Information for pest management professionals and pesticide applicators

UC IPM

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Ways to Calibrate Spray Application Equipment

Applying the wrong amount of pesticide can result in poor control if not enough is used or overuse if too much is applied. If little control is achieved, the end result might be a second application that will be more expensive due to the cost of labor involved. If too much is used, the cost of the extra material is one consideration, but there might also be crop damage and a higher risk of pesticide moving off-site in runoff or leaching into groundwater.

In addition to reading the label carefully and making sure that pesticides are not washed off into storm drains, the applicator must be sure equipment is properly calibrated so that the proper amount of pesticide is applied. Poor calibration also can result in a lot of leftover pesticide. The less solution that is leftover, the less there is that has to be disposed of. For liquid applications, one needs to know the area to be sprayed, how much pesticide is needed to spray that area, and how much water to use to apply the pesticide so that it will cover the area to be treated. Because people walk at different speeds or otherwise move the sprayer differently than another person, it is important that each person perform the calibration steps (Fig. 1) if the equipment is shared.

Liquid applications usually are made using backpack sprayers with a single nozzle and a hand-pumping bar on the side, tanks with a gun-type nozzle and electric or gas pump, or a small tractor with a tank and boom with multiple nozzles on the boom. Be aware that people walk at different speeds, so the calibration for one person is not the same as another even if using the same sprayer. Also, you can't assume that one sprayer is set up the same as another, so you need to do a calibration if you change sprayers.

Below are two calibration methods you can use to determine how much water and pesticide to put in a tank for a given area and for a specific person doing the application and using a specific piece of equipment. A third method is illustrated in Table 1. For estimating how much pesticide is needed when spraying trees and shrubs, see the *Ask the Expert!* section on Page 6 of this newsletter.

Backpack Sprayers

- Measure out a representative area of 1,000 square feet (20 by 50 feet works well, or 5 by 200 feet is good if you are going to be spraying medians).
- Put clean water into the tank.
- Walking at your normal pace and using your normal method of spraying, time how long it takes for you to spray the area you measured out. It is best to do this two to three times and get an average time.
- Get a bucket or other container that has markings in ounces and spray water into it for the same amount of time it took you to spray 1,000 square feet. This amount is how much water you need to put in the tank for 1,000 square feet.
- How much area will you be spraying? Measure the area. If you are applying to a number of small sites, you can combine the measured areas.
- How much pesticide do you need? Most landscape pesticide labels give the amount to apply as ounces per 1,000 square feet. If you have 2,000 square feet and the label says 5 ounces per 1,000 square feet, then you need 10 ounces. If you have 500 square feet and the label says 5 ounces per 1,000 square feet, then you need 2.5 ounces.
- How much water do you need? You found out how much water you needed to cover 1,000 square feet. If you need to spray 2,000 square feet, you will need two times more water (2,000 divided by 1,000 equals 2); if you need to spray 500 square feet, you would need half as much water (500 divided by 1,000 equals 0.5).

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Supplies for Calibrations

- Buckets and a measuring container with markings in ounces;
- A stopwatch;
- A tape measure and stakes to mark out the test area; and
- A calculator.

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Calibrating Spray Application Equipment

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Let's Try an Example

Output: You find it takes 130 seconds to spray 1,000 square feet. When you spray water from the tank into a bucket for that same amount of time, you find that you used 22 ounces of water.

Area: You need to spray three locations; one is 600 square feet, one is 900 square feet, and the third is 200 square feet. So you will be spraying a total of 1,700 square feet (600 plus 900 plus 200).

Pesticide: The pesticide label says use 2 ounces per 1,000 square feet. Since you are spraying more than 1,000 square feet, you will need 1.7 times more (1,700 square feet divided by 1,000 square feet). Multiply 1.7 by 2 ounces, and the result is 3.4 ounces.

How much solution to use if it is a dry formulation: The 1,000 square feet used 22 ounces, but you are going to spray 1,700 square feet. Take 1,700 and divide it by 1,000, and the result is 1.7, so you need to add 1.7 times more water. Multiply 1.7 by 22 ounces of water, and the result is 37 ounces of water. **If it is a liquid formulation:** You need to subtract the amount of liquid pesticide from the total. Therefore, to mix 37 ounces of solution you will need to subtract 3.4 ounces of pesticide from the 37 ounces of total solution needed to determine the amount of water you must add (37 ounces total solution minus 3.4 ounces of pesticide equals 33.6 ounces of water).

