Precision Application Depends on Accurate Calibration of Sprayers and Spreaders

By Steve and Suz Trusty

Accurate calibration of sprayers and spreaders allows precise application of material at proper labeled rates in accordance with local, state and federal regulations. The rates listed on product labels have been determined through extensive research and testing to be the most effective to accomplish the task for which the materials are being applied. Using less of the product may not accomplish that purpose and may make a second application necessary, which is more expensive than doing it right the first time. Using more of the product may cause damaging side effects and definitely will be more expensive.

SPRAYERS

Hand-pressurized and powered sprayers both operate on the same basic principles. Start with clean and well-maintained equipment prior to calibration on both types of sprayers. Calibrate both types using plain water.

Hand-pressurized sprayers

Make sure spray tips are clean. Spray water through the tips to visually check the delivery pattern. On individual tips, check for clogging or uneven delivery of material. Then fill the sprayer tank with a premeasured amount of water, generally 1/2 to one gallon.

Pressurize the unit, but be consistent. For example, always pump 15 times. Once the unit is pressurized, start spraying in a premeasured area of known size. For handheld or backpack sprayers, the best size for a premeasured area is 1,000 square feet. Spray the entire premeasured area.

Then pour the water left in the sprayer into a clean container and measure the amount. Subtract the leftover amount from the beginning amount. The difference is the amount of material actually sprayed based on the walking speed of the person spraying and the pressure level to which the sprayer was set. This determines the amount of liquid sprayed per the premeasured area of the site. Repeat this entire procedure three times to develop consistent results. Always calibrate and spray under standard conditions, with winds of 10 miles per hour or less.

Power sprayers

To check calibration accuracy, check the output of each individual nozzle. First, adjust the operating pressure for your sprayer. Find the numbers on the nozzles that identify the size and style. All nozzles on the sprayer must be identical. Refer to the nozzle manufacturer's catalog for information on that nozzle. Each specific nozzle will be rated for the capacity of the nozzle in gallons per minute (GPM) at a certain pressure in pounds per square inch (psi). For example, a nozzle may have a capacity of .28 GPM at 20 psi; the same nozzle could have a capacity of .45 GPM at 50 psi.

Calibrate the sprayer by referring to the catalog for the correct pressure setting and the GPM capacity for the nozzles. Adjust the pressure regulator valve to the desired pressure. To avoid excessive wear in actual spraying conditions, run the sprayer at the lowest pressure setting possible to deliver the number of gallons needed.

Make sure the suction-line valve is open. Select a container with easy-to-read measurement marks. Set a specific time interval, such as 30 seconds, and catch the water output from a single nozzle in the container. Measure and record the output. Follow the same steps to check the output from each of the remaining nozzles. Compare the output as delivered by each nozzle.

Any tip with a variance of plus or minus 10 percent should be replaced. Once tips are replaced, repeat the procedure to recheck output accuracy. Continue changing tips until all are within the acceptable, less-than-10-percent range.

When the nozzles are operating properly, recheck the degree of overlap specified by the manufacturer for that nozzle size and type. For example, some nozzles have a 100-percent overlap specified, meaning that each nozzle sprays on each side to the center of the nozzle next to it.

After these adjustments have been made, arrange to test the accuracy of the spray pattern along the boom by operating the water-filled sprayer on a dry portion of an unused paved area, such as a parking lot, with no visible wind movement to alter the spray pattern. Make adjustments as indicated by the spray delivered and recheck for accuracy.

In actual operation, it is essential that the sprayer deliver the precise amount of material per acre (or per 1,000 square feet) recommended by the product manufacturer. The ground speed at which the sprayer travels is combined with all the other factors of the nozzle operation to determine this application rate.

If your sprayer is not equipped with a spray monitor, you'll need to set ground speed for accurate application of materials. Measure a set distance on a surface similar to that on which spraying will take place. For example, mark off 100 feet for speeds up to five miles per hour; 200 feet for speeds ranging from five to

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10 miles per hour. Base the width of the premeasured area on the width of the spray boom. The measuring area should give the equipment a "straight shot" run span appropriate to the type of sprayer being calibrated.

Fill the sprayer tank. Select the gear setting that will be used and run at wide-open throttle at all times. Then operate the unit through the measured area in each direction. Turn the sprayer on and off while at operating speeds and time the spray interval from the beginning to ending point. Average these times. Use the equation or chart below to determine ground speed. With a spray monitor, this determination is done for you.

