



Texas Agricultural Extension Service
The Texas A&M University System

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Sprayer Calibration for Turfgrass



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Proper application of pesticides and fertilizers on turfgrass is possible only with an accurately calibrated sprayer. Failure to calibrate spray equipment can result in a misapplication of pesticides and fertilizers by more than 10 percent. Misapplication can lead to repeat applications, damaged plants, excess cost or environmental contamination.

Before every use, check the sprayer system and nozzles. Calibrate sprayers every fourth application. Before any spraying operation, make a visual check of the spraying unit. Make sure all equipment is in working order and that there are no leaks in hoses or connections.

VISUAL inspection check list

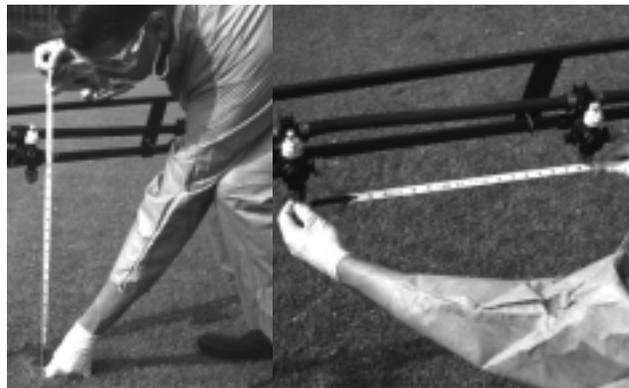
1. Fill the sprayer tank approximately half full with water only. (Never add pesticides to a sprayer until it is checked for leaks and is in good operating condition.)
2. Check tank, hoses and fittings for leaks.
3. Start the sprayer and engage the pump. Water should recirculate into the tank.
4. Check the pump, hoses and fittings for leaks again and fix any leaks. A small leak at the beginning of the spraying operation may result in a large leak while spraying.
5. Turn on the spray boom and check for leaks in the hoses that lead to the boom, the nozzle hoses and the nozzle assemblies.
6. Visually check the spray pattern from each nozzle. If a nozzle has an improper spray pattern, replace it with a new one of the same style and output volume.
7. Measure the distance between nozzles. Adjust the spray tips to the recommended height from the ground.



Check and clean filters on the sprayer before use.

PHYSICAL adjustments and measurements

1. Remove and clean the main in-line filter.
2. Remove, clean and replace, if needed, the screen behind each nozzle.
3. With the nozzles removed, engage the pump and flush out any particles or debris.
4. Turn off the pump and return the nozzles to their assemblies, making sure the spray pattern stays in line with the boom.
5. Set the sprayer pressure to the appropriate operating pressure for the particular type of nozzles. For example, the optimal operating pressure for flat fan tips is 40 psi (pounds per square inch).



Measure the nozzle height from the ground and the distance between nozzles in inches.

6. With a large measuring container (used for calibration only) catch the output from each of the nozzles for 1 minute and compare to the specified output for the nozzles.
7. If one nozzle's output is off by more than 10 percent, replace it with a new one. If two or more nozzles are off by 10 percent, replace all of the nozzles on the boom. (See section on nozzle calibration to determine percent error.)
8. Refill the tank half full.
9. Select the machine/tractor gear and RPM (revolutions per minute) that will be used during the spraying operation. The gear and RPM settings should allow a speed between 3 to 5 MPH (miles per hour). Actual speed should be based on the conditions of the site to be sprayed and operator ability. (Recalculate sprayer output anytime the speed of the sprayer is changed.)

When the sprayer has been thoroughly checked, begin the actual calibration process. There are three main formulas that calculate GPA (gallons per acre), GPM (gallons per minute), and MPH (miles per hour). Use each of these formulas to determine and or change the output of the sprayer over a given area (usually per acre or per 1,000 square feet).

MILES per hour formula

Before making any of the other calibration calculations, determine the actual ground speed of the sprayer in miles per hour (MPH).

1. Measure out 200 feet of terrain in the area to be sprayed and mark it visibly.
 2. Fill spray tank to half full.
 3. Extend the booms of the sprayer.
 4. Select and record an appropriate RPM and gear that allows the tractor to maintain a constant speed while maintaining recommended spray pressure.
 5. Drive the sprayer through the 200-foot course at least three times, recording the time, in seconds, for each test run. (Begin the course run well behind the first mark so the sprayer will be up to full speed when the first mark is crossed. Starting at the line increases the time it takes to cross the 200 feet, thus giving an inaccurate speed estimation.)
 6. Average the three test run times (in seconds).
- $$\frac{\text{time 1} + \text{time 2} + \text{time 3}}{3} = \text{average time of sprayer to cross 200 ft.}$$
7. Incorporate the appropriate course distance and average time (in seconds) into the following formula to calculate the speed of the sprayer at the selected gear and RPM setting.

$$\text{MPH} = \frac{\text{test run distance (ft.)} \times 60}{\text{average time} \times 88}$$

GALLONS per acre formula

Next, determine the output of the sprayer. Simply incorporate the output of a **single nozzle** in gallons per minute (GPM) and multiply by 5,940. Then divide by the product of miles per hour (MPH) times the distance between nozzles in inches (width) on the spray boom.

$$\text{gallons per acre} = \frac{5,940 \times \text{GPM}}{\text{MPH} \times \text{width}}$$

- width:** distance between nozzles in inches, not the width of the boom
- GPM:** the average output of each nozzle in tenths of a gallon, not ounces

Example: Assume the following information has been gathered.