Bottom line: You will put 37 ounces water plus 3.4 ounces of dry product (or 33.6 ounces water plus 3.4 ounces of liquid product) in your tank and use it to spray 1,700 square feet.

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Table 1.

Easy 128th Acre Broadcast Sprayer Calibration for Backpack and Larger Tank Sprayers.*

If the label rate is ounces or pounds per acre:	
Step 1	Measure out the 128th acre (324 square-feet) calibration area: 10 feet by 34 feet or 18.5 feet by 18.5 feet.
Step 2	Spray the calibration area evenly while recording the amount of time to complete the spray. Time: _____
Step 3	Spray water into a bucket for the same amount of time. For booms with more than one nozzle, put buckets under all the nozzles. Measure the amount of water in the bucket(s) in **ounces**; this will equal the gallons per acre (GPA) that the sprayer is applying. Put this value in the Step 3 section of the box below.
Rate calculation:	
Step 4	Look up the total volume of your spray tank, in **gallons**. Put this value in the Step 4 section of the box below.
Step 5	From the pesticide label, determine the amount of product to be applied **per acre in ounces**. Put this value in the Step 5 section of the box below.
Step 6	Divide Step 4 by Step 3; this will determine the number of acres sprayed per tank load. Put this value in the Step 6 section of the box below.
Step 7	Multiply Step 5 times Step 6; this will determine the amount of product to be added to each tank load.

Step 4 _____ (spray tank volume) ÷ Step 3 _____ (GPA) = Step 6 _____ (acres per tank load)

Step 5 _____ (ounces of herbicide per acre) x Step 6 _____ (acres per tank load) = Step 7 _____ (herbicide per tank load in ounces)

Notes: If the area to be sprayed is less than the area that a full tank load will spray, reduce the amount of water and pesticide by the same proportion as the reduction in acres to be sprayed, therefore reducing the amount of leftover solution. For example, you calculate that a full tank that holds 3 gallons will spray 2,000 square feet and you will need 1 ounce of pesticide for that size area but you are going to spray only 1,000 square feet; then you need to reduce the amount of water and pesticide by half. To do so, put 1 $^1/_2$ gallons of water plus $^1/_2$ ounce of pesticide in the tank.

*Adapted from Bell, C. E., C. A. Wilen, and M. E. McGiffen Jr. *Easy, No Math, 128th Acre Herbicide Broadcast Sprayer Calibration.*

For more examples and ways to calibrate granular equipment, see:

Dill, J., and G. Koehler, eds. 2005. *Agricultural pocket pesticide calibration guide.* Orono: Univ. of Maine Coop. Exten. Available online, http://pronewengland.org/INFO/PROpubs/CalibrationGuide-small.pdf.

O'Connor-Marer, P. J. 2000. *The Safe and Effective Use of Pesticides (Pesticide Application Compendium 1), 2nd ed.* Oakland: Univ. Calif. Agri. Nat. Res. Publ. 3324.

O'Connor-Marer, P. J. 2006. *Landscape Maintenance Pest Control.* Oakland: Univ. Calif. Agri. Nat. Res. Publ. 3493.

Conversions

1 acre=43,560 square feet

1,000 square feet=.023 acre

8 ounces=1 cup

16 ounces=1 pint

32 ounces=1 quart

128 ounces=1 gallon

Calibrating Spray Application Equipment

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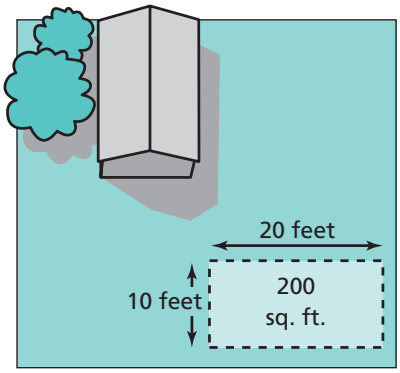
Before you start:

- Run the sprayer to flush out the hoses.
- Make sure your tank is properly rinsed.
- Make sure you have clean and nonleaking nozzles and screens.
- Check nozzles to make sure they are spraying properly at the desired pattern and size.

