GREENHOUSE TESTS OF AN ELECTROSTATIC SPRAYER

The following is excerpted from "Electrostatic Sprayers Improve Pesticide Efficacy in Greenhouses," by John Kabashima, D. Ken Giles, and Michael P. Parrella (all with the University of California), California Agriculture 49(4), July-August 1995, 31-35 (Division of Agriculture and Natural Resources, University of California, 300 Lakeside Dr., 6th Floor, Oakland, CA 94612).

The application of pesticides in greenhouses devoted to the production of ornamental plants is dominated by the use of fully dilute wet sprays under the historical concept of "spray to runoff." It is common for applications to be in the range of 100 to 800 gallons per acre, depending on the type of crop, its stage of growth, and the target pest. It has been documented that this is a grossly inefficient use of pesticides, with less than 1% of the active ingredient applied actually reaching the target pest. Despite this lack of efficiency, the ease, convenience, and familiarity of this application method have made it routine among growers. In addition, pesticide labels consistently reinforce this application technology and have contributed to continued dominance of dilute sprays in the greenhouse. This type of pesticide application is clearly inconsistent with the principles and practices of integrated pest management (IPM), which strive for conservative and efficient use of pesticides, where needed, with the absolute minimum amount entering nontarget areas....

One of the most intriguing new developments in greenhouse pesticide application technology is the use of electrostatic sprayers. These sprayers produce small droplets of highly concentrated pesticide, which are electrically charged as they leave the nozzle. These charged droplets penetrate foliage and adhere to all plant surfaces, including the undersides of leaves. Manufacturers claim that these sprayers provide excellent pest control while using very little water and reducing the total amount of pesticide needed.

Many of the claims for these sprayers may be true, but it is important to obtain objective data in the following areas: (1) efficacy in comparison to full volume wet sprays; (2), longevity of residues and potential hazards to the applicator; and (3) overall deposition in target and nontarget areas.

For the past three years we have been evaluating one of the newer candidate electrostatic sprayers available to the greenhouse industry with respect to these areas....

The electrostatic sprayer used in our evaluations (Electrostatic Spraying Systems, Inc., Watkinsville, GA) employs an air-atomizing induction-charging nozzle to produce droplets in the range of 30 to 60 microns. Within the nozzle, air pressure is equivalent to 30 to 40 psi [pounds per

square inch], and liquid pressure is equivalent to 15 psi. (For comparison, a conventional hydraulic sprayer might require approximately 2,000 psi to produce droplets in this range.) Two 9-volt batteries impart a negative charge ... on the droplets as they leave the nozzle. The technology used in this sprayer is a departure from earlier electrostatic sprayers, which were designed primarily for use in orchards.

A cooperating grower provided a site ... We used chrysanthemum plants, in 6-inch-diameter pots, that had just begun to set buds. Although there was a natural infestation of green peach aphid (Myzus persicae) on the plants, numbers were very low and there was too much interpot variation for a good test. Therefore we selected four pots randomly from each of the 12 benches in the trial, for a total of 48 pots. These pots were placed in a UC Davis greenhouse, where they were artificially infested with melon aphid (Aphis gossypii).... Before the pots were returned to the test greenhouse, a pretreatment count was taken, using a subsample of 12 pots .... The remaining infested pots were returned to the test greenhouse and placed in exactly the same location from where they were taken. These pots were marked with red flagging tape. At the time of this trial, the cooperating grower's choice of insecticide for aphid control was nicotine sulfate. We measured the amount of water that the grower typically used in a full-volume hydraulic spray at 30 gallons per 10,000 square feet of bench; the rate of nicotine sulfate was

16 oz/100 gallons. In trials with water, the electrostatic sprayer used 0.67 gallons per 10,000 square feet of bench. To keep the amount of active ingredient the same per bench, we used 720 oz of nicotine sulfate per 100 gallons in the electrostatic sprayer. For comparison, these application rates are equivalent to 130 gallons per acre for the wet spray and three gallons per acre for the electrostatic spray. A randomized design was used ... four days after the pesticide application, the test pots were returned to UC Davis... [for] quantifying posttreatment aphid numbers....

Both full volume and electrostatic application methods significantly reduced numbers of green peach aphid nymphs, but there was no significant difference between the two methods ... Similar results were found with melon aphid adults. However, with respect to melon aphid nymphs, the electrostatic application provided significantly improved control over the full volume spray. Although 100% control was not achieved, results reflected actual performance of nicotine sulfate in this commercial nursery....

