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# Calibrating Home and Garden Sprayers

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*This publication contains instructions on steps to calibrate home sprayers while saving time with easy to follow steps.*

**HOME AND GARDEN PESTICIDE PRODUCTS OFTEN ARE** applied using compressed air or hose-end spray equipment. Homeowners may be tempted to disregard calibrating spray equipment for the sake of time or lack of technical knowledge, however calibrating sprayers is important to pesticide applicators desiring optimum management of pests with little negative consequences. Both time and money are wasted when improper pesticide rates are used. By applying too much pesticide product an applicator increases the potential for 1) contamination of both surface and groundwater; 2) non-target toxicity towards beneficial plants; and 3) risk to their personal safety. Too little pesticide product poses the risk of pest resistance and poor management of pests.

## Calibration

For pesticides to be effective, they must be applied uniformly at the recommended rates noted on the label. Calibration ensures the correct amount of pesticide (the labeled rate) is applied in the proper dilution (a given volume of water) to control a particular pest. Applicators must ensure they are applying the correct amount of solution (diluent, usually water, plus pesticide product) per unit area as required on the pesticide product label to determine the amount of pesticide product to add to the tank. This is often expressed in gallons per 1,000 square feet or acre (GPA) when using compressed air systems or ounces per gallon over given unit area using hose end systems. Failure to properly calibrate pesticide sprayers is the most frequent cause of ineffective pesticide applications. Always read and follow the product label.

## Pesticide Safety

Most pesticides sold in the home and garden trade are lower toxicity products that do not require a high level of personal protective equipment. Applicators, even when using low toxicity

products, should read and follow the personal protective equipment required on the pesticide product label. Low toxicity products often require a long-sleeved shirt, long pants (or a coverall-type garment). It is always a good idea to wear waterproof boots and unlined nitrile, neoprene or rubber gloves (a lining can absorb pesticides). When handling or applying pesticides, never wear shorts, sandals, tennis shoes, or leather footwear and always read the pesticide label.

## Steps in Calibrating any type of Liquid Sprayer

### 1. Calculate the area to be sprayed.

*Example:* 20 feet x 20 feet = 400 square feet (ft<sup>2</sup>).

### 2. Calculate the dilution factor.

Divide the area you want to spray by the area noted on the pesticide label. This will give you a dilution factor.

*Example:* If you want to spray an area that is 400 ft<sup>2</sup> and the label says apply 3 ounces of product per 1,000 ft<sup>2</sup>, your dilution factor is 0.4 (400 ft<sup>2</sup> ÷ 1,000 ft<sup>2</sup> = a dilution factor of 0.4).

### 3. Determine the total volume of spray solution needed.

If the label does not recommend a certain product to water ratio, you can determine the amount of water to use on your own. Fill the tank or jar with a known volume of water, spray the desired area as if applying a pesticide. Subtract the volume of water left over from the original volume. The resulting amount is what you will use to apply the pesticide.

You must ensure adequate coverage by adjusting nozzle openings and spraying speed for the type of spray pattern desired. On trees, shrubs and other upright growing plants, spray until the pesticide solution begins to drip from the leaves. For soil-applied pesticides, make sure you have a coarse spray. Make certain the water is applied uniformly, with no gaps and with only a small amount of overlap. Always read and follow the label spray directions as coverage may vary.

*Example:* You filled a backpack sprayer with 5 gallons of water. Only 3 gallons of water solution remained after spraying a 400 ft<sup>2</sup> area. So you will mix 2 gallons of spray solution for a pesticide application to the 400 ft<sup>2</sup> area.

4. **Determine the amount of pesticide to apply.** Multiply the dilution factor times the rate found on the label.

*Example:* From Step 2, a label calls for you to apply 3 ounces of pesticide per 1,000 ft<sup>2</sup> and you have a dilution factor of 0.4. You will apply 1.2 ounces of pesticide to cover 400 ft<sup>2</sup> (0.4 dilution factor x 3 ounces = 1.2 ounces).

5. **Fill the tank with the proper amount of water and pesticide product.** Fill the tank with  $\frac{1}{2}$  of the water solution as defined in Step 3 (Example: 2 gallons  $\div$  2 = 1 gallon). Add the total pesticide product to the tank as defined by Step 4 (Example: 1.2 ounces). Then add the remaining water solution to the tank (Example: 2 gallons  $\div$  2 = 1 gallon).