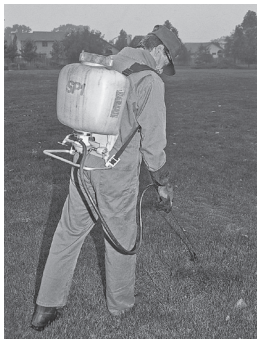
1. Mark off 200 square feet.



2. Fill the spray tank with clean water and mark the level.

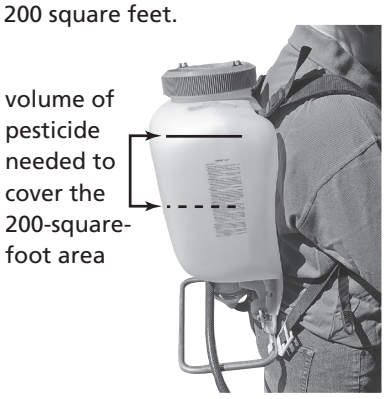
NILA HINES

3. Spray the water on the marked 200-square-foot area, as if you were making an actual pesticide application. Operate at the proper speed.

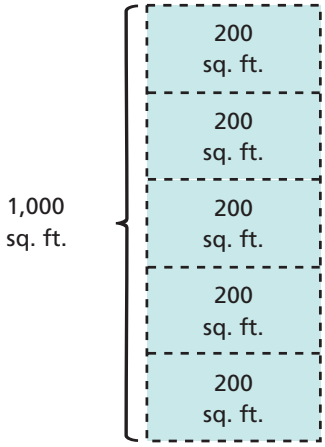


4. Mark the new water level in the spray tank.

5. Measure the amount of water needed to refill the sprayer to the first marked water level. This measured amount of water equals the volume of pesticide solution needed to cover the 200 square feet.



6. Use the amount from Step 5 to find out how much liquid you need to cover the area you are treating. For instance, if you are treating 1,000 square feet, you will need 5 times the amount of water needed for 200 square feet (from step 3). You may need multiple tanks.



7. Read the label and determine the pesticide application rate. Calculate the total amount of pesticide you will need for the entire treatment area and the total amount of liquid mixture. Calculate the amount of pesticide needed for each tank for the desired application rate.

From Cohen, S., M. L. Flint, and N. Hines. 2009. *Lawn and Residential Landscape Pest Control: A Guide for Maintenance Gardeners.* Oakland: Univ. Calif. Agri. Nat. Res. Publ. 3510.

Figure 1. Steps for calibrating a liquid pesticide sprayer.

Guide to Common Weeds in Lawns in California

Crabgrass Spring/summer annual weed. Control by reducing irrigation; check for leaks and overseeding. Apply a preemergent herbicide in February. Note seed heads (right) come out from different places. Compare to bermudagrass below.		
Oxalis, woodsorrel Found year-round. Sometimes has purple leaves. Often confused with clover, but has heart-shaped leaflets and five petals on yellow flowers. Seeds expelled from pods (right) stick to mowers. Clean mowers with air or water. Use postemergent herbicides, but make sure they are safe for the turf species.		
Bermudagrass Perennial. Grows in warm weather. Spreads by seeds, stolons, and rhizomes. Can use a nonselective herbicide or mechanical means to renovate. Can use some postemergent herbicides depending on the turf species. Note seed head (left) meets at one point.		
Kikuyugrass Perennial. Grows in warm weather. Spreads by seeds, stolons, and rhizomes. Can use a nonselective herbicide or mechanical means to renovate. Can use some postemergent herbicides depending on the turf species. Flowers look like white fungus on cool, humid days.		
Burclover (left), **black medic** (right) Annual. Burs on burclover can be spiny or smooth. Black medic is similar looking but does not have burs. Control by hand pulling, increasing nitrogen and reducing phosphorus, and herbicides depending on the turf species.		
Yellow nutsedge Perennial. Sprouts from tubers in spring; dies back in late fall. Flowers are green-yellow. Produces numerous tubers. Often introduced in contaminated topsoil or fill. Hand pull frequently, dig up small sections at least 10 inches deep, modify irrigation and drainage, and apply postemergent herbicides before the 5-leaf stage.		

