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SS-AGR-102

Calibration of Herbicide Applicators [1]

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Calibrate your pesticide application equipment on a regular basis to ensure that output from each spray nozzle is consistent and the desired application output is achieved. If pesticide applicator equipment is not properly calibrated, the pesticide will probably be applied below or above the desired application rate. Under-application of pesticides generally leads to a lack of pest control and poor pesticide performance. Over-application increases cost and may unintentionally result in injury to desirable crop species.

The two most common methods for sprayer calibration are discussed below.

5940 Method

The 5940 equation is a very accurate way to determine sprayer output (Equation 1). Each term in this equation is discussed in order.

Equation 1:

GPA = (5940*GPM) / (MPH*W)

Where:

GPA = Gallons per acre

5940 = Constant number/value

GPM = Gallons per minute per nozzle

MPH = Miles per hour

W = Spacing between two nozzles or spray width of one nozzle (in inches)

GPM—Gallons per Minute

This is the amount of water or spray solution discharged per nozzle in one minute. The GPM can be measured by following the steps below.

1. Turn on the sprayer and hold a measuring cup or GPM measuring device underneath the nozzle for one minute.
2. Transfer the water into a measuring device that will accurately quantify the water in terms of either fluid ounces or milliliters.
3. Convert that amount of water from ounces or milliliters to gallons (because the desired unit is gallons per minute).

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One gallon consists of 128 fluid ounces or 3,786 milliliters. To convert to gallons, divide the amount of water acquired in one minute by 128 or 3,786; the number you need for this conversion depends on whether your container measures the water volume in ounces or milliliters. The result of this calculation is gallons per minute (GPM).

For the most accurate measurement, collect water from multiple nozzles to ensure that output is similar across the boom. It is common for a nozzle to become plugged, and this practice will identify any malfunctioning nozzle. You can also pour the samples together to determine an average GPM.

MPH—Miles per Hour

Most equipment will have a somewhat reliable speedometer. Nevertheless, check the accuracy of the instrument periodically because speed is directly linked to sprayer output in gallons per acre (GPA). If speed is doubled, GPA decreases by half; therefore, small changes in ground speed cause large changes in the amount of applied pesticide. To check speed, measure an area (usually 100 feet) and note the time it takes to travel that distance. If using a tractor, make sure the engine speed (RPM) and transmission gear are at the same settings as those used for spraying. After you have traveled the course, use the following equation:

MPH = (distance in ft*60) / (time in sec*88)

W—Nozzle Spacing/Spray Swath (or Width)

This is a measurement in inches describing spacing between two nozzles or width covered by one nozzle. If calibrating a boom sprayer, this measurement is the spacing between the nozzles (Figure 1). Common spacing for flat fan nozzles ranges from 15 to 24 inches (see manufacturer specifications). If using a boomless nozzle (Figure 2), W will be the width of the pattern for that nozzle. One boomless nozzle will commonly spray a pattern of 12 to 15 feet. In that case, W for that nozzle will be between 144 and 180 inches.

Figure 1. Measuring nozzle spacing to determine "W."
Credits: J. Ferrell, UF/IFAS

Figure 2. A wide-swath, boomless nozzle.
Credits: J. Boyd, University of Arkansas

After determining GPM, MPH, and W, plug these values into Equation 1 and solve to get GPA. Equation 1 will allow you to determine sprayer output in terms of gallons per acre. However, if GPA is too high or too low, change GPM (by increasing pressure or changing sprayer nozzles) or the driving speed.

Increasing spray pressure increases GPM and that in turn increases GPA, but only slightly. To illustrate, spray pressure will have to quadruple in order to double GPM. Most spray nozzles are not rated to operate over such a large range of pressures, so adjusting pressure is simply a way to fine-tune sprayer output. Large adjustments in GPM or GPA are best achieved by changing to different-sized nozzles and adjusting pressure, or changing driving speed if possible.

What GPA is common? GPA varies depending on the type of application. Generally, carrier volumes that range from 15 to 30 gallons per acre will perform very well. If a specific GPA is desired, Equation 1 can be reorganized—as in the example below—to solve for GPM.

Equation 2:

GPM = (GPA*MPH*W) / 5940

In this example, inputting the desired GPA, speed (MPH), and nozzle spacing (W) will give the exact amount of water that must be caught from one nozzle in one minute (GPM). However, the equation will give the answer in gallons per minute. Since gallons are difficult to measure with accuracy, convert the answer to ounces or milliliters. Multiplying GPM by 128 (for ounces) or 3,786 (for milliliters) will give the amount of ounces or milliliters that must be caught from one nozzle in one minute to achieve the desired GPA.

1/128 Acre Method

The 1/128 acre method is a simplified form of calibration based on spraying 1/128 acre. There are 128 ounces per gallon; therefore, the number of ounces sprayed per 1/128 acre is equal to the number of gallons sprayed per acre (GPA). The advantage of this method is that there are fewer opportunities for mistakes, because little math is involved. This procedure is ideal for boom-type sprayers but less effective for boomless sprayers. If calibrating a boomless sprayer, use the 5940 equation. A boom-type applicator can be calibrated accurately by following the steps below.

1. Determine nozzle spacing or swath width. This is the W term from Equation 1.

2. Using Table 1, determine the course length you will need to travel, relative to nozzle spacing. Measure and mark the distance required and prepare to drive that distance.

3. Record the time required to drive the length of the calibration course at gear, engine RPM, and implement settings to be used while spraying.

4. Park the sprayer, maintain the engine RPM used to drive the course, and turn on the sprayer.

5. Collect all spray from one nozzle for the amount of time determined in Step 3.

6. Measure the ounces caught. This is equal to gallons per acre of spray applied.

7. Repeat Steps 5 and 6 for several other nozzles to ensure accuracy.

Table 1.

Swath Width or Nozzle Spacing (in)*	Course Distance (ft)
16	255
18	227
20	204
22	186
24	170

*If the necessary nozzle spacing is not listed above, the course distance for a specific nozzle spacing can be calculated using the following equation: Course Distance (ft) = 4080 / (Nozzle Spacing (in)).