

# SPRAYERS and SPRAY APPLICATION TECHNIQUES



Learn more about the advantages and disadvantages of low- and high-volume sprayers to help you choose the best one for your greenhouse.

By John W. Bartok, Jr.

**T**he most important goal in the application of agricultural pesticides is to get uniform distribution of the chemicals throughout the crop foliage. Underdosing may not give the desired coverage and control needed. Overdosing is expensive as it wastes pesticide and increases the potential for groundwater contamination.

Two general types of sprayers are available for greenhouse application of pesticides: hydraulic and low-volume. There are many variations of these that fit particular crops or growing methods.

In the hydraulic sprayer, a pump supplies energy that carries spray material to the target (plant foliage). Water is the carrier and the pump creates the pressure at 40-1000 psi. Spray material is usually applied to "wet" or "drip." Nozzles on the boom or handheld gun break the spray into small droplets and direct it to the foliage.

In a low-volume (LV) sprayer, spray material in a water or oil carrier is injected into a high-speed air stream developed by a fan, blower or compressor. In most LV sprayers, a small pump is used to inject a concentrate pesticide solution into the air stream. The speed of the air stream may be as high as 200 mph. To get sufficient coverage, the air within the foliage canopy must be replaced with air that contains the pesticide. As the droplet size is much smaller, good coverage can be achieved with less chemical.

## SPRAYER DIFFERENCES

One way to distinguish between a hydraulic sprayer and low-volume sprayer is by droplet size. Hydraulic sprayers produce a spray with most droplets in the 200-400 micron diameter range (thickness of the human hair is about 100 microns). Low-volume sprayers develop a mist (50-100 microns) or fog (0.05-50 microns). Small droplets from a mist or fog applicator can result in more uniform coverage and greater likelihood of contact with the insect or disease. In contrast to the hydraulic sprayer,



Top: Gas engine-powered hydraulic sprayer with cart. Middle: Hydraulic rechargeable backpack sprayer. Bottom: Gas engine-powered hydraulic sprayer with hose reel and spray gun. (All photos courtesy of John Bartok)

spray material is usually applied to "glisten" as it is difficult to see the individual droplets on the leaf.

One disadvantage to smaller droplets is that they evaporate quicker when the humidity is low and may not reach the target. Another is that the tiny droplets tend to bounce or skip on the leaf surface. This can be overcome somewhat by adding a spreader and sticker.

## TYPES OF HYDRAULIC SPRAYERS

A hydraulic sprayer contains the following components: tank, pump with agitator, pressure gauge, regulating valve, relief valve, control valves, piping and nozzles, power source and support frame.

### Compressed air sprayer.

The smallest sprayers are hand-carried, compressed air sprayers. They contain a 1- to 5-gallon tank with an air pump in the top and a wand with a nozzle for directing the spray. Their best use is for spot treatment of small areas. In operation, the tank has to be pumped up frequently to maintain pressure, and the tank must be shaken to agitate the chemical.

**Backpack sprayer.** The tank in this sprayer holds about four gallons of material. A hand-operated pump pressurizes the spray material as the operator walks along, and the wand with nozzle directs the spray to the target. ◆

### Advantages to a hydraulic sprayer include:

- Deeper penetration into dense foliage;
- Reduced drift, as spray material is applied closer to the foliage;
- A wide variety of application rates, droplet size and spray patterns are possible, depending on nozzle selection; and
- More easily seen spray coverage because more material is being applied.

### Advantages to a low-volume sprayer include:

- Less spray material is needed to get good coverage;
- Less water needs to be carried because concentrate sprays are used;
- More uniform coverage above and below the leaf surface; and
- May take less application time.

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Its use is limited to small areas that can be reached from a walkway.

**Skid-mounted sprayer.** With a tank size up to 200 gallons, these sprayers will fit onto an ATV or electric cart. They can also be mounted on wheels and pulled by hand or with a compact tractor. A small electric or gas engine powers the pump. The unit may contain a hose reel and gun or a boom with nozzles.

**Irrigation boom sprayer.** With increasing production in plug and cell trays, the use of the boom sprayer has become an important tool for getting uniform watering. By installing three-way turrets with nozzles for irrigation, misting and pesticide application, one piece of equipment serves multi-purposes. An alternate method is to add a pesticide application boom to the same transport cart. An independent mixing tank, pump, filter and valves are needed.

**Central pesticide application system.** In gutter-connected ranges, it is possible to install a piping system that will deliver pesticides to any part of the greenhouse. Pesticide preparation and filtration are done in a mixing area. A single pump and piping that will handle the pressure developed are required. A hose can be easily attached to one or more outlets in each bay to apply the pesticide. The disadvantage is that the entire system must be drained and cleaned before changing to a new chemical.

### LOW-VOLUME SPRAYERS

**Backpack Mist Blower.** A small gas engine and integral fan creates an air stream with a velocity of 100-200 mph. Concentrate spray injected into the air stream by a special nozzle is carried to the foliage by the air. The spraying technique is more complicated than with a hydraulic sprayer. The nozzle should be directed into the plant canopy to get good penetration and coverage, but it should be kept at least six feet away from the plants to avoid blast damage. The operator should visualize that all the air within the canopy must be replaced by the air from the mist blower.

**Electrostatic sprayer.** Compressed air, given a negative electric charge as it travels through the nozzle, forms spray droplets and carries them to the plants. This helps to create more uniformly sized particles that disperse well because they repel each other. Charged particles are attracted to leaves, metal and some plastics; when they strike a surface, these particles create a momentary overcharge that repels other particles. These other particles land elsewhere on the leaf, so there is more uniform coverage.

