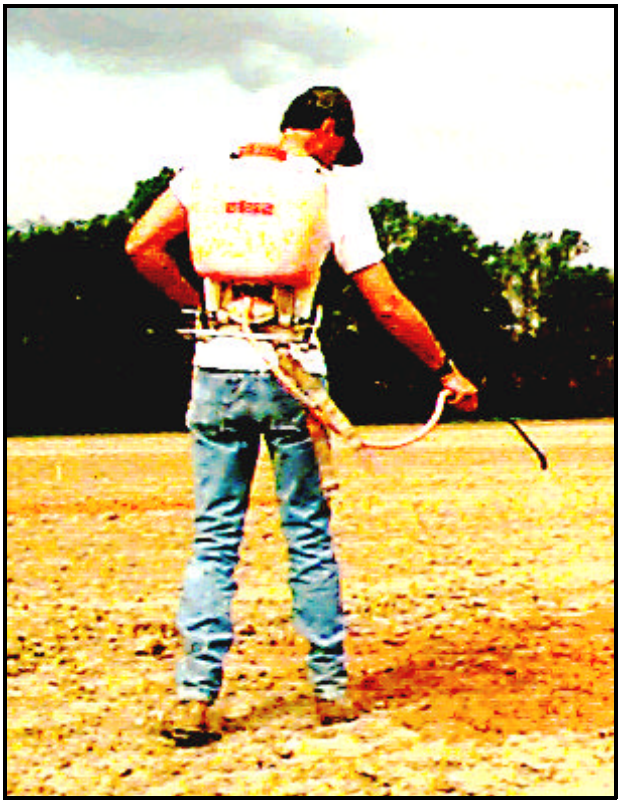
Hand-held and Backpack Sprayers for Applying Pesticides

Putting Knowledge to Work



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Cooperative Extension Service
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Athens

Hand-held and Backpack Sprayers for Applying Pesticides

Paul E. Sumner
Extension Engineer

INTRODUCTION

Hand-held and backpack sprayers are inexpensive tools used to apply pesticides on small acreages. Home gardens, yards, and small orchards are examples of areas that often require pesticide applications to protect them from weeds, insects, and diseases. Effective pest control depends on applying the proper amount of pesticide. This can only be done if the spray equipment is calibrated accurately.

EQUIPMENT DESCRIPTION AND CARE

Every pesticide application tool consists of three major parts: a tank to hold the spray mix, a pump to provide pressure, and a nozzle/wand to deliver the chemical in the desired spray pattern.

Both hand-held and backpack sprayers are commonly used.

Most backpack sprayers have pressure regulators that allow delivery of the spray mix at a constant pressure. Since a constant pressure must be maintained for consistent application rates, these devices must be kept in good working order. Follow the manufacturer's recommended procedure for periodic cleaning and inspection. Few hand-held sprayers contain pressure regulators, but fairly even pressure can be maintained if the hand pump is operated at a constant number of pumps per minute. It is not necessary to know the exact pressure output to calibrate your hand-held sprayer, just that it be constant.

The total volume of the spray tank must be known to determine the area that can be covered per tankful. Most backpack sprayers hold 4 to 6 gallons of spray mix; hand-held sprayers hold 1 to 3 gallons. Spray tanks should be rinsed thoroughly after each use because many pesticides are corrosive and can damage internal parts. It is also advisable to use different sprayers for insecticides and herbicides. If your spray tank is plastic and diesel or fuel oil is used as a carrier, the tank should be cleaned with detergent immediately after use. The oil may impregnate the plastic, leaving pesticide residue that could affect future applications.

Hand-held and backpack sprayers usually come equipped with a trigger valve and spray wand to which a single nozzle is attached. Nozzles come in various shapes and sizes and are carried by most agricultural chemical dealers. Common types of nozzles include:

