

AREA METHOD

1. Fill or partially fill the sprayer with a measured volume of water, for example, 2 gallons. Lay out a test course in the area to be sprayed. Choose a starting point, and spray until the sprayer is empty. Be sure to maintain a constant walking speed. Measure the distance that was sprayed and the full working width of the sprayer. Use row spacing for row crop applications or the full swath if you are using a broadcast application. Use treated band width for band applications. Calculate the area sprayed:

$$\text{Area sprayed (acres)} = \frac{\text{Spray distance (ft)} \times \text{Spray width (ins)}}{522,720}$$

2. Calculate the application rate (gpa):

$$\text{Application rate (gpa)} = \frac{\text{Volume sprayed (gal)}}{\text{Area sprayed (acres)}}$$

3. Compare the application rate measured to the rate required. If the measured application rate is not within 5 percent of the recommended rate, choose the appropriate adjustment method and reset the sprayer.
4. Recheck the system. Once you have the accuracy you want, calibration is complete.

Spot spraying

Accurate spot spraying requires visual examination of the target. If the chemical is mixed according to manufacturer recommendations for spot spraying, spray the target until lightly wet. Avoid overspraying; stop spraying just before the water begins to run from the foliage.

Making adjustments

When calibrating a sprayer, changes are often necessary to achieve the application rates needed. The sprayer operator should understand what changes can be made to adjust the rate and what the limits of each adjustment are. The goal should be to have application rate errors of less than 5 percent. The adjustments and the recommended approach are:

- *Pressure:* If the error in application rate is less than 10 percent, adjust the pressure if the sprayer has a pressure adjustment feature. Increasing pressure will increase the application rate; decreasing pressure will decrease the application rate. Increasing pressure also may increase the number of fine droplets produced and increase drift potential.
- *Nozzle size:* If the error is greater than 10 percent, change nozzle size. Use a larger nozzle for higher rate, a smaller nozzle for a lower rate.

Adjusting ground speed while walking is difficult to do and still maintain accuracy. It is better to walk at a consistent speed during all applications. Once you have established a comfortable and repeatable pace, try to maintain it. Do not change your speed to try to adjust output.

Prepared by

Gary T. Roberson, Extension specialist,
Department of Biological and Agricultural Engineering,
North Carolina State University

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CALIBRATING A BACKPACK SPRAYER

Handheld and backpack sprayers are inexpensive tools for applying crop-protection products on small acreages. Yards, gardens, and small orchards are areas that often require applications to protect against weeds, insects, and diseases. Effective pest control depends on applying the correct amount of the protective product. Proper calibration, measurement, and adjustment of sprayer output are essential to achieve accurate application.

Preparing to calibrate

For calibration to be successful, you need to perform several tasks before going into the field to work on adjustments. Calibration will not be worthwhile if the equipment is not properly prepared. Whenever possible, calibration should be performed using only water. If you must calibrate using the product mixture, do it on a site approved on the chemical label and with wind speeds of less than 5 miles per hour. Be sure to wear proper protective clothing and equipment.

Follow the steps outlined below to prepare spraying equipment for calibration:

1. Inspect the sprayer. Be sure all components are in good working order and undamaged. Pay particular attention to the pump, control wand, strainers, pressure gauge, pressure regulator, and hoses. Be sure there are no obstructions or leaks in the sprayer. If the sprayer has a pressure gauge, check it for accuracy. Most backpack sprayers have pressure regulators that allow delivery of the spray mix at a constant pressure. Since constant pressure must be maintained for a consistent application rate, these devices must be kept in good order. Follow the manufacturer's recommendations for periodic cleaning and inspection. Few handheld sprayers contain pressure regulators, but fairly even pressure can be maintained if the hand pump is operated at a constant number of strokes per minute.
2. Check the label of the product or products to be applied, and record the following information, if provided:
3. • *Application rate:* gallons per acre (gpa).

