14. SPRAYER CALIBRATION

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The performance of any pesticide depends upon many things, not the least of which is proper application at the correct rate. Failure to apply the correct rate uniformly can lead to poor pest control, crop injury, or unnecessary expense.

Every sprayer should be thoroughly calibrated before the first use of the season, and the calibration should be checked periodically during the season. In addition, the sprayer should be recalibrated every time nozzles, pressure, or travel speed is changed.

BEFORE CALIBRATION

Remove nozzles and strainers, including in-line strainers. Using a soft brush, wash nozzles and strainers in soapy water. Be sure to remove all deposits. Do not clean nozzles with any hard object (such as a knife or wire) because this will destroy the nozzle.

Thoroughly wash out sprayer and flush lines using a strong detergent or commercial tank cleaner. Check hoses and connections for leaks or signs of aging or damage. Replace defective hoses. Check components such as the pressure gauge, pressure relief/regulating valve, control valves, and agitator. Replace defective parts.

Select proper size and type of nozzle for the particular pesticide application planned. Consult nozzle manufacturers' catalogs or pesticide labels for guidance. Replace nozzles at least once a year. If the sprayer is used on a large acreage, nozzles may need replacing more frequently. Remember that brass nozzles wear more quickly than stainless steel or ceramic nozzles.

Make sure every nozzle on the sprayer is the same type and size (an exception may be hooded sprayers; see discussion below). Then check for proper spray pattern. Replace nozzles that do not produce the proper pattern. Next, check for uniformity of nozzle output. This check needs to be done even if new nozzles are installed.

To check for uniformity of output, partially fill sprayer with clean water. Adjust pressure to the level desired during the spraying operation. Catch and measure output from each nozzle separately for a given length of time. Replace any nozzle having an output of 10 percent more or less than the average of all nozzles.

CALIBRATION PROCEDURE

The procedure uses the equation below.

$$GPA = \frac{(GPM)(5940)}{(MPH)(W)}$$

GPA = gallons per treated acre
GPM = gallons per minute
MPH = travel speed, miles per hour
W = effective coverage per nozzle, inches

Step 1. Determine effective coverage per nozzle, or W.

W = nozzle spacing for broadcast application
W = band width when banding with one nozzle per band
W = band width divided by number of nozzles per band if banding with more than one nozzle per band

Step 2. Determine travel speed.

Measure off a distance of at least 200 feet in a field with surface conditions similar to fields to be sprayed. Engage any equipment to be used during the actual spraying operation (such as a disk or planter), choose the gear and throttle setting you plan to use during actual spraying, and determine the time required to drive the designated distance. You can improve your accuracy by doing this several times and taking the average.

$$MPH = \frac{(\text{feet traveled})(60)}{(\text{seconds to travel})(88)}$$

Step 3. Determine nozzle output.

Partially fill the tank with the desired liquid carrier (water or fluid fertilizer), but do not add pesticide. Adjust the pressure to the level that will be used during the actual spraying operation. Catch the output from several nozzles separately for one minute. Average the output over nozzles. It is best to catch the output as ounces per minute (OPM) and then convert to gallons per minute (GPM).

$$GPM = \frac{OPM}{128}$$

Step 4. Determine sprayer output, as gallons per treated acre (GPA).

$$GPA = \frac{(GPM)(5940)}{(MPH)(W)}$$

Step 5. Determine amount of pesticide to add to tank.

$$\text{Amount to add} = \frac{(\text{pesticide rate per acre})(\text{gallons spray solution})}{GPA}$$

EXAMPLES

Broadcast Application: Preplant, Preemergence, or Postemergence Overtop

Assume you plan to broadcast 1.0 pint per acre of Reflex as a preemergence application. Your sprayer has nozzles mounted 19 inches apart along the boom, hence W = 19. The tank holds 240 gallons. It takes 20 seconds to drive 200 feet. You catch an average nozzle flow of 42 oz per minute (OPM).

