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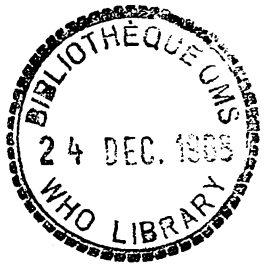

A SIMPLE METHOD FOR THE FIELD EVALUATION OF DROPLET SIZE OF SPRAYS

by

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A recommended method for the determination of droplet size of aerosols and mists is given in the WHO publication, Equipment for Vector Control.[2] The method, whilst providing an accurate means of evaluating droplet size is both complex and laborious and therefore unsuitable for field workers, whose prime interest is the evaluation of sprays. In designing a simpler method, consideration must be given to the limited facilities available in the field and the method must, at the expense of accuracy, eliminate the arduous task of microscopic measurement and the mathematical computation of the important droplet parameters.

This report describes a simple subjective method of evaluating the variation in droplet size when different nozzles are tested at different pressures. A permanent record of a droplet pattern of a nozzle is obtained and compared visually with some standard patterns whose droplet characteristics were predetermined. To define the method precisely, the formulation of the spray used, the sampling surface, the method of application and the classification of droplet size are described.

Formulation of spray and sampling surface

To produce a visible spray deposit, a solution of 1% Nigrosine WS dye (BDH Laboratory Chemicals Group, Poole, England) in water was used. Physically a water solution behaves more like a water dispersible powder than does an emulsion.

A suitable sampling surface is Kromekote Cover 65 lb glossy paper coated on one side (manufactured by the Champion Paper and Fibre Co., Hamilton, Ohio, United States of America). This paper produces well defined circular strains of approximately twice the original spherical droplet size in the range 100-600 microns diameter.

The limitation in the accuracy of the stain method is that the ratio of stain size to original droplet size can vary with the velocity of impact of the droplet. Provided that nozzles are assessed within a narrow pressure range, and the distance of collection of spray from the nozzle is fairly constant, this variation can be negated.

Application of spray

By far the most common anopheline control operations involve the application of spray of residual insecticides to the interior of dwellings. These sprays are applied to the walls, ceilings and other surfaces at the rate of 40 cc/m^2. To obtain a sample of discrete droplets, it is necessary to speed up the process of spraying, so that all the individual droplets are easily seen on the sampling surface.

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[1] On secondment from The Ministry of Overseas Development, United Kingdom.

[2] Equipment for Vector Control, World Health Organization, Geneva, 1964. Annex 1, p. 191.

Three pieces of Kromekote paper are cut 3 in^2 (19.4 cm^2) and secured (glossy side up) side by side 3 in (7.6 cm) apart on a flat board. The board is then placed on level ground and the operator stands 20 in (50.8 cm) to the left-hand side (for right-handed operators) of the centre target, the operator's two feet and the targets forming a straight line. The sprayer is charged with a solution of 1% Nigrosine WS dye in water. The operator takes up the machine as if he is about to spray a wall surface in front of him, except that he must grasp the lance from beneath, with a javelin or spear throwing grip. This facilitates the spraying of the targets which is done by releasing the trigger and swinging the lance in a rapid pendulum action from the horizontal through an arc of 180° so that the nozzle passes over the centre target. The distance from nozzle to target in the vertical position is approximately 30 in (76.2 cm). A "goose neck" attachment to the lance would facilitate the spraying of test cards directly in front of the operator maintaining a constant distance and without need for swinging the lance in a pendulum action.

Droplet size classification

Nozzles used for vector control produce droplets which vary in size from 100-600 microns diameter. It is therefore expedient to re-define the size range of droplets which constitute sprays, and the following definitions are used in this report.

(1) FINE SPRAY where the vessel median diameter of the spray is in the size range 100-200 microns.

(2) FINE/MEDIUM SPRAY where the v.m.d. of the spray is in the size range 200-300 microns.

(2) MEDIUM SPRAY where the v.m.d. of the spray is in the size range 300-400 microns.

(3) MEDIUM/COARSE SPRAY where the v.m.d. of the spray is in the size range 400-600 microns.

(3) COARSE SPRAY where the v.m.d. of the spray is approximately 600 microns or above.

The size ranges were determined by conventional droplet sizing techniques. Examples of these three spray categories are shown in the Annex page I. It is intended that these droplet patterns be used as standards to define the droplet characteristics of nozzles used in vector control programmes.

Assessment and reporting of droplet size

The degree of spray coverage on the targets is determined by the speed of nozzle movement. Visual comparison is made easier if the spray coverage is approximately the same as the standard patterns. This may require a certain amount of trial and error. Three targets are sufficient to evaluate the droplet pattern across the swathe, and these should be compared in turn against the standard patterns.

Droplet characteristics should be reported under one of the five categories or combination of categories. Nozzle specification, tank pressure and discharge rate must be reported. The droplet characteristics should be tabulated as appended in this report, which records the results of evaluations of some familiar nozzles as a guide to field workers.

Additional notes of guidance

(1) Dissolving the dye is facilitated by grinding the crystals to a powder prior to mixing with water.

(2) It is essential that the sprayer tank is perfectly clean and free of insecticide; wetters or emulsifying agents will tend to increase the spread factor of the stains.

