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A Laboratory Model Thermal Aerosol Generator[1, 2]

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Studies were conducted in the laboratory in which insecticidal-aerosol particles were pulled into 20-bu lots of stored shelled corn by means of air movement. One of the 1st steps in preparation for the studies was the construction of a small thermal-aerosol generator that would produce aerosol particles of a controlled size and that would operate on somewhat the same principle as a commercially-used thermal aerosol generator. The construction and the operation of this generator is reported here.

MATERIALS AND METHODS.—The machine was constructed from an enclosed cylindrical heating element, taken from a small commercially-available aerosol machine. This was combined with a small-pressure siphon-type spray nozzle. The nozzle emitted an insecticidal aerosol into the heated cylinder in which small aerosol particles were formed. The heating portion of the aerosol machine was from a commercial BVI TM aerosol machine, Model No. F-900, Part No. 02080, Burgess Vibocrafters, Inc., Grayslake, Ill. (Fig. 1, 2). The heating element of the machine contained a built-in thermostat under a tin cover, but this was bypassed so that the machine was on constantly. A thermocouple unit, attached to an input controller (Fig. 1, 2), was inserted 2 in. into the barrel of the heating element. The heating element was hooked to the input controller and the heat of the barrel was thus controlled by the "percent time on" knob of the input controller. The "percent time on" was set at 37% for the 250°C setting and 15% for the 150°C setting. The siphon atomizing system (Fig. 3) was made with a siphon-type nozzle system, No. 1/4 J.N. spray setup 7A, and has a fluid noz-

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[2] Mention of a proprietary product does not imply endorsement by the USDA.
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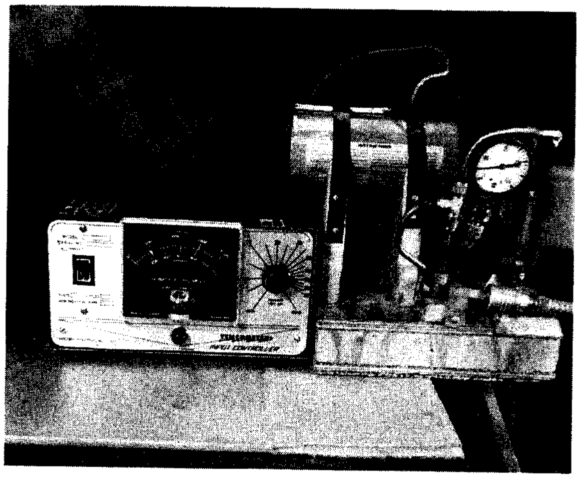

FIG. 1.—Input controller with thermocouple cable inserted in operating aerosol generator.

zle No. 1650 and an air nozzle 65 (Spraying Systems Co., Bellwood, Ill.). Ordinary copper tubing and fittings were used to complete the hookup (Fig. 1). The pressure was furnished by an air compressor equipped with a pressure regulator set at 15 lb/in.[2] The entire nozzle was placed within the heat tube up to the nozzle body. The machine was operated at 3 different temperatures: room temperature (26°C), 150°C, and 250°C. At each of these tempera-

Table 1.—Temperature of heat tube and resulting particle sizes.

Temperature of heat tube (°C)	Smallest particles (µm)	Largest particles (µm)	Mass median diam (µm)
250[a]	0.25	1.0	0.50
150	0.25	4.0	2.00
26[b]	0.50	13.0	10.00

[a] The particle sizes at this temperature also were checked by A. H. Yeomans.
[b] Heating tube removed, particles produced directly from the nozzle.

tures, different variations in particle size were produced. The formulation used in the machine was a mixture of 6.6 ml of 95% malathion dissolved in 66.0 ml of carbon tetrachloride. The aerosol particles were collected with an electrostatic precipitator as suggested by Yeomans (1949) and thus precipitated on an ordinary microscope slide treated with an oleophobic substance also described by Yeomans (1960). The slides were examined under a high-power microscope. An attempt was made to measure and count the particles visually as suggested by Yeomans (1960), but this proved very difficult, especially with the particles below 2 µm. Therefore, with a camera mounted on a high-power microscope, a 35-mm black and white photograph was made of an area of the slide. Pictures were taken at the low magnification and the area covered was 180 µm wide. Figure 3 shows a portion of the photo-