Repeat this procedure three times for accurate measurement of time and distance. Now that you have determined the time it takes to cover the premeasured area, measure the volume of output from each spray tip for that same time interval. Add the total output from each of the tips to find the total liquid spray rate. That total is the volume of spray that actually will be delivered over the designated area. Again, repeat the procedure to ensure consistency and accuracy.

Individual walking speed may influence the proper calibration of walk-behind spreaders.

With the calibration volume known, you can now mix material according to the calibration rate. To fill a power sprayer with a known output — say 100 gallons per acre — read the product label to find the amount of material that should be applied per 100 gallons or per acre.

Seasonal Pre-Spray Preparation

Before using a sprayer, check it thoroughly. Inspect the pump bearings, seals and drive. Turn the pump sheave by hand. If it doesn't move freely, bearings may require replacement. Look for any leakage around the seals. Replace parts as necessary. If the pump is belt-driven, check the belt condition. Replacing the belt each spring as part of the preparation process may be best.

Make sure all safety shields are installed properly. Check the tank for corrosion, scale and foreign material. These problems will be more likely if proper cleanup procedures were not followed prior to seasonal storage. If problems exist, add a cleaning agent such as household ammonia or detergent to the water when filling the tank. Remove the drain plug, completely flushing the solution from the tank. You may need to repeat this process several times. Fill the tank with clear water for a final rinse.

Remove the suction line and pressure line strainers for inspection and cleaning. Clean with water, detergent and a brush. The basic function of these strainers is to save the sprayer from damage. If they are penetrated by sand or other impurities, they may plug the pump or clog the sprayer. If the suction strainers become plugged, the pump may be starved for fluid and could pump air, damaging the system. Cracked, damaged or broken strainers must be replaced.

Examine the suction hose from the strainer to the pump. If this collapses inadvertently, it could impede fluid flow. Replace as necessary.

New spray nozzles and screens (if your sprayer is equipped with screens) should be installed to ensure spraying accuracy for the start of the season. Make sure nozzle placement is correct. Follow the recommendations of the nozzle manufacturer for the proper degree-angle nozzle tilt for the nozzles used.

Keep one unused nozzle from the new set to compare for nozzle deterioration at appropriate usage intervals (daily, weekly or monthly) for the chemical(s) being applied. Lack of spray uniformity is commonly caused by nozzle wear. The orifice becomes larger due to the abrasive action of the materials passing through it, in turn causing increased or uneven output from that nozzle.

Examine the sprayer hoses and piping for weathering cracks, kinks or damaged areas. If the suction hose appears worn or collapsed at any location, replacement is recommended. Because downtime is so critical during the rush of the season, many maintenance supervisors prefer to replace sprayer hoses as a standard procedure during seasonal preparations.

Reinstall the spray monitor (if equipped) and flow meter. Reinsert all drain plugs that have been removed during seasonal storage. Check to ensure that all drain plugs fit properly and securely. Lubricate all bearings.

Fill the sprayer tank with water. A tank full of water is used to verify if any leaks are present and can be used for calibration. Make sure nozzle size, nozzle spacing, flow rate and spray pattern are uniform across the boom.

Information supplied by the nozzle manufacturer will show the precise amount of water a specific size and type of nozzle will deliver at a given pressure so that calibration may be measured precisely. With a spray monitor, calibration is set by programming the rate of application following this information.

Check calibration accuracy. Check that proper safety precautions have been taken to ensure operator safety and prevent contamination of the water source. Anti-backflow devices and check valves must be installed on pumping and filling equipment. Chemical-resistant clothing, gloves, hard hat, boots, goggles or face shield, and a respirator are appropriate items a sprayer operator should wear. The sprayer should be equipped with a freshwater tank for use in case of a chemical splash and for rinsing the operator's clothing after each use.

GRANULAR SPREADERS

Granular spreaders can be centrifugal-type or drop-type. Drop spreaders deliver material along the base of the hopper directly to the ground below. Centrifugal spreaders deliver material from the base of the hopper onto a dispensing device that rotates, throwing the material in a curving pattern over a distance to the right, front and left of the spreader hopper.

When calibrating either type, always start with clean equipment. Have a premeasured area of known dimensions. Calibrate the equipment with the material that will be applied. Use an amount of material realistic for the size of the spreader, enough to achieve a proper flow.