(3) It is advisable to apply the spray in an enclosed space where draughts and sunlight are excluded.

(4) The targets must be secured to a flat board surface to avoid movement during spray application.

(5) The stains must be allowed to dry under shade prior to examination.

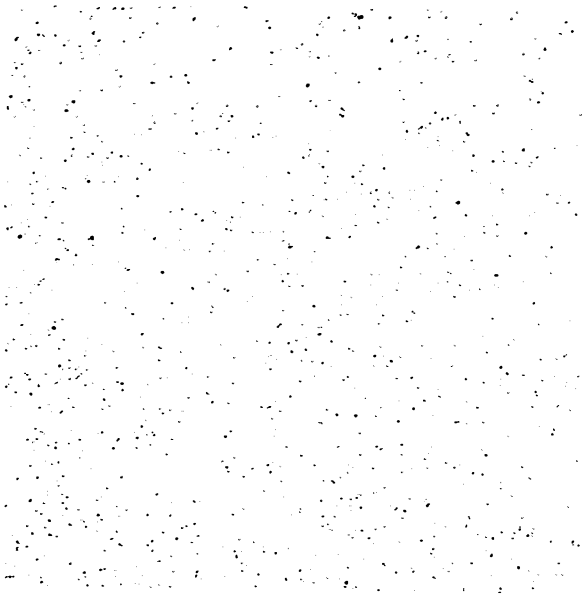
(6) It is anticipated that this method will be applicable to all hydraulic energy nozzles used in conjunction with manually operated sprayer equipment specified under 2.1.2.2, 2.1.3.2, 2.1.3.3, 2.1.3.4 of "Equipment for Vector Control" (op. cit.).

(7) The method is not suitable for evaluation of droplet size of different insecticides since different formulations produce different stain size/droplet size relationships due to variations in surface tension, contact angle, etc.

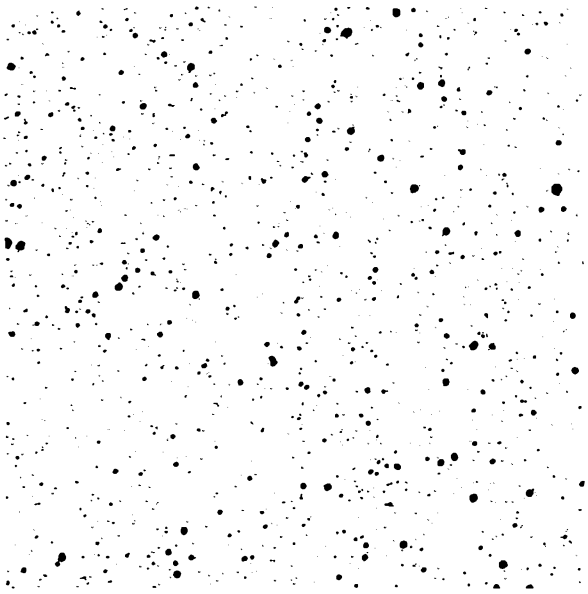
(8) This method is not considered suitable for measuring droplet size of pesticides dispersed by power ground equipment and aircraft because of the variety of additional factors involved.

DROPLET CHARACTERISTICS OF SOME NOZZLES USED FOR VECTOR CONTROL

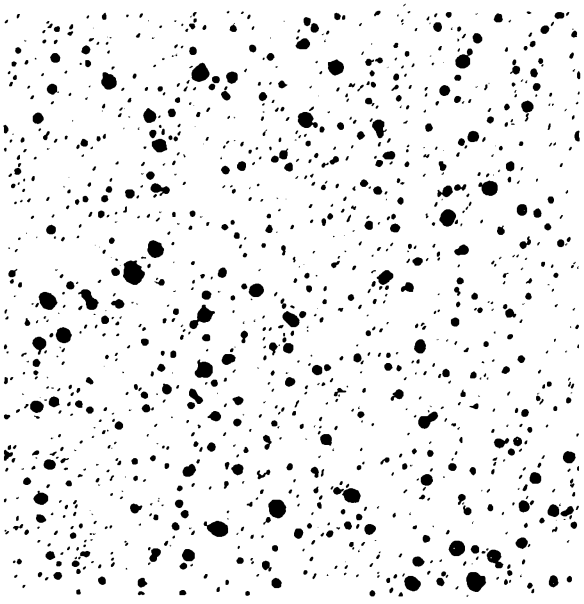
Nozzle	Tank pressure lbf/m^2 (kgf/cm^2)	Emission rate (ml/min)	Droplet size classification
Hudson 153 - 400 + No. 2 flow regulator	40 (2.8)	760	Coarse
Teejet HSS8002E	40 (2.8)	760	Medium
Allman No. 00	50 (3.5)	760	Medium
Galeazzi	23 (1.6)	760	Medium/Coarse
S.S. Hollow cone D3 - 25	45 (3.2)	760	Medium



FINE SPRAY
(100 - 200 microns v.m.d.)



MEDIUM SPRAY
(300 - 400 microns v.m.d.)



COARSE SPRAY
(600 microns or larger v.m.d.)

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