- **Nozzle type:** droplet size and shape of pattern (flat fan, even fan, solid cone, hollow cone).
- **Nozzle pressure:** pounds per square inch (psi).
- **Type of application:** broadcast, band, or spot.4. Gather information about the sprayer and how it is to be operated:
- **Swath width:** inches. Most backpack sprayers use a single nozzle. Swath width is the effective width of the area sprayed, being sure to account for overlap between passes. For example, a flat fan nozzle requires overlapping passes to achieve uniform coverage. If you use a sweeping motion from side to side, be sure to measure the full width sprayed as you walk forward. If you spray on foliage in rows, use the row spacing. Dyes can be mixed with the test water to show what has been covered by the spray. Some sprayers use mini-booms with multiple nozzles. For these sprayers, the swath width per nozzle should be the spacing between the nozzles on the boom.
- **Ground speed:** miles per hour (mph). When using a backpack sprayer, you should walk at a comfortable pace that is easy to maintain. Walking slowly means the task will take longer to complete, but walking at a high speed may be tiresome. Choose a safe, comfortable speed that will enable you to finish the job in a timely manner. You can calculate your ground speed by determining how long it takes you to walk a measured distance. Lay out a calibration course in the area to be sprayed or in an area with similar walking conditions. Use the equation or the chart below to determine your ground speed:

$$\text{Ground speed (mph)} = \frac{\text{Distance (ft)}}{\text{Time (sec} \times 1.47)}$$

Ground Speed Chart	
Time (secs) to walk 100 ft	Speed (mph)
68	1.0
45	1.5
34	2.0
27	2.5
23	3.0
19	3.5
17	4.0
15	4.5
14	5.0

- **Discharge rate:** gallons per minute (gpm). In order to choose the correct nozzle size, the discharge rate must be calculated, using application rate, ground speed, and swath width. If the sprayer has a single nozzle, swath width is the effective width sprayed. If it has a boom with multiple nozzles, swath width should be the spacing between nozzles.

$$\text{Discharge rate(gpm)} = \frac{\text{Application rate} \times \text{Ground speed} \times \text{Swath width}}{5,940}$$

5. Choose an appropriate nozzle based on the manufacturer's charts, and install it on the sprayer.
6. Fill the tank with water and adjust the pressure to the recommended range. Measure the discharge rate for the nozzle. This can be done by using a flow meter or by using a collection cup and stopwatch. The flow meter should read in gallons per minute (gpm) and must be calibrated to ensure accuracy. If you are using the collection cup and stopwatch method, you can use the following equation to convert ounces collected and collection time, in seconds, into gallons per minute.

$$\text{Discharge rate (gpm)} = \frac{\text{Ounces collected}}{\text{Collection time} \times 2.13}$$

7. Compare the discharge rate of the nozzle or nozzles on the sprayer to the manufacturer's tables for that nozzle size. Reject any nozzle that has a bad pattern or that has a discharge rate 10 percent more or less than the manufacturer's recommended rate. If the sprayer has more than one nozzle, reject any nozzle that is 10 percent more or less than the average of all nozzles on the sprayer. Install a new nozzle to replace the rejected one and retest the sprayer.

Once you have properly prepared the sprayer for calibration, select a calibration method.

Choosing a method

Two methods may be used to calibrate a backpack sprayer:

- **128th acre.**
- **Area.**

The 128th acre method is a "time"-based method that requires using a stopwatch or watch with a second hand to ensure accuracy. The area method is based on a test distance and swath measured in the field. Each method offers certain advantages. Choose the method you are comfortable with and use it whenever calibration is needed. Calibrate the sprayer then application rate, type of product, or nozzles are changed.

128TH ACRE METHOD

1. Calculate the distance necessary for one nozzle to cover 128th of an acre (340 square feet) for the swath being sprayed. The spray distance equation or table below can be used.

$$\text{Spray distance (ft)} = \frac{4,084}{\text{Spray width (ins)}}$$

Spray Distance Chart	
Swath width (in)	Spray distance (ft)
12	340
18	227
24	170
30	136
36	113
42	97
48	85
54	76
60	68

Be sure to measure the full width sprayed as you walk forward. If you are spraying a row crop, spray both sides and use the row width in the swath width calculation.

2. Measure the spray distance on a test course in the field. Walk the course with the sprayer strapped on and the tank half full, and measure the time required. Walk across the course at least twice and average the time to cover the course. On tall row crops, be sure to include the time it takes to cover both sides of the row if sprayed in two passes. Do not apply any spray during this step.
3. Collect the output from the nozzle for the time determined in step 2 in a container marked in ounces. Ounces collected will equal application rate in gpa.
4. Compare the application rate measured from step 3 to the rate required on the product label. If the measured rate is not within 5 percent of the recommended rate, choose an appropriate adjustment method (see page 6) and reset the sprayer.
5. Recheck the system. Once you have the accuracy you want, calibration is complete.