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OPERATIONAL AND SCIENTIFIC NOTES

A SPRAY MANAGEMENT VALVE FOR HAND-COMPRESSION SPRAYERS[1]

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ABSTRACT. The commercially available spray management valve provided consistent flow rates when used with hand-compression sprayer systems. The 15-psi spray management valve maintained a constant flow rate of 180, 150, and 155 ml/min in combination with a fine 45° flat fan nozzle and Hudson, B&G, and Chapin hand-compression sprayers, respectively. The 30-psi spray management valve maintained a constant flow rate and adequate spray-on time when combined with the coarse flat fan nozzle for each of the 3 hand-compression sprayers tested.

The economy, durability, and simplicity of the hand-compression sprayer makes it a primary tool of vector control programs in many mosquito-plagued areas of the globe. One type of application method employed by vector control programs requires application of residual pesticides throughout a dwelling, targeting resting mosquitoes (World Health Organization 1990). This method requires thorough coverage of the walls and ceilings. However, due to the large coverage and lengthy spray-on time, diverse application rates can occur when an entire family dwelling is sprayed.

When pesticides are applied with a hand-compression sprayer, a wide range of application rates can occur from one pressurization. This variability is related directly to the decrease in pressure supplied to the nozzle as the spraying process depletes the initial pressure when the liquid volume drops. Unless the applicator stops and repressurizes the hand-compression sprayer at frequent intervals (usually 2–3 min), the application rate will vary widely. The spray management valve (H. D. Hudson Mfg. Co., Chicago, IL) provides a potentially simple solution to the variability associated with hand-compression sprayer and operator differences. The spray management valve is an add-on "in-line" device designed to maintain a uniform spray pressure from a hand-compression sprayer. It is a pressure-activated valve that shuts off when the fluid pressure at the valve falls below a preset point. A spray management valve operates at a fixed pressure, with 3 spray management valves available at 15, 30, and 45 psi. The spray management valve has been described (Craig et al. 1993) and drawings are available (Green Garde Technical Bulletin No. 08, H. D. Hudson Mfg. Co.). This study tested and evaluated the 3 spray management valves provided by H. D. Hudson Mfg. Co. on 3 commercially available 2-gallon hand-compression sprayer systems (H. D. Hudson Mfg. Co.; B&G Equip. Co., Plumsteadville, PA; and R. E. Chapin Mfg. Works, Inc., Batavia, NY).

The sprayers were tested with a coarse and fine 45° flat fan TeeJet® (Spraying Systems Co., Wheaton, IL) nozzle without a spray management valve and with the 15-, 30- and 45-psi models. Each hand-compression sprayer was fitted with an air chuck and pressure gauge for ease and consistent pressurization.

Each hand-compression sprayer was filled with 2 liters of tap water and pressurized to 55 psi. The sprayers were manually discharged and the water was collected in a 1,000-ml graduated cylinder. Volume and pressure were recorded at 1-min intervals for 10 min, unless the spray management valve activated before the testing period was completed. Each hand-compression sprayer–spray management valve combination was replicated 3 times. Because liquid depletion with the 45-psi spray management valve occurred so rapidly, 30-sec intervals, rather than 1-min intervals, were used when evaluating the 45-psi spray management valve in order to provide sufficient data points for regressions.

The effect of the spray management valve on spray pattern was also determined. In the initial testing all 3 sprayers delivered similiar spray patterns. Therefore, a hand-compression sprayer was randomly selected (B&G), filled with 2 liters of water, pressurized to 55 psi, and fitted with the fine 45° flat fan nozzle. Water-sensitive dye cards (TeeJet, Spraying Systems Co.) were stapled onto a vertical service. Two rows and 5 columns of dye cards were placed 15 cm center to center between columns and rows. The nozzle was held *ca.* 60 cm away from the dye cards. Water was then sprayed on the cards from top to bottom down the center column one time. The dye cards were collected and

[1] The opinions and assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or Naval Service.