GPM = 0.5 (output of a single nozzle is 1/2 gallon per minute)

MPH = 4.5 (as calculated from the MPH formula)

width = 18 inches (distance between two nozzles on the boom of the sprayer)

Plug in the correct numbers to the GPA formula as shown.

$$\text{GPA} = \frac{5,940 \times 0.5}{4.5 \times 18} = \frac{2,970}{81} = 36.66 \text{ GPA}$$

At these set parameters, the sprayer has an output of 36.66 gallons per acre. To determine gallons per 1,000 square feet, divide the GPA by 43.56.

$$\frac{36.66 \text{ GPA}}{43.56} = 0.84 \text{ gallons per 1,000 sq. ft.}$$

GALLONS per minute formula

Now that sprayer output over 1 acre has been determined, recalculate the formula to adjust the output of the sprayer.

In the previous example, the pesticide must be applied in 20 gallons of water per acre, so 36.66 GPA from the above calculation is too much. Options are to increase the speed of the sprayer or change the output of the nozzles.

Do not increase the speed of the sprayer if it is already at or near 5 MPH. In this example, the speed is close to 5 MPH, so increasing speed is not a good option. However, the output of the nozzles can be changed easily by switching nozzles. To determine the output of the nozzle needed, use the gallons per minute formula.

$$\text{GPM} = \frac{\text{GPA} \times \text{MPH} \times \text{width}}{5,940}$$



Drive the 200-foot distance with the tank half full, and at desired RPM and gear settings.

Use the same information from the GPA example, except substitute 20 GPA for the 36.66 GPA calculated for the sprayer.

$$\frac{20 \text{ GPA} \times 4.5 \text{ MPH} \times 18 \text{ inches}}{5,940} = 0.27 \text{ GPM}$$



Therefore, changing to a 0.27 GPM nozzle allows the application of 20 gallons mixed material per acre. The nozzle selected probably would put out 0.30 GPM; therefore, reduce the sprayer pressure (PSI - pounds per square inch) to get 0.27 GPM.

NOZZLE calibration

All nozzle tips used in spraying applications have a number stamped on them. The number indicates output (GPM) and recommended operating pressure. For many nozzles, the rated pressure is 40 PSI, but this can change between types and styles of nozzles.

For a flat fan nozzle, the number indicates the angle of spray and the output in gallons per minute. The first two or three numbers are the spray angle of the tip. For example, an 8005 nozzle has an 80-degree angle. For a 11005 tip, the spray angle is 110 degrees.

The last two numbers are the output of the nozzle in gallons per minute. For an 8005 tip, the output is 0.5 gallon per minute. For an 8015, the output is 1.5 gallons per minute.

To calculate the percent error for a worn or old nozzle, complete the following steps for each nozzle.

1. Set proper PSI for the nozzle on the boom.
2. Using water only, engage the spray flow for the boom.
3. Collect the water from a single nozzle in a large measuring container for 1 minute.
4. To find GPM, divide the total ounces collected in the container during 1 minute by 128 (number of ounces in 1 gallon).

Example: The boom is fitted with 8005 tips. From the first tip, 75 ounces were collected in 1 minute.

$$\frac{75 \text{ oz. collected}}{128 \text{ oz. per gallon}} = 0.58 \text{ GPM actual}$$

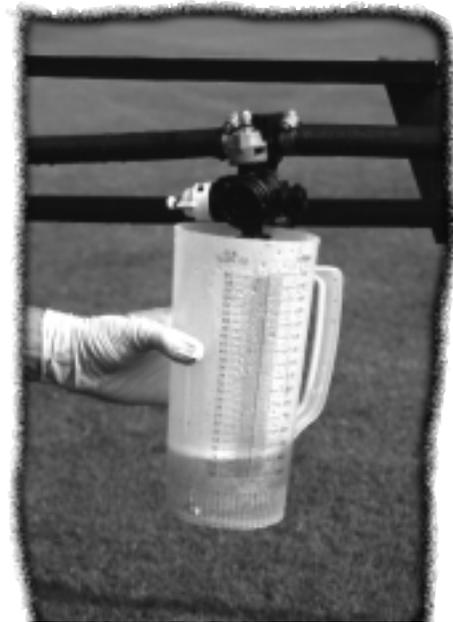
5. Subtract the actual GPM from the GPM of the nozzle number to get the difference in GPM.

$$\begin{array}{r} 0.58 \text{ actual GPM} \\ - 0.50 \text{ nozzle set GPM} \\ \hline 0.08 \text{ difference in GPM} \end{array}$$

6. Divide the difference in actual GPM by the GPM of the nozzle number to determine the percent error in the tip ($0.08 \div 0.50 = 0.16$ or 16 percent). A 16 percent difference between the actual nozzle output and the expected nozzle output is too large. If one nozzle is off by more than 10 percent (0.10), replace it with a new one! If two or more nozzles are off by more than 10 percent, replace all nozzles on the boom.

KEYS to proper calibration

1. When calculating MPH always have the spray tank half full.
2. Always have the sprayer moving at full speed before crossing the starting line of the 200-foot course.
3. Always make at least three runs over the 200-foot course and average the time.
4. Set and record the RPM speed and the gear selection for future use in the MPH calculation.
5. Read the label on the pesticide to determine the best GPA volume to apply the product.
6. Follow all safety recommendations for the equipment and the pesticides in use.



Measure the output from each nozzle for 1 minute.

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