MEASURING VISCOUS INSECTICIDES

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The development by the Jefferson County Mosquito Control District of techniques for applying small quantities of insecticides per unit area has demanded improved methods of application, Thompson (1969). The development of better methods of application revealed that a spraying system could be calibrated to deliver a relatively accurate amount of spray in a given period of time. It also revealed that, during intervals of time within that period, the rate of flow of the spray was unknown, Thompson (1970a). Further investigations into the behavior of liquids in motion disclosed interesting facts and laws.

Ford and Furmidge (1969) discuss in detail the formation of spray drops from viscous fluids and Tate (1968) provides information about spray nozzles. Although the two papers do not deal directly with the measurement of insecticides, they provide a wealth of information about fluids in motion, our basic concern.

The variation of viscosity with temperature is most important to insure application of the correct amount of spray. It is possible to increase both the rate of application per acre and the droplet size by simply allowing the temperature of a spray solution to decrease 4 or 5° F, Thompson (1970b).

The need for detailed information that would permit the application of a known amount of insecticide, not only over an area but throughout the area, became apparent while calibrating a fog applicator in the spring of 1971. The desired output from the unit was 480 ml per minute. The solution was 7 parts Cythion made up to 10 parts with a high boiling H. A. N. (Heavy Aromatic Naphtha). A flow meter reading of 7.5 was necessary to secure a delivery of 480 ml per minute when the solution temperature was 65° F. The spray solution temperature increased to 77° F during the period of observations. The flow meter was adjusted to the initial flow reading of 7.5, and the output of spray for one minute was determined. The spray delivered was 520 ml. The same solution, the same pressure, the same equipment, and the same flow meter reading, but an increase of 12° F had changed the output from 480 ml at 65° F to 520 ml at 77° F. The desired 480 ml output at 77° F was obtained at a flow meter reading of 6.9.

At approximately 81° F a surprising phenomenon occurred. With the flow meter set at 6.7, the correct amount, 480 ml per minute, of spray solution was delivered at all temperatures up to 94° F. Above 94° the slope is reestablished.

Investigation of the literature shows that the "plateau" is a normal function of flowing, viscous liquids. Subsequent work indicates that the plateau changes its location in the flow-rate/temperature curve as diluents change the viscosity of the liquid. Therefore, any change in the amount of diluent added to a viscous spray solution, or a change of diluents, will necessitate a recalibration of the spray unit.

Much early spring and late fall work involves spray solution temperatures within the critical range. Sufficient data to allow for the intelligent use of the equipment were accumulated by starting early in the morning and determining flow meter settings for the desired output as the spray solution reached different temperatures during the day. Actually, 3 days were required to calibrate one unit.

A calibrating device has been developed that will determine flow meter settings quickly and simply with any spray solution at any selected temperature. In the event that different model flow meters are involved, the equipment provides for easy interchange of the meters.

The device (Fig. 1) consists of an alu-

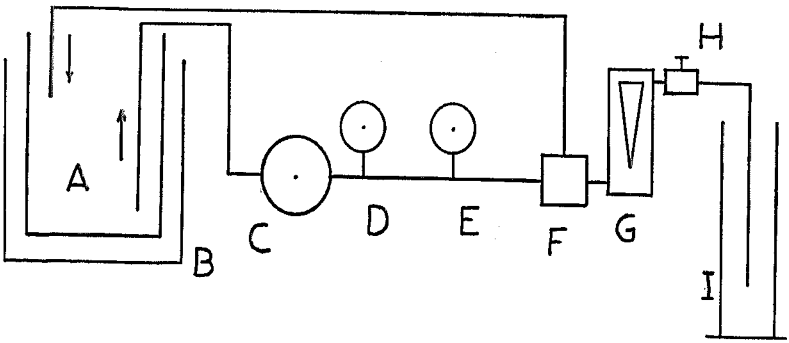

FIG. 1.—Diagram of device for measuring viscous insecticides.

minum spray solution container (A) in a water bath (B), hot or cold as needed. The spray solution travels through a suction line to a suitable pump (C). From the pump the solution travels under moderate pressure to a sensitive pressure gauge (D), and a good thermometer (E).

A pressure control valve (F) is placed next in the line with the relief return going back into container (A). The arrangement will permit the recirculation of solution through the system while the desired temperature is being obtained. Down stream from the pressure control is located a flow meter (G), followed by a shut-off valve (H), a delivery tube and a graduate (I), or other suitable container that will receive the solution to be measured.

An excellent thermometer for use in the device can be obtained at an air conditioning repair shop. The remote bulb is designed to be placed in a pressure line and is supplied with pipe or tubing fittings. The same model thermometer can be installed in a spraying system near the flow meter to monitor the spray solution temperature changes.

The flow meter should be installed in the line with unions or similar fittings so that little difficulty will be experienced changing flow meters to calibrate different models. Flow meters of the same model should not require separate calibration. In the event that the flow meter being used is not supplied with a needle valve, it will be necessary to install a needle valve in the line near the flow meter, preferably between the pressure control (F) and the flow meter (G).

The amount of pressure, within limits, in a system is not significant in determining flow rates. The fluctuation of pressure is highly important. Any variation in pressure will affect the flow of the fluid and require adjustment of the flow meter to reestablish the desired flow. It is at this point in the calibration procedure that the operator will be impressed with the crude pressure control provided by the "pop-off" valve so common in our spraying systems.

The measurement of spray solutions during application should provide a more economical distribution of insecticides. In addition, the even distribution of an insecticide throughout the control area should provide for a lower overall amount of insecticide applied within an area. Substandard doses within the area will be eliminated and it will not be necessary to over-dose part of the area to secure a kill in the other part. The calibration device should provide a simple means to determine flow rates desired for different spray rigs.

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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.