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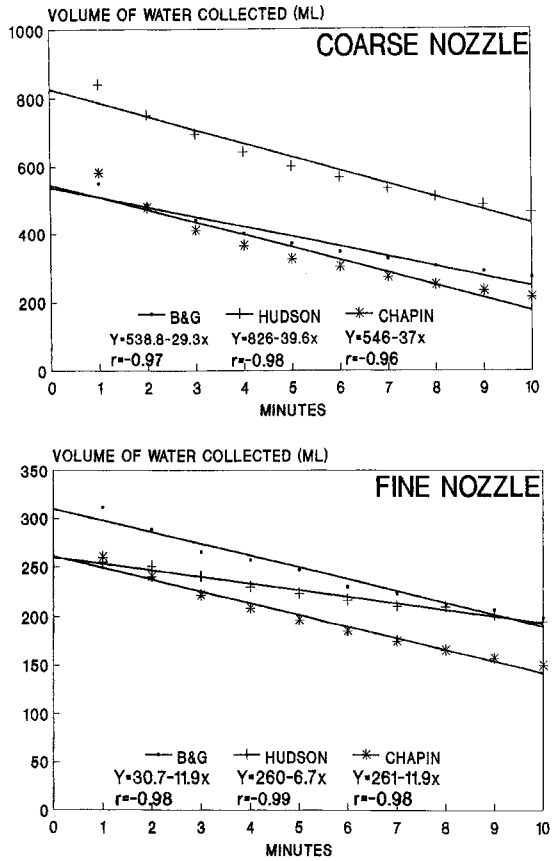

Fig. 1. Volume of water collected per minute from Hudson, B&G, and Chapin hand-compression sprayers using fine and coarse nozzles without the spray management valve.

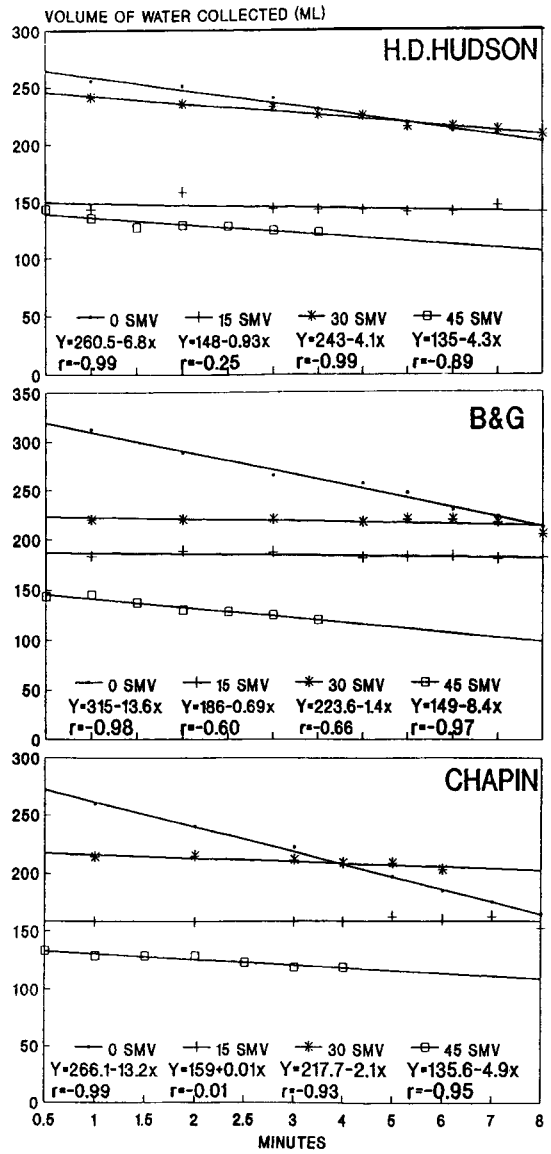

Fig. 2. Volume of water collected per minute from Hudson, B&G, and Chapin hand-compression sprayers using a fine nozzle with the spray management valve.

droplets/cm^2 counted. Three replications were conducted.