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Guide to Common Weeds in Lawns in California

Purple nutsedge
Perennial that sprouts from tubers in spring and dies back in late fall. Generally found in warmer locations. Produces numerous tubers. Tubers often found in chains (right). Flowers are reddish brown. Often introduced in contaminated topsoil or fill. Hand pull frequently, dig up small sections at least 10 inches deep, modify irrigation and drainage, and apply postemergent herbicides before the 5-leaf stage.

Annual bluegrass
Cool weather annual. Shallow roots with tuft-like growth. Spreads by seeds, which are produced very quickly. Grows best in moist areas. Hand pull and modify irrigation. Must apply premergent herbicides by early September. Difficult to control with postemergent herbicides.

For additional information on weed identification, visit the UC IPM weed photo gallery at http://www.ipm.ucdavis.edu/PMG/weeds_intro.html.

Download a copy of this guide in Spanish as well as a copy of the *Guide to Common Turfgrass*, also in both English and Spanish, from the UC IPM Green Bulletin Web page, http://www.ipm.ucdavis.edu/greenbulletin/.

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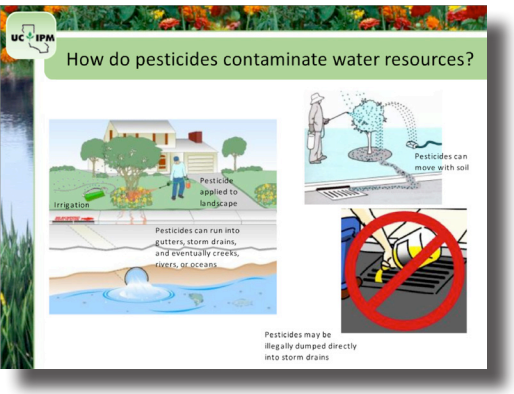
The UC Guide to Healthy Lawns: Special Weed Problems

Weed species	Associated condition(s)	Management
Annual grasses		
Annual bluegrass	Overwatering; compacted soil	Reduce irrigation; aerate
Crabgrass (smooth and large)	Overwatering or frequent light watering; mowing too short	Water longer and less often; check mowing height
Goosegrass	Overwatering; compacted soil	Reduce irrigation; aerate
Perennial grasses		
Bermudagrass	Previous bermudagrass lawn or infestation; close mowing; sun and heat	Remove plants before they spread; increase mowing height
Dallisgrass	Overwatering; compacted soil	Remove plants before they spread; reduce irrigation; aerate
Annual broadleaves		
California burclover, black medic	Low nitrogen fertility	Fertilize
Common knotweed	Compacted soil	Aerate
Spurges (spotted and prostrate)	Closely mowed turf with open areas; low nitrogen fertility	Check mowing height; remove plants before they spread
Perennial broadleaves		
White clover	Low nitrogen fertility	Fertilize
Creeping woodsorrel	Nearby sources of infestation	Remove plants before they spread
Dandelion	Poorly maintained thin areas or nearby sources of infestation	Remove plants by hand; improve turf management practices
English daisy	Moist areas of turf in cool coastal climates	Keep turf on dry side; improve turf management practices
Plantains (buckhorn and broadleaf)	Overwatering; compacted soil; poorly maintained open turf areas; shaded areas in warm climates	Reduce irrigation; aerate; improve turf management practices
Sedges		
Green kyllinga	Overwatering; poor drainage; sun and heat	Reduce irrigation
Nutsedge	Overwatering; poor drainage; sun and heat; nearby infestation	Reduce irrigation; remove plants before they spread

New Online Training Available

Pest management professionals and pesticide applicators that want information about urban pesticide runoff and mitigation can now get free online training from the UC Statewide IPM Program. UC IPM has just released a new online course that focus on pesticides, their impact on water, and practical solutions for reducing runoff.