1. Flat-fan nozzle; makes a narrow, oval pattern with tapered edges.

2. Solid-cone nozzle; used for spot treatment.

3. Even-flat-fan nozzle; makes a uniform pattern across its width; used for band or strip spraying.

4. Adjustable nozzle, common on hand-held sprayers; adjusts from solid stream to solid cone.

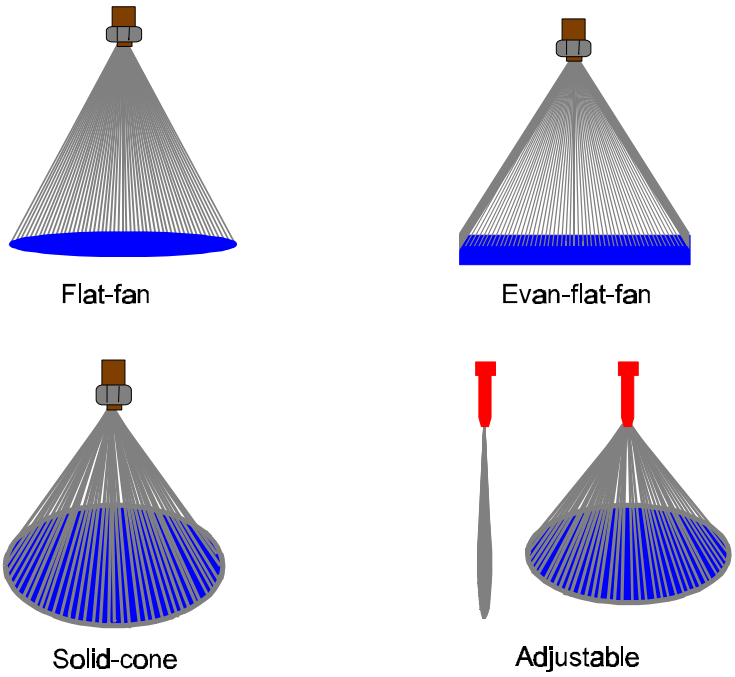

Figure 2. Common types of nozzles used with backpack and hand-held sprayers.

The newer nylon nozzles are lighter, more resistant to abrasive damage, and will not corrode. For spot applications, hollow or solid-cone nozzles work well, but only even-flat-fan or flood-jet types should be used for single-nozzle band applications. These nozzles will deliver a relatively even pattern and a constant application rate across the bank. Nozzle output is measured in gallons per minute (GPM) at different pressures. Nozzles with low delivery rates (less volume per minute) are best for small sprayers, since more acreage can be covered with less carrier (water, oil, etc.). The angle of a nozzle's spray pattern and the height at which it is held from the ground determine the width of the spray pattern. This width is known as the effective swath width (ESW) and is important for sprayer calibration.

Simplified Sprayer Calibration

Hand sprayers should be calibrated before applying any materials. The method described is easy, quick, and accurate if measurements are made carefully. The procedure is for knapsack (backpack) sprayers but will also work with most hand sprayers.

1. On an area that best represents the average topography for the area to be sprayed, measure and mark off the Calibration Distance that coincides with your band width, if band applying, or your nozzle spacing (width covered by single nozzle) if broadcast applying. See Table 1.

   Calibration Distance = _____ Feet

Table 1. Calibration distance to spray. One ounce discharged equals one gallon per acre.

Nozzle Spacing (inches)	Distance (feet)	Nozzle Spacing (inches)	Distance (feet)
6	681	20	204
8	510	22	186
10	408	24	170
12	340	30	136
14	292	36	113
16	255	38	107
18	227	40	102

To determine a calibration distance for an unlisted spacing, divide the spacing expressed in feet into 340. Example: Calibration distance for a 13" band = 340÷13/12=313 feet.

2. Fill the sprayer with water only and record the number of seconds required to walk the Calibration Distance at a comfortable, steady speed while spraying and pumping to maintain a uniform pressure.

   Time = _____ Seconds

3. While pumping to maintain the selected application pressure, collect the spray output from one nozzle for the same number of seconds needed to travel the Calibration Distance.

   Collected Water = _____ Fluid Ounces

Example: With a 30 inch band, if it took 28 seconds to travel 136 feet, collect the nozzle discharge for 28 seconds.

THE NUMBER OF FLUID OUNCES COLLECTED EQUALS THE GALLONS PER ACRE (GPA)

Example: 16 ounces collected equals 16 GPA

4. If using a boom, repeat step 3 two more times, collecting water from a different nozzle each time. The average number of ounces collected for each of the three nozzles is equal to the gallons of water applied per acre for that boom, speed, and pressure.

5. To determine the amount of chemical to add to the spray tank, divide the capacity of the tank by the number of gallons of water per acre (GPA) to determine the fraction of an acre that can be covered with a tankful of spray.

   Example: 3 gallon tank divided by 16 GPA = 0.188 acre covered per tank

6. Multiply the application rate of the product per acre times the fraction of the acre covered per tank and add that amount of chemical to the sprayer tank.

   Example: 2 qts. per acre = 64 fl. oz. per acre x 0.188 acre per tank
   = 12 fl. oz. per tank.

   Example: 5 lb. per acre x .188 acre per tank =0.94 Ib. per tank x 16
   = 15 oz.(by weight) per tank.

Uniform Application Check

Hand sprayers require skilled operators to achieve a uniform broadcast application. A simple and quick test is to spray an area on a paved surface with water in your normal spraying manner on a warm day. In a few minutes the drying pattern will indicate your distribution. Fast drying areas indicate low application rates while slow drying areas received high amounts of spray. Uniform drying without streaks indicates uniform application. Practice until uniform distribution is obtained.