Figure 1 illustrates the flow rates of the Hudson, B&G, and Chapin hand-compression sprayers when using a fine and coarse 45° flat fan nozzle without the spray management valve. Over the course of 10 min with the fine fan nozzle, flow rate differed by 60, 100, and 110 ml for the Hudson, B&G, and Chapin, respectively. Flow rates for the coarse flat fan were 277, 280, and 368 ml for the Hudson, B&G, and Chapin, respectively. The graphs clearly show that consistent application rates could not be achieved as flow rate decreased with the standard hand-compression sprayers.

Figure 2 compares the flow rates of the B&G hand-compression sprayer fitted with a fine nozzle combined with the spray management valves. The flow rates for the B&G hand-compression sprayer fitted with a fine nozzle and either the 15- or 30-psi spray management valves remained constant through the 10-min test period. The 45-psi spray management valve showed a definite downward trend, indicating a similar slope to the B&G without a spray management valve.

The characteristics of the Hudson hand-compression sprayer in combination with a fine nozzle and spray management valve are also shown in Fig. 2. The 15-psi spray management valve varied the least of the 3. The 45-psi spray management valve delivered a consistent volume for only 4 min. There was approximately a 40-ml decrease between 1 and 10 min with the 30-psi spray management valve.

Flow rates delivered by the Chapin hand-compression sprayer are also illustrated in Fig. 2. The correlation coefficient (−0.01) clearly indicates that

Table 1. Effective spray-on time (min) for selected hand-compression sprayer and spray management valve combinations.

	0 psi		15 psi		30 psi		40 psi	
Sprayer	F[1]	C[2]	F	C	F	C	F	C
B&G	10	10	10	10	9	2	7	1
Hudson	10	10	10	10	10	4	6	1
Chapin	10	10	10	7	6	2	7	1

[1] Fine 45° flat fan nozzle.
[2] Coarse 45° flat fan nozzle.

Table 2. Swath width characteristics (droplets/cm²)[1] for the spray management valve (SMV) using the B&G hand-compression sprayer.

	Row[2]				
SMV	1	2	3	4	5
0	85.8	205.3	324.6	259.3	119.3
15	6.2	29.2	84.0	79.7	9.7
30	11.0	106.8	196.7	88.7	21.5
45	5.0	35.7	159.3	121.3	30.8

[1] Means of 2 replications.
[2] Columns (rows) represent the grid pattern. Row 3 is the center of the swath.

the 15-psi spray management valve provided a constant flow rate. The 30-psi spray management valve was unable to control the flow rate delivered by this hand-compression sprayer. The 45-psi spray management valve showed a trend more similiar to a hand-compression sprayer without the spray management valve.

Trends when using a "coarse" flat fan with a spray management valve were similiar to that with the "fine" nozzle. The B&G exhibited a loss in volume of water collected over the 10-min collection period with all 3 spray management valves. The Hudson delivered a constant flow rate over the test period with the 15-psi and 30-psi spray management valves. The Chapin delivered a constant flow rate only with the 15-psi spray management valve.

Table 1 shows the effective spray time for each hand-compression sprayer configuration. The 30- and 45-psi spray management valves decreased the spray time, before the valve was shut off, in almost every configuration. This decrease is offset by the accurate control of flow rate.

The effect of the spray management valve on the spray pattern delivered by a hand-compression sprayer is shown in Table 2. When the spray pattern of a standard hand-compression sprayer is compared to that of a spray management valve–hand-compression sprayer combination, the differences are dramatic. Droplets/cm² for the standard hand-compression sprayer were 324 as compared to 84, 197, and 159 for the 15-, 30-, and 45-psi spray management valves, respectively.

Consistent flow rate will not be achieved when using a standard hand-compression sprayer unless pressure to the nozzle is accurately controlled or head pressure is constantly maintained. The spray management valve appears to provide the control necessary for consistent flow rate for water-based insecticides. The 15- and 30-psi spray management valves appear to function appropriately with hand-compression sprayer systems. They provide a reasonable operating time before the valve activates, function adequately with both the fine and coarse nozzles, and the flow rate is sufficient for proper application rates. The valves provide a program manager the necessary tool for accurate application of insecticides by a minimally trained technical work force. The valves may also allow the program manager a more accurate method of monitoring chemical usage, which potentially provides a more effective program of managing the development of resistance.

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