$$MPH = \frac{(ft)(60)}{(sec)(88)} = \frac{(200\ ft)(60)}{(20\ sec)(88)} = 6.82$$

$$GPM = \frac{OPM}{128} = \frac{42}{128} = 0.3281$$

$$GPA = \frac{(GPM)(5940)}{(MPH)(W)} = \frac{(0.3281)(5940)}{(6.82)(19)} = 15.04$$

$$\text{Amount to add} = \frac{(\text{pesticide rate per treated acre})(\text{gallons spray solution})}{GPA}$$

$$\text{Amount to add} = \frac{(1\ pt\ \text{per treated acre})(240\ gal\ \text{solution})}{15.04\ gal\ \text{per acre}} = 15.96\ pt$$

Banded Application Using One Nozzle Per Row: Preemergence or Postemergence Overtop

Assume you plan to apply Cotoran behind the planter at the broadcast rate of 1 quart per acre. You want to make a 14-inch band of Cotoran over the row using a single nozzle per band. In this

case, W = 14. Your cotton is planted on 30-inch rows. The tank holds 240 gallons. It takes 28 seconds to drive 200 feet. You catch an average nozzle ouput of 26.5 oz per minute (OPM).

$$\text{MPH} = \frac{(\text{ft})(60)}{(\text{sec})(88)} = \frac{(200\text{ ft})(60)}{(28\text{ sec})(88)} = 4.87$$

$$\text{GPM} = \frac{\text{OPM}}{128} = \frac{26.5}{128} = 0.2070$$

$$\text{GPA} = \frac{(\text{GPM})(5940)}{(\text{MPH})(\text{W})} = \frac{(0.2070)(5940)}{(4.87)(14)} = 18.03 \text{ This is gallons per treated acre.}$$

$$\text{Amount to add} = \frac{(\text{pesticide rate per treated acre})(\text{gallons spray solution})}{\text{GPA}}$$

$$\text{Amount to add} = \frac{(1\text{ qt per treated acre})(240\text{ gal solution})}{18.03\text{ gal per acre}} = 13.31\text{ qt}$$

NOTE: When banding, always think of application rates in terms of "rate per treated acre," which is the rate given on labels. Obviously, you are not treating the whole acre, hence the pesticide rate per planted acre will be less. But, you have calibrated your sprayer output on the basis of "gallons per treated acre," and you want to calculate the amount of pesticide to add to the tank on that same basis.

Banded Application Using Two Nozzles Per Row: Postemergence-directed

Assume you plan to direct Caparol in a 16-inch band under the cotton. Your cotton is planted on 36-inch rows, you have two nozzles per row on your directed sprayer, and your sprayer tank holds 250 gallons. In this case, W = 8. The Caparol label suggests 1 quart per treated acre. It takes 25 seconds to drive 200 feet. You catch an average nozzle output of 19 oz per minute (OPM).

$$\text{MPH} = \frac{(\text{ft})(60)}{(\text{sec})(88)} = \frac{(200\text{ ft})(60)}{(25\text{ sec})(88)} = 5.45$$

$$\text{GPM} = \frac{\text{OPM}}{128} = \frac{19}{128} = 0.1484$$

$$GPA = \frac{(GPM)(5940)}{(MPH)(W)} = \frac{(0.1484)(5940)}{(5.45)(8)} = 20.22 \text{ This is gallons per treated acre.}$$

$$\text{Amount to add} = \frac{(\text{pesticide rate per treated acre})(\text{gallons spray solution})}{GPA}$$

$$\text{Amount to add} = \frac{(1 \text{ qt per treated acre})(250 \text{ gal solution})}{20.22 \text{ gal per acre}} = 12.36 \text{ qt}$$

NOTE: When banding, always think of application rates in terms of "rate per treated acre", which is the rate given on labels. Obviously, you are not treating the whole acre, hence the pesticide rate per planted acre will be less. But, you have calibrated your sprayer output on the basis of "gallons per treated acre," and you want to calculate the amount of pesticide to add to the tank on that same basis.

Hooded sprayers

Hooded sprayers can be a challenge to calibrate, depending upon the particular design and how one intends to use them. Hooded sprayers are relatively simple to calibrate if one is using them to apply herbicides only to the row middles or only directed under the cotton row. In that case, one would follow the procedures previously outlined for calibrating a banded application.