The simplest electrostatic sprayer is backpack-carried and contains a tank and spray gun. It requires an independent air supply to charge the tank. Other units are cart-mounted with an integral compressor powered by a gas engine or electric motor. Electrostatic sprayers work best if the spray distance is less than 15 feet.



Top: Grower-assembled hydraulic sprayer on 3-wheel cart. Middle: Electrostatic sprayer with gas-powered compressor, 5-gallon tank and hose reel. Bottom: Mechanical foggers, or cold foggers, use a high-pressure pump (1,000-3,000 psi) and atomizing nozzles to produce fog-size particles.

**Rotary Disk sprayer.** The spinning disk is used to impact and break a stream of water into droplets that are 60-80 microns in diameter. A variety of sizes are available for greenhouse use.

**Thermal Fogger.** This machine requires a specially formulated carrier that is mixed with the pesticide to improve uniformity of droplet size and distribution of the spray material. The carrier also decreases molecular weight, allowing the particles to float in the air for up to six hours, a disadvantage if you have to get into the greenhouse to care for the plants.

In the operation of a thermal fogger, the pesticide is injected into an extremely hot, fast-moving air stream that vaporizes it into fog particles. Moving from one end of a greenhouse to the other, a thermal fogger can cover in as little as 15 minutes. Air circulation from an HAF system will give more uniform coverage and better foliage penetration. Temperature and humidity ►

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also affect the spray droplets. Because of the noise associated with the jet engine, hearing protection is recommended.

**Mechanical Fogger.** Also called a cold fogger, this device uses a high-pressure pump (1,000-3,000 psi) and

atomizing nozzles to produce fog-size particles. Distribution of the spray material is through a handheld gun or external fan unit. With the fan unit, the distance and amount of area that can be covered depends on the capacity of the fan.

Multiple units or settings may be needed to cover large areas.

As with other foggers, penetration and coverage may not be as good as with a mist or hydraulic sprayer. Droplets in the 30-micron size drop out of the air fairly quick-

ly but droplets in the 5-micron size may evaporate or float in the air currents for hours. Small particles don't have the mass or velocity to move into heavy foliage; however, in most studies, good insect control has been achieved.

Safety is important when using spray equipment employing a high-pressure pump. Keep hands and arms away from the nozzle because at high pressure, spray particles can penetrate the skin very easily.

### CALIBRATION AND OPERATION

Before selecting the sprayer to use, check the label and the IPM guidelines for the particular pesticide that will be applied. These give the recommended application rate, the type of equipment best suited for the application, the style of nozzle and other information for best results. Based on the type of crop and its size, select the sprayer that will give a good balance between droplet size and coverage.

Calibrating sprayers is important to get good control without applying excess material. Low-volume sprayers can provide more uniform coverage with less spray material. Where applicable, most labels have recommendations for low-volume equipment.

When making a tank mix, both the dosage and water requirement need to be considered. The dosage, the amount of chemical that should be applied to a given area, is listed on the label. With most pesticides, a range such as 4-12 oz. per 100 gal. is given. Selection of the rate should be made based on the level of infestation, type and maturity of the crop, past experience and other variables. If this is the first time that the pesticide is being used, a dosage in the middle of the range is a good starting point.

The amount of water needed to cover the growing area depends on the type of equipment used. With hydraulic sprayers, a rate of 25-50 gal. per 10,000 sq. ft. is common. Low-volume sprayers use only 1/4-2 gal. per 10,000 sq. ft.

Most chemical labels state the amount of pesticide to be diluted in 100 gallons of water and not the amount of spray concentrate that is to be applied to a given area. Some labels now list the amount of

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chemical that should be applied per acre. The instruction manual that comes with each sprayer contains charts or tables that help determine how much spray material to mix with the water. This is usually based on a 10,000-sq. ft. area, so you will need to adjust the rate to fit the growing area to be sprayed.

### SPRAYING TECHNIQUE

The technique you use to spray crops is very important to get good coverage. It should be developed to fit the type of equipment that is to be used. With a hand-held gun, a sweeping motion over the foliage will allow the spray material to penetrate and get to the underside of the leaves.


With fixed-fan type units, an airflow pattern needs to be established so that all the plant canopy receives the pesticide; location of the unit contributes to good air flow. Using an air circulation system, such as HAF, will enhance the movement and distribution of the fog and mist particles. The fans should continue to operate for 30-60 minutes after the spraying operation is completed.

Observation should be made to ensure that the sprayer is operating correctly and that sufficient coverage is obtained. A good way to monitor coverage with a hydraulic or mist sprayer is to use strips of water-sensitive paper (available from Spraying Systems Co., Wheaton, Ill.,

or from a local spraying equipment supplier). The paper is folded over and attached to representative leaves in the plant canopy. When exposed to spray droplets, stains will appear indicating the size and number of particles that were received by the leaf.

For fog applications, evaluation of coverage can be made using a fluorescent dye in the water. Placing representative leaves under an ultraviolet or black light will show droplet size and distribution.

Another tool that can help promote better technique and coverage is to keep a log of the spraying operations and the results that were obtained. This should include the date, time and location of application; crop and pest; pesticide used; tank mix; and an evaluation of the results obtained. Adjustments should be made in subsequent applications to try to improve the results.

Proper selection, calibration and operation of spray equipment is important in achieving optimal pest control, as well as in meeting environment and safety requirements. 

*John W. Bartok, Jr. is an agricultural engineer and extension professor-emeritus in the Natural Resource Management & Engineering Department at the University of Connecticut, Storrs, Conn. He may be reached by phone at (860) 486-2840 or via E-mail at [jbartok@rcn.com](mailto:jbartok@rcn.com).*

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