Calibration of Air-blast Sprayers

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B. Bordelon, M. Ellis and R. Weinzierl (eds.) Used with permission.

Accurate calibration is the only way to ensure that a sprayer is applying the intended amount of chemical. The operator must know the amount of water that will be applied per unit of area to make a proper spray mix. Failure to calibrate a sprayer can result in crop injury, creation of a hazardous situation and wasted money. Frequent calibration identifies worn nozzles and keeps the operator aware of factors affecting application rate, such as travel speed, pressure and type of nozzle in use.

Precalibration check

Before calibrating, check the sprayer carefully. Be sure the nozzle tips are clean. Replace all worn or damaged nozzles. Check all hoses and fittings for leaks and aging. Make sure that the pressure is constant and the tank is free of dirt and debris.

Determining sprayer speed

The rate of travel needed for proper distribution of spray within the canopy can be determined by trial by placing water-sensitive spray paper at various locations within the canopy or trellis. For proper pesticide application, the air within the canopy must be completely replaced with spray-laden air from the sprayer. In general, a travel speed of 1 to 3 miles per hour has proved satisfactory, depending on the size and density of the canopy and the capacity of the sprayer. Before a sprayer can be calibrated, the travel speed must be determined in miles per hour (mph). To determine the travel speed, load the sprayer with clear water and make a test run in the orchard or vineyard. Always make the test run on similar ground — tractor speed changes dramatically from soft to firm surfaces. Set the tractor throttle at a level sufficient to operate the sprayer (PTO speed) and select an appropriate gear. Remember or mark these settings. Speed can be calculated by measuring the time required to travel any measured distance. A good conversion factor to remember is that 1 mph=88 feet/min. A convenient test length is 176 feet because it is a multiple (2x) of 88. The following formula can be used to determine travel speed:

$$\text{Speed (mph)} = \frac{\text{distance (ft)} \times 60}{\text{time (sec)} \times 88}$$

For example, if it requires 60 seconds to travel a measured distance of 176 feet, the travel speed is:

$$\text{mph} = \frac{176 \times 60}{60 \times 88} = \frac{10{,}560}{5{,}280} = 2 \text{ mph}$$

Determining nozzle flow rate

To select the correct nozzle and whirlplate sizes, the total gallons per minute (gpm) of output for each particular application must be determined. To determine gpm, it is necessary to know the travel speed of the sprayer (mph), the gallons per acre (gpa) to be applied and the spacing (W) between the rows of plants. Once these three variables are measured or selected, a simple equation can be used to calculate the gpm. This equation is for one side of the sprayer manifold only. Double the calculated answer if both sides of the sprayer are to be used. Once the nozzle and whirlplate combinations are determined, place the same size nozzles and whirlplates in both sides of the sprayer if both sides are to be used.

Step 1. Calculate the total gpm required per side:

$$\text{gpm (per side)} = \frac{\text{gpa} \times \text{mph} \times W}{1{,}000}$$

gpm = gallons per minute (per side)
gpa = gallons per acre
mph = speed (in miles per hour)
W = spacing between rows (in feet)

Example: You have decided to apply 70 gpa while traveling 2 mph, and the rows are spaced 10 feet apart. What is the gpm per side?

$$\text{gpm} = \frac{70 \times 2 \times 10}{1{,}000} = \frac{1{,}400}{1{,}000} = 1.4 \text{ gpm}$$

Step 2. Select the correct nozzle-whirlplate combination and operating pressure. Air-blast sprayers normally use disk-core-type cone spray tips. The correct size nozzles and whirlplates can be selected by using a table, which indicates the nozzle size and gallons-per-minute output at various pressures using specific whirlplates. These tables can be found in the sprayer manufacturer's literature or in nozzle catalogs. Nozzles in the sprayer manifold should be arranged so that approximately *two-thirds of the total flow comes from nozzles in the upper half of the manifold, and one-third of the total flow comes from nozzles in the lower half.* Adjust nozzles this way to provide uniform coverage throughout the canopy. It should provide adequate penetration to the top and center of the canopy while avoiding excess application in the lower outside areas.

Step 3. Install the nozzles in their proper outlets. Inspect and clean all nozzles and outlets and determine that the sprayer is operating correctly. Nozzles are a very important part of the sprayer; if any defects or wear is showing in the nozzles, replace them.

Step 4. Measure the total gpm from all the nozzles selected in Step 2. Fill the sprayer tank at least half full. Prime the sprayer system and check all the nozzles to make sure none are clogged or partially clogged. Record the exact level of water in the spray tank. Bring the sprayer up to the desired pressure and turn the nozzles on. Use a stopwatch to record how long the sprayer is running. The sprayer should be operated for at least 3 minutes. Record the new level in the tank or measure the amount of water needed to refill the tank to the original level.

Example: The spray tank is filled to the 100-gallon level. It was predetermined from the manufacturer's tables that the nozzles selected would give a total gpm output of 4. The sprayer was operated for 5 minutes at 150 psi on the gauge. After the 5 minutes, the sight gauge read 75 gallons. The actual output was:

100 gal (start) - 75 gal (stop) = 25 gal per 5 min = 5 gpm

The theoretical output from table information, however, was 4 gpm. When actual output differs from the calculated output, make adjustments by changing the pressure (when the difference is small) or changing the nozzle sizes (when the difference is large). Experiment with the pressure to see if the output can be fine-tuned. Refer to manufacturer's tables for recommended operating pressures for nozzles. Never operate above or below recommended pressures. Repeat these calibration procedures whenever changes are made in the speed, gallons per acre or row spacing. Periodically check the output from the nozzles during the spraying season. Remember, the effectiveness of the spray material depends directly on your skill as an operator. Field test to confirm calculations:

$$\text{gpa (gallons per acre)} = \frac{\text{gal sprayed} \times 43{,}560\ \text{ft}^2}{\text{distance traveled (ft)}}$$

Example: A field test is run in which 10 rows, each 200 feet long, were sprayed. Row spacing was 10 feet. It took 35 gallons to refill the sprayer to the original level. What was the gpa?

$$\frac{35\ \text{gal} \times 43{,}560\ \text{ft}^2}{2{,}000\ \text{ft} \times 10\ \text{ft}} = 76\ \text{gpa}$$