60	110.11	115.44	114.60
9/9	85.84	144.45	115.44	115.44	114.90
9/13	88.80	134.68	115.44	116.92	116.90
9/16	89.67	141.49	113.37	115.44	115.00
9/21	87.91	134.68	110.41	115.44	115.40
9/28	82.29	144.45	111.30	116.92	116.30
10/2	66.90	139.71	112.48	115.44	114.60
10/11	66.90	161.11	115.74	117.07	116.60
10/12	97.08	155.99	114.85	118.40	117.50
Range	66.90–97.68	134.68–161.11	110.11–115.74	115.44–118.40	114.60–117.50
Mean $\bar{x}$	84.21**	145.76*	113.49^{ns}	116.34^{ns}	115.81

* Significant (P < 0.05).
** Highly significant (P < 0.01).
^{ns} Non-significant (P > 0.05).

[3] Hobbs: Stewart-Warner Co., 1826 Diversey Placeway, Chicago, IL 60614; Marine: Electrical Supplies, 1876 57th St., Sarosota, FL 33580.

There was a difference of ca. 31.6 ml/min between the Hobbs #15002-3 and the measured flow rates. This indicated that when the machine was operating at the recommended rate using flow rates calculated from this hour meter it was actually dispensing 31.6 ml/min more than desired. This increased amount of insecticide would cost approximately $1,147.00 over the entire year. If all spray units had this same situation it would have cost $15,236.00 in a year which was 9.6% of our insecticide budget.

No significant difference ($P>0.05$) existed between the measured flow rates and the C.V. read-outs. Over the entire test there was no difference between their flow rates greater than 0.90 ml/minute, with an average difference of 0.53 ml/minute. When compared to the average differences obtained using the 3 types of hour meters, 1) 31.60, 2) 29.95 and 3) 2.43 ml/minute, the C.V. panel was considerably more efficient.

In conclusion, only the Hobbs instant on-off #24963-2 and the C.V. panel showed no significant differences ($P>0.05$) from the actual flow rates obtained during adulticiding operations. We feel constant volume devices can improve the efficiency and effectiveness of adulticiding operations by producing more consistant flow rates. However, if any mosquito control agency can not afford this type of equipment and is using hour meters to measure flow rates, these devices should be tested to determine which is the most efficient for their needs. In either case, the operation will benefit in savings of time, money and in possible damaging effects to the environment.

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THE USE OF PROGRAMMABLE CALCULATORS FOR THE CALCULATION OF MASS MEDIAN DIAMETER

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In determining the mass median diameter and other parameters for the periodic certification of our ULV machines, the majority of time consumed in the process is in the repetitive math involved in the calculation for each machine. After pursuing several possibilities for a remedy to this problem, it was finally decided that the easiest, least costly, and fastest solution was to use a small programmable calculator. The calculator of our choice was the Radio Shack EC—4000 ($59.95), though other programmables may be used with equal ease after minor changes in the programming format.

While writing the program, it became apparent that several avenues of approach were feasible. The most severe handicap was the limited ability (50 steps) of the calculator. To circumvent this, it was decided to sub-divide the program into three essentially separate sections and to reduce the number of internal steps the calculator would otherwise (as a luxury to the operator) have to perform. The first section would multiply the eyepiece division (D) by the droplet numbers (N) to yield $D \times N$ while simultaneously keeping a cumulative total of N and $D \times N$. The second would yield the percent of total and the accumulated percentage. Since it was felt that some people have difficulty in interpolating the mass median diameter, the third part of the program included this process with as few steps as possible.

The end result of this effort was a program that was quick to enter and easy to use. Once the operator becomes familiar with the process, the program can be entered in a minute or less, and the certification sheet can be run in less than 60% of the time normally required.