The original Redball hoods (Model 410 Conservation Spray Hoods) typically had three nozzles under the hood and one nozzle on either side of the hood directing spray into the row. The later "layby" or "dolphin nose" hoods (Redball model 420 Lay-By Spray Hoods) have one nozzle under the hood and one mounted into either side of the hood and directed under the row. Many operators block the nozzles mounted into the sides of the "layby" hoods and mount an adjustable post-directed nozzle on each rear corner of the hood. The newest version of spray hoods is the Willmar Model 915. It has three nozzles mounted under the row, and a kit can be purchased to mount a nozzle on the back of either side of the hood to direct under the row. If using adjustable post-directed nozzles spraying under the cotton row, make sure the patterns produced by the two nozzles overlap sufficiently under the row to provide uniform coverage across the band.

Any of the above types of hoods can be plumbed so that the nozzle or nozzles under the hood are on a separate system from the nozzles directing into the row. This technique allows one to apply different chemicals in the row middle from what is directed into the row. In that case, one would need to calibrate for each system independently. One would follow the previously described procedures for calibrating banded applications in the row middles and repeat the process for the directed spray.

When using the "layby" type hoods to apply the same chemical under the hood and directed into the cotton row, it is critical that one selects a lower output nozzle for directing under the row

compared with the single nozzle spraying under the hood. If all nozzles are the same size, and one tries to calibrate based on average nozzle output, there will be a much higher than intended herbicide rate in the directed band and a lower than intended rate in the row middles. This rate difference may result in cotton injury or inadequate control in the row middles. For example, if one is covering 28 inches with the single nozzle under the hood and directing a 14-inch band under the row using two nozzles, the effective coverage per nozzle under the hood is 28 inches and the effective coverage per nozzle in the row is 7 inches. If the same size nozzle is used both under the hood and directed into the row, the application rate in the cotton row will be four times greater than the rate in the row middle.

As an example of how to calibrate a hooded sprayer, assume your rig has three nozzles spraying under the hoods and two nozzles directing into the row and you have 36-inch rows. Your sprayer is plumbed to apply separate herbicides under the hoods and directed under the row. Assume the area being effectively covered under the hoods is 27 inches (hence W = 9) and you are making a 12-inch band under the row (W = 6). Your tractor has two 200-gallon saddle tanks. You intend to apply 2.0 pints Direx plus 3.0 pt Gramoxone under the hood, and 1.25 pounds of Suprend plus 2.5 pt of MSMA under the row. You will need to calibrate under the hood and under the row separately. It takes 44.5 seconds to drive 300 ft. For the nozzles under the hood, you catch an average of 24 ounces per minute. For the nozzles directing into the row, you catch an average of 20.5 ounces per minute.

Under the hood:

$$\text{MPH} = \frac{(\text{ft})(60)}{(\text{sec})(88)} = \frac{(300\text{ ft})(60)}{(44.5\text{ sec})(88)} = 4.60$$

$$\text{GPM} = \frac{\text{OPM}}{128} = \frac{24}{128} = 0.1875$$

$$\text{GPA} = \frac{(\text{GPM})(5940)}{(\text{MPH})(\text{W})} = \frac{(0.1875)(5940)}{(4.60)(9)} = 26.90 \text{ This is gallons per treated acre.}$$

$$\text{Amount Direx to add} = \frac{(\text{rate per treated acre})(\text{gallons spray solution})}{\text{GPA}}$$

$$\text{Amount Direx to add} = \frac{(2\text{ pt})(200\text{ gal})}{26.90\text{ GPA}} = 14.9\text{ pt}$$

$$\text{Amount Gramoxone to add} = \frac{(3\text{ pt})(200\text{ gal})}{26.90} = 22.30\text{ pt}$$

Directed in the row:

$$\text{GPM} = \frac{\text{OPM}}{128} = \frac{20.5}{128} = 0.1602$$

$$\text{GPA} = \frac{(\text{GPM})(5940)}{(\text{MPH})(\text{W})} = \frac{(0.1602)(5940)}{(4.60)(6)} = 34.5 \text{ This is gallons per treated acre.}$$

$$\text{Amount Suprend to add} = \frac{(\text{rate per treated acre})(\text{gallons spray solution})}{\text{GPA}}$$

$$\text{Amount Suprend to add} = \frac{(1.25 \text{ lb})(200 \text{ gal})}{34.5 \text{ GPA}} = 7.25 \text{ lb}$$

$$\text{Amount MSMA to add} = \frac{(2.5 \text{ pt})(200 \text{ gal})}{34.5 \text{ GPA}} = 14.5 \text{ pt}$$