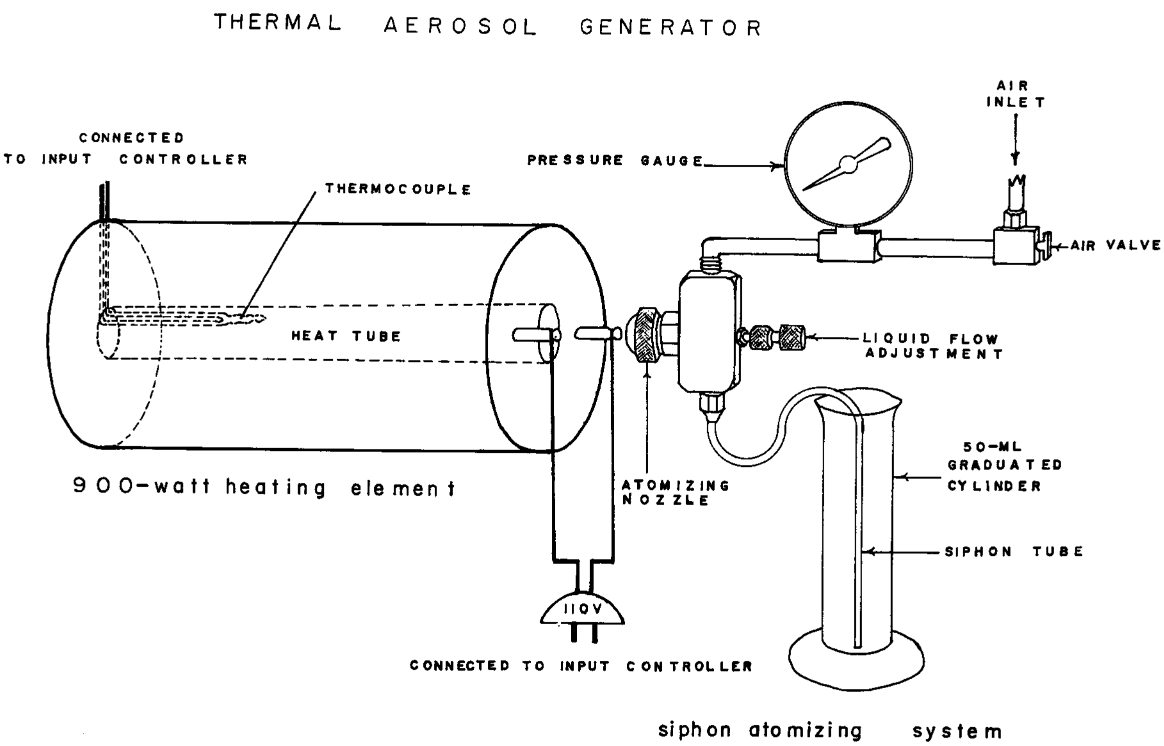

FIG. 2.—Schematic drawing of thermal aerosol generator showing heating element and siphon atomizing system.

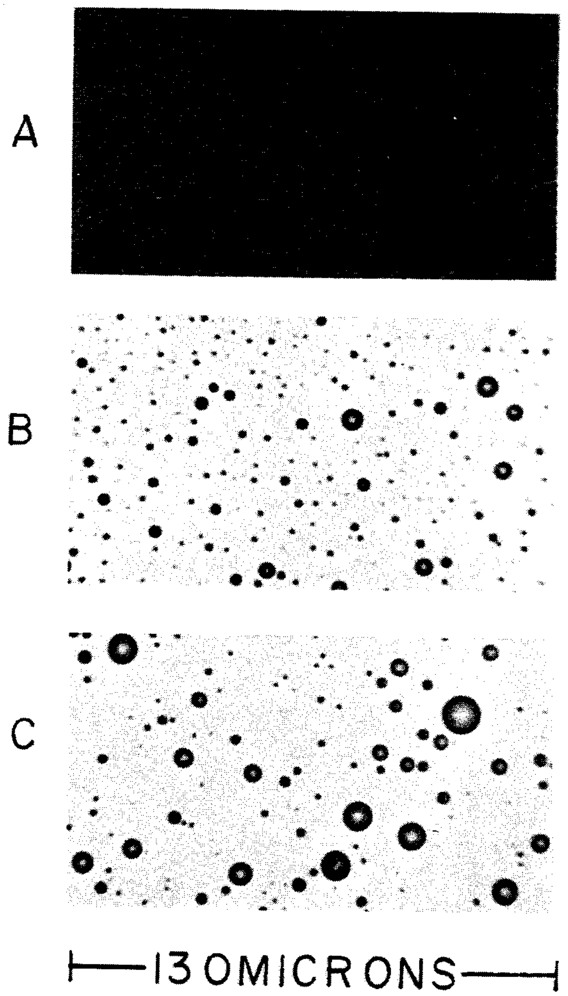

FIG. 3.—Aerosol particles: (A) mass median diam of 0.5 μ (250°C); (B) mass median diam of 2.0 μ (150°C); (C) mass median diam of 10.0 μ (26°C).

graphs. The negatives were enlarged and then measured with a metric rule. As each particle was measured and recorded, a pin hole was punched in the particle image so that it would not be recounted. A particle correction factor was applied to each particle as described by Yeomans (1960). The nozzle liquid flow adjustment was opened ¼ turn which resulted in a delivery of 1 ml of aerosol formulation/min. At that setting, the various particle sizes were produced. Table 1 lists diameter in microns of the smallest and the largest particles produced. Figure 3 illustrates the various particle sizes. The mass median diam of the particles (Table 1) was determined by calculating the volume of each particle. The diameter of the particles was measured in microns. The volume was determined by multiplying the cube of the corrected diameter by 0.5236. The volume of the particles of each diameter was expressed as a percentage of the total volume. The accumulative percentages were then plotted on logarithmic probability paper and the 50% point was the mass median diameter. This method was described by Yeomans (1949). This method formed the basis for the "Tentative Official Method of Determination of the Particle-Size Distribution of Space Insecticidal Aerosol" adopted by CSMA (Beard 1960). The presentation of the smallest and the largest diameter particle and the mass median diameter in Table 1 gives the reader an idea of drop-size dispersion.

The machine proved satisfactory. Consistent results were obtained each time particle size was checked for each temperature.

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