### Calibrating Compressed Air Sprayers

Two common types of compressed air sprayers used for home and garden use are the backpack and hand-held tank or canister sprayers. Both are useful for small jobs where only a few gallons of material are needed. It is important to maintain a constant pressure by pumping the sprayer regularly during application. It is equally important to maintain the same pressure during the actual application as during calibration of the sprayer.

#### BACKPACK SPRAYER EXAMPLE

You have a 5-gallon backpack sprayer. The area you want to spray is 50 feet by 35 feet and the pesticide you want to use calls for 2 ounces of product to be applied over 500 ft<sup>2</sup>. For calibration purposes, you started with 5 gallons of water in your sprayer.

**Step 1:** 50 ft x 35 ft = 1750 ft<sup>2</sup>

**Step 2:** 1750 ft<sup>2</sup>  $\div$  500 ft<sup>2</sup> = 3.5 dilution factor

**Step 3:** You sprayed the area with water and you had 1 gallon left. Therefore you used 4 gallons to cover 1750 ft<sup>2</sup>.

**Step 4:** 2 ounces of product per 500 ft<sup>2</sup> x 3.5 = 7 ounces of pesticide to be applied to 1750 ft<sup>2</sup>.

**Step 5:** You will now add 7 ounces of pesticide in four gallons of water to spray 1750 ft<sup>2</sup>.

Now spray the designated area using the same time, pressure and spray motion as when you calibrated. Consistency is the key to effective pest control. If you have some left over, you went too fast. If you ran out, you went too slowly.

Some labels may be very precise; “use 3 ounces of a product in 2 gallons of water applied to 1000 ft<sup>2</sup>.” In this case you will need to make sure you are applying 2 gallons of water per 1000 ft<sup>2</sup>. It may take a few times to get the speed and pressure just right in order to consistently apply the right amount of volume to a given area.

### Calibrating Hose-End Sprayers

Hose-end sprayers attach directly to the end of a garden hose and are easy to use. They consist of a plastic reservoir or jar to hold a mixture of water/pesticide and a lid that contains a tube that siphons the pesticide from inside the jar and distributes it uniformly into the water flow. The jar is generally marked with two scales: fluid ounces and gallons. When you fill the jar with a water/pesticide mixture up to one of the gallon marks; you will be applying that many gallons of finished spray over a given area. For instance, a pesticide label might call for 1 ounce of product in 1 gallon of water to cover 400 square feet. When you fill the jar up to the one gallon mark, your goal is to cover 400 square feet with that amount of liquid.

Some hose-end sprayers come with a “dial-in” option. You add undiluted pesticide to the jar and then turn the dial on the sprayer body to the labeled rate. Adjust nozzle openings and spraying speed for the type of spray pattern desired. On trees, shrubs and other upright growing plants, spray until the pesticide solution begins to drip from the leaves. For soil-applied pesticides, make sure that you have a coarse spray. For dial-in hose-end sprayers, adjust the setting to the recommended dilution rate on the product label. Make certain the water is applied uniformly, with no gaps and with only a small amount of overlap.

#### HOSE-END SPRAYER EXAMPLE 1

The label for Smoke'em<sup>®</sup> herbicide calls for you to mix 2 tablespoons of pesticide with 1 gallon of water to cover 200 ft<sup>2</sup>. You want to spray an area 26 feet x 27 feet.

**Step 1:** 26 ft x 27 ft = 702 ft<sup>2</sup>.

**Step 2:** 702 ft<sup>2</sup>  $\div$  200 ft<sup>2</sup> = 3.51 or 3.5 dilution factor

**Step 3:** 3.5 x 1 gallon per 200 ft<sup>2</sup> = 3.5 gallons of finished spray that is desired to cover 702 ft<sup>2</sup>. Add only water up to the  $3\frac{1}{2}$  gallon mark on the jar and spray the 702 ft<sup>2</sup> area. You should use the whole amount. If you did not, adjust your spraying speed and try again.

Do not add pesticide yet.

**Step 4:** 3.5 dilution factor x 2 tablespoons = 7 tablespoons of product for a 702 ft<sup>2</sup> area.

**Step 5:** You will add 7 tablespoons of Smoke'em<sup>®</sup> herbicide to the jar and then fill with water up to the  $3\frac{1}{2}$  gallon mark.