Hand Sprayer Calibration for Ornamental and Turf

Hand sprayers are often used to treat ornamental or small areas of turf. The directions on many ornamental pesticide product labels say to "spray until foliage is wet" or perhaps "spray until runoff." Unfortunately, these directions are subject to each applicator's interpretation of what "wet" or "runoff" is.

Recommendations are based on amount per 100 gallons. This is the dilution ratio for the chemical applied. Use the following to convert 100 gallon rate to bed area rate.

1. Measure the length and width of the area to be sprayed. Then calculated the area to be covered.

Bed Area is: length _____ X width _____ = _____ ft^2

2. Fill sprayer with water and spray the area. Record the amount of water to refill the sprayer.

   Gallons per bed area _____

3. Obtain the rate of material to be applied per 100 gallons.

   Rate _____

4. $\frac{\text{Rate x Gallons per bed area}}{100}$ = Amount per bed area

5. Calculate the total amount of material to be used for the application (total bed area) as follows:

$$\frac{\text{Amount per bed area}}{\text{Bed area } (ft^2)} \times \text{Area to be Sprayed } (ft^2) = \text{Amount of material}$$

6. Total solution to prepare is:

$$\frac{\text{Gallons per bed area}}{\text{Bed area } (ft^2)} \times \text{Area to be sprayed } (ft^2) = \text{Total Solution}$$

Solutions derived from the above may need to converted to a smaller units in order to accurately measure the pesticide. Refer to the conversion section to help simplify this problem.

EXAMPLE

Chris Tree wanted to spray atrazine, as Aatrex 80W (the "W" indicates the herbicide is in a wettable power form), in his 20-acre white pine Christmas tree farm. He filled his 4-gallon back-pack sprayer half full with water, installed a 15-p.s.i. (pounds per square inch) pressure spring in the regulator, and attached an even-flat-fan nozzle. Holding the nozzle at a constant height, he then sprayed 50 foot section and measured the ESW at several points. His average ESW was 36 inches. Mr. Tree obtaining the calibration distance for Table 1, marked a 113 foot calibration in his tree farm. He then traveled 4 times the calibration distance measuring the time in seconds. The times were 21, 24, 23, and 24 seconds. His average travel time was 23 seconds. He then measured the flow from the nozzle four times in ounces. His average collection was 18.34 ounces or 18.34 GPA.

This is well within the 10-20 gallons/acre carrier rate suggested.

Chris wanted to spray a 3-foot band over his trees, which are planted 5 feet apart in the row and 8 feet between rows in the 20-acre plantation. Since he is spraying 3 feet of every 8 feet, he will need enough chemical to spray 3/8 (or 0.375) x 20 acres = 7.5 acres. His Extension agent recommended spraying 5 pounds active ingredient of atrazine per acre. The label of Aatrex 80W says it is 80% active ingredient. Since Chris's sprayer holds 4 gallons/tank, he can cover:

$$\frac{\text{4 gallons/tank}}{\text{18.34 gallons/acre}} = \text{0.218 acres/tank}$$

He will need:

$$\frac{\text{5 pounds a.i./acre}}{\text{0.80}} = \text{6.25 pounds/Aatrex per acre}$$

Then, 6.25 pounds/acre x 0.218 acre/tank = 1.36 pounds Aatrex, which should be added to each 4-gallon tankful to get the rate he desires. As a check on calculations, he will need 6.25 pounds/acre Aatrex x 7.5 acres = 46.9 pounds of Aatrex. Then, since he can cover 0.218 acres/tank, he will need:

$$\frac{\text{7.5 acres}}{\text{0.218 acres/tank}} = \text{34.4 tanks}$$

Then 34.4 tanks x 1.36 pounds/tank = 47 pounds Aatrex, which matches the above calculation.

Accurate sprayer calibration is essential to a successful application. Following the simple calibration steps described herein will ensure that your time and money will not be wasted on an application that does not give the desired results.

Conversions: Volume

pints x 16 = fluid ounces (fl oz)
fl oz x 29.57 = milliliters (ml)
gallon x 4 = quarts (qts)
quarts x 2 = pints (pts)
fl oz x 2 = Tablespoons (tbs)
tbs x 3 = teaspoons (tsp)
tsp x 5 = milliliters (ml)

Weight

pounds x 16 = weight ounces (wt oz)
wt. ounces x 28.35 = grams (g)
grams x 1000 = milligrams (mg)

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ENGINEERING

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Robert Isaac, Associate Dean for Extension