Reduced volume electrostatic application provided approximately 3.7 times more foliar deposition ... than the use of the conventional full volume wet spray technique ... In addition, there was less deposition in the aisles and [on the] bench top from reduced volume electrostatic application ...

Deposition from the conventional sprayer dissipated at the same rate for both summer and winter applications; electrostatic application dissipated almost twice as fast in summer as in winter.... Over 30% of the surface residue on the leaf after wet spraying could be removed by mechanical brushing [which provides an assessment of the amount of residue that workers might actually contact]. Less than 14% of the residue from electrostatic spraying could be mechanically removed.

Although these data may satisfy some concerns about safety aspects of using electrostatic applications, additional research is needed in these and other areas. This is particularly true when considering the number of different pesticides that might potentially be applied using this application technique. Two major concerns are applicator exposure and spray concentration. If the spray is directed away from the applicator, there is little problem of contact because the charged droplets are attracted to the plants where the spray is directed. However, the higher concentration used in the spray tank of electrostatic and other low volume, high concentrate sprayers is a problem from a pesticide labeling perspective. The pesticide label is a law. If a statement is made on the label regarding specific dilution rates (for example, if the label states "Apply in at least 100 gallons of water per acre"), and the label does not otherwise suggest the use of "concentrate sprays," then it is illegal to use the pesticide in concentrate sprays because it is inconsistent with the label.

It is ironic that greenhouse labels that specify a given rate of pesticide per 100 gallons of water often include no recommendation about how much water should be used per acre or unit of bench area. In essence, these labels allow legal application of an unlimited amount of pesticide active ingredient per acre, but forbid use of reduced volume sprayers that may apply greatly reduced rates of pesticide active ingredient.

The labels of many newer pesticides registered for greenhouse use include directions for use in reduced volume ("concentrate") sprayers and foggers. The future "fast-track" registration for bio-rational pesticides may allow more efficient application techniques. Currently, the greenhouse industry, the University of California, and the California Department of Pesticide Regulation are working cooperatively to address the regulatory issues. In the meantime, growers who wish to use reduced volume application systems are limited to pesticides labeled for that use.

INSECT SCREENING MATERIALS FOR GREENHOUSES

Installation of fine-mesh screens on doors and vents to limit entry of pest insects into greenhouses is becoming a popular technique among

commercial growers eager to reduce their use of chemical pesticides. Such screening can be beneficial in hobby greenhouses, too—but careful design is necessary, since the total greenhouse volume relative to total entryway and vent area is generally much larger for commercial greenhouses than for hobby greenhouses. (In a smaller greenhouse, keeping out every individual pest insect is much more important than in a larger greenhouse, where the effect of a few interlopers will be "diluted" by the larger space.) In a hobby greenhouse, even the smallest air gaps need to be plugged up! And it is essential to avoid importing pests on newly introduced plants (keep your "newbies" in a separate quarantine area for a few days, checking them for pest problems, before putting them in the greenhouse).

Several types of insect screening materials are currently available. The mesh size needn't be very small to exclude most common pest insects, such as leafminers and whiteflies, but it can be difficult to exclude tiny thrips. The smaller the mesh size, the higher the screen's resistance to air flow, possibly requiring a larger vent area for proper greenhouse cooling, especially after dust and debris have accumulated on the screen. Greenhouse designers suggest that one complete air change per minute is appropriate for summer cooling in the North, one and one-half per minute in the South. Typical commercial ventilation systems are designed to move air through vents at a speed ("approach velocity") of about 250 feet per minute at a standard pressure differential from inside to outside of about 0.03 inches of water. Most of the currently available insect screening materials have significant resistance to air flow, so that at the standard pressure differential, there will be a lower approach velocity (see table below). If your greenhouse vents are sized for an approach velocity of 250 feet per minute without screening, if you install screening with an approach velocity of only 120 feet per minute, then to maintain ventilation as before, you will have to increase the area of the screened vents by a factor of at least 250/120 = 2.1. In practice, because of clogging of screens with dust and debris, you'll need to increase the area of the screened vents considerably more (by a factor of three to five). For a small greenhouse, this might require adding screened boxes over the original vents in order to provide enough extra area.

After installation, be sure to clean the screening regularly. But don't spray the screens with water on a hot day, when the ventilation system is on—you'll risk overheating when the mesh becomes filled with water droplets. And keep an eye out for insect invaders—the screens won't work perfectly!