## HOSE-END SPRAYER EXAMPLE 2

You want to spray an area 25 feet by 10 feet. Grub-Out® insecticide calls for a rate of 5 tablespoons in 3 gallons of water to cover 1000 ft<sup>2</sup>.

**Step 1:** 25 ft x 10 ft = 250 ft<sup>2</sup>

**Step 2:** 250 ft<sup>2</sup> ÷ 1000 ft<sup>2</sup> = 0.25 dilution factor

**Step 3:** 3 gallons per 1000 ft<sup>2</sup> x 0.25 = 0.75 or ¾ gallons per 250 ft<sup>2</sup>. Add water up to the ¾ gallon mark and spray the area. Again, if you have some left over, you went too fast. If you ran out, you went too slowly.

**Step 4:** 0.25 x 5 tablespoons-per-1000 ft<sup>2</sup> = 1.25 or 1¼ tablespoons in ¾ gallons of water to spray a 250 ft<sup>2</sup> area.

**Step 5:** You will add 1¼ tablespoons of Grub-Out® insecticide to the jar and then fill with water up to the ¾ gallon mark to cover 250 ft<sup>2</sup>.

### IMPORTANT

Since hose-end sprayers are attached directly to the end of a garden hose, a sudden loss of water pressure in the system can draw (back-siphon) the pesticide from the jar into your water supply.

**Always install an anti-siphon device between the water spigot and a hose-end sprayer.**

## Useful Measurements and Conversions

1 gallon = 4 quarts = 8 pints = 128 ounces

1 cup = 8 ounces

1 quart = 2 pints = 32 ounces

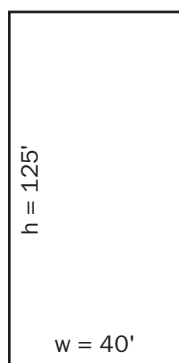
1 ounce = 2 tablespoons = 6 teaspoons

1 pint = 2 cups = 16 ounces

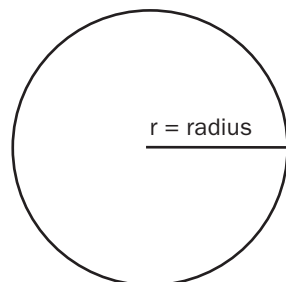
1 tablespoon = ½ ounce = 3 teaspoons

Gallons = Ounces ÷ 128

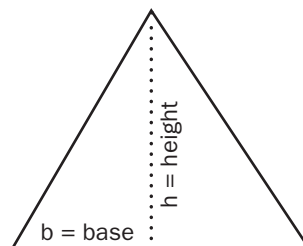
Ounces = Gallons x 128



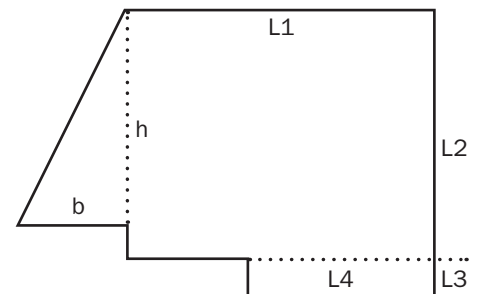
**Figure 1.** Area of a rectangle.



**Figure 2.** Area of a circle.



**Figure 3.** Area of a triangle.



**Figure 4.** Irregular shaped area composed of geometric shapes.

## Area Measurements

To determine how much pesticide you will need to do a job, you must measure the area to be treated. If the area is a rectangle, circle or triangle, simple formulas may be used. Determining the area of an irregularly shaped site is more difficult. The following examples will help you in computing the area of both regularly and irregularly shaped areas.

### RECTANGLES

The area of a rectangle is found by multiplying the length by the width. See **Figure 1**.

*Example:* 125' x 40' = 5,000 ft<sup>2</sup>

### CIRCLES

The area of a circle is the radius (half the diameter) squared and then multiplied by 3.14. Area = r<sup>2</sup> x 3.14. See **Figure 2**.

*Example:* r = 35'

35' x 35' x 3.14 = 3846.5 ft<sup>2</sup>

### TRIANGLES

The area of a triangle is one-half the base (b) multiplied by the height (h). Area = b x h ÷ 2. See **Figure 3**.