Drop Spreaders

Place the material in the spreader hopper. Start with some calibration number or letter. This will be easier if you have some experience with the material or if the product label gives a suggested calibration setting. Otherwise, the starting point is a random choice.

With drop spreaders, devices can be attached to the base of the spreader to collect output to measure for calibration determination. Without such a device, use plastic sheeting or butcher paper to collect the material. Walk a known, premeasured distance over this material, opening and closing the spreader while

walking at a normal, steady pace. Gather the material spread, pour it into a measuring device and weigh it. Be sure to deduct the weight of the measuring device from the total.

Once you know what rate the spreader is delivering material, you can compare that rate to what should be put down. Use the following formula:

$$\frac{\text{rate X area}}{\text{analysis of material}}$$

(for example .38 for 38 percent N)

Adjust the calibration number or letter up or down until the proper output rate is achieved. Once that calibration has been reached, repeat the measurement process two or three more times for consistency and accuracy.

Centrifugal Spreaders

Centrifugal spreaders have varying kinds of adjustments of distribution. The distribution pattern should be consistent, not skewed to the right or left. The peak of the pattern should be aligned with the center of the spreader.

Determining if a spreader is throwing more heavily to the left or right by sight alone may be difficult; however, kits are available to measure the patterns of some spreaders. For an accurate check without a kit, run the spreader across a series of boxes or grids that reach across the distribution swath to catch the material delivered. Measure the material caught in each container to determine inconsistency.

Most centrifugal spreaders have some form of adjustment to correct pattern skew. The main goal is to make the distribution pattern as even as possible so that the rate of material applied will be the same across the swath of the spreader.

Again, when checking calibration, use a sufficient amount of material to ensure proper flow. Weigh the amount of material put into the hopper. Base your initial calibration setting on product label recommendations if they are available.

To cover the premeasured area, work from the outside pass to the inside passes. Open and close the spreader while moving at a normal, consistent rate. With centrifugal spreaders, speed of movement is important: The faster the spreader moves, the farther the material is thrown. At a slower rate of movement, less area is covered with each

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pass, and a heavier rate of material is applied. On walk-behind units, the average swath — and therefore the average pass — is 6 to 8 feet. Position each pass so that the leading edge of the swath of the material applied is thrown back to the wheel prints of the previous pass.

Once the area has been covered, pour the material remaining in the hopper into a measuring device and weigh it. Be sure to deduct the weight of the container. Subtract the amount of material remaining from the amount initially placed in the spreader. Compare the amount of material actually applied to the label application rate. Use the formula shown above.

Reset the application rate up or down to reach the proper calibration rate for accurate distribution. Once the accurate setting has been reached, repeat the procedure two or three more times to ensure accuracy.

Because material will be applied with each checking process, have multiple premeasured areas on which to apply the product. If a deflector shield is to be used for the outside pass with a centrifugal spreader, check calibration with the deflector attached. Then make appropriate adjustments in the application rates to ensure proper material delivery.

Large, pull-behind spreaders are calibrated in the same manner as smaller, walk-behind units but on a bigger scale. Because emptying a bigger hopper can be difficult, the amount of material left in the hopper usually can be determined from measurement markings inside the hopper or from the difference in starting and ending weight of the total unit.

Adjust for Individuals

Because each person walks at a different rate, each should calibrate walk-behind spreaders or handheld and backpack sprayers individually to arrive at an accurate calibration. Using a tonal stop watch can help set a more consistent walking speed for all personnel.

Once calibrations are set, cross-check them throughout the day. Ideally, this would be done at the beginning of every application. Realistically, check once or twice during the day on areas where measurements are known to ensure accuracy.

Equation for Determining Ground Speed:

$$\frac{\text{Distance (feet)} \times 60}{\text{Time (seconds)} \times 88} = \text{Speed (MPH)}$$

Chart for Determining Ground Speed:

	Time Required in Seconds to Travel:		
Speed in MPH	100 feet	200 feet	300 feet
0.5	13	272	409
1.0	68	136	205
1.5	46	92	136
2.0	34	68	103
2.5	27	54	82
3.0	23	46	68
3.5	20	40	58
4.0	17	34	5
4.5	15	30	46
5.0	13	28	41

Accurate application is to everyone's benefit. When applications are done right the first time, results will be more consistent and money will not be wasted. ❑

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