*Example:* b = 55', h = 53'

55' x 53' ÷ 2 = 1457.5 ft<sup>2</sup>

### IRREGULAR SHAPED AREAS

Irregular shaped areas often can be reduced to a combination of rectangles, circles, and triangles. Calculate the area of each and add them together to obtain the total area. See **Figure 4**.

*Example:*

b = 25' Calculate the area of a triangle: Area = ½ b x h

h = 35' Area = (25' x 35') ÷ 2 = 437.5 ft<sup>2</sup>.

L1 = 40' Calculate the area of a rectangle: Area = L1 x L2

L2 = 40' Area = 40' x 40' = 1600 ft<sup>2</sup>.

L3 = 5' Calculate the area of a rectangle: Area = L3 x L4

L4 = 25' Area = 5' x 25' = 125 ft<sup>2</sup>.

**Total area = 437.5 ft<sup>2</sup> + 1600 ft<sup>2</sup> + 125 ft<sup>2</sup> = 2,162.5 ft<sup>2</sup>.**

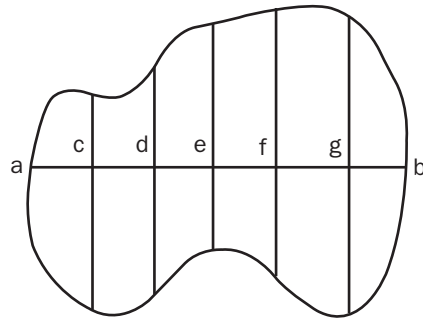
### Using Measurements along a Line

Another way is to establish a line down the middle of the property for the length and then measure from side to side at several points along this line. Areas with very irregular shapes require more side-to-side measurements. The average of the side measurements can be used as the width. Then calculate the area as a rectangle. See **Figure 5**.

*Example:*

$$ab = 45' \quad c = 22' \quad d = 21' \quad e = 15' \quad f = 17' \quad g = 22'$$

$$\begin{aligned} \text{Area} &= (ab) \times \frac{(c + d + e + f + g)}{5} \\ &= 45' \times \frac{(22' + 21' + 15' + 17' + 22')}{5} = 873 \text{ ft}^2 \end{aligned}$$



**Figure 5.** Irregular shaped area measured from points on a line.

### Using Radial Measurements

A third method is to convert the area into a circle. From a center point, measure the distance to the edge of the area in 10 to 20 increments. Average these measurements to find the average radius. Calculate the area using the formula for a circle. See **Figure 6**.

*Example:*  $a = 11'$ ,  $b = 12'$ ,  $c = 15'$ ,  $d = 16'$ ,  $e = 18'$ ,  
 $f = 14'$ ,  $g = 15'$ ,  $h = 16'$ ,  $i = 11'$ ,  $j = 12'$ ,  $k = 14'$

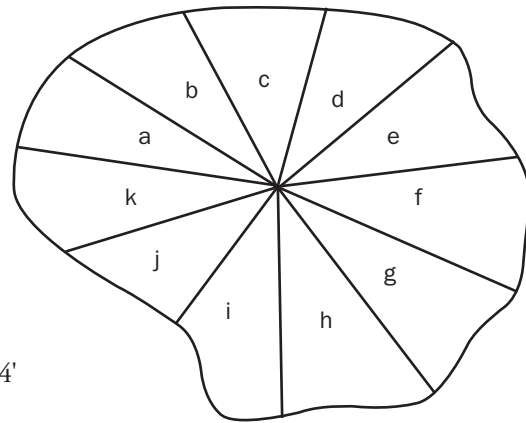
$$\text{Radius} = \frac{a + b + c + d + e + f + g + h + i + j + k}{11}$$

$$\frac{11' + 12' + 15' + 16' + 18' + 14' + 15' + 16' + 11' + 12' + 14'}{11} = \frac{154'}{11} = 14'$$

$$\text{Radius squared} = 14' \times 14' = 196'$$

$$\text{Area} = 3.14 \times \text{radius squared}$$

$$\text{Area} = 3.14 \times 196' = 615.44 \text{ ft}^2$$



**Figure 6.** Irregular shaped area converted to a circle.

### For more Information Contact:

- Your local MSU Extension office at [pesticides.montana.edu/pat/patcolist.html](http://pesticides.montana.edu/pat/patcolist.html)
- The MSU Extension Pesticide Education Program  
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