The first part of the course, *IPM—A Solution for Reducing Pesticides / Water Quality: Pesticide Properties,* teaches the key elements of an IPM program, helps users determine if a pesticide really is necessary, and goes into detail about alternative methods in an IPM program. When pesticides are needed, users learn how to choose the right product and how to use it properly and safely. Also included are how pesticides get into the environment and what properties of pesticides affect their movement.

The second part of the course, *The Impact of Pesticides on Water Quality / Mitigating Urban Pesticide Runoff,* teaches how pesticides applied to landscapes can be carried in water and run into storm drains leading to creeks, rivers, and streams. Users learn about various chemicals and their impact on the water and aquatic organisms. Also detailed are 10 practices that help reduce the offsite movement of pesticides.

Funded in part by the Department of Pesticide Regulation (DPR), this course includes narrated presentations with short quizzes throughout, a final test for each section, and summary handouts. One unit of continuing education credit in the category "other" is available from DPR for each part completed.

UC IPM soon will release an additional component, one focusing on water quality and mitigation with an emphasis on the insecticides fipronil and bifenthrin. To check out these and other online training materials, visit the UC IPM Web site, http://www.ipm.ucdavis.edu/training/.

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The contents of this document do not necessarily reflect the views and policies of UC IPM or CDPR nor does mention of trade names or commercial products constitute endorsement or recommendations for use.

Ask the Expert!

Q **I'm applying spinosad (Conserve) to manage thrips on rhododendron. The label says to apply 0.1 ounce per gallon. How do I figure out how much to apply?**

A When applying insecticides to trees and bushes, you need to determine how many gallons of water will be required to thoroughly cover the plant or plants you are treating. This can be done by measuring a known amount of water into your sprayer and thoroughly covering the plant with water using your spray equipment. Then measure the water remaining in your tank and subtract that amount from the known amount. For instance, if your tank holds 5 gallons and 3 gallons remain after spraying with water, you can determine that 2 gallons will be required to treat the tree. Add 2 times 0.1 ounces of your pesticide to 2 gallons of water to complete your spray.

Q **My boss won't let me wear a baseball cap when I'm spraying. Why is that?**

A Never wear cloth caps such as baseball caps when spraying. The cap can absorb pesticides and keep the pesticide on your skin. If you wear a hat, be sure it is made from a material that doesn't absorb water, such as plastic.

Q **I am applying imidacloprid (Merit) to control aphids on hackberry trees. The label says to apply 0.7 to 1.4 level teaspoons per inch of trunk diameter. How do I determine how much pesticide to use?**

A **CALCULATING TRUNK DIAMETER AND APPLICATION RATES**

1. Read the label to find the rate of application. For instance, the label might say to apply 1.2 teaspoons (tsp) of a systemic pesticide for every inch of the circumference of the trunk. Some rates require you to determine the diameter of the tree.

2. Measure the tree. To determine how much pesticide is needed for drench applications, you need to know the circumference or diameter of the tree trunk at chest height. To measure the circumference of the trunk (the distance around it), use a tape measure or string.

Once you know the circumference, you can find the diameter by multiplying the circumference by 0.32. For example, a trunk that has a circumference of 32 inches would have a diameter of about 10 inches (32 inches x 0.32 = 10.24 inches.)

3. To determine the total pesticide you will need, multiply the tree size by the application rate. For instance, if your rate is 1.2 teaspoons per inch of circumference and your circumference is 15 inches:

15 in x 1.2 tsp = 18 tsp

4. Convert the teaspoons to liquid ounces (oz). (6 teaspoons = 1 liquid ounce):

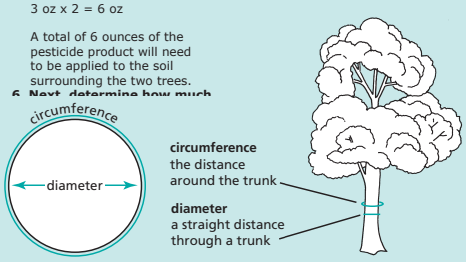
18 tsp ÷ 6 tsp/oz = 3 oz

5. Multiply by the number of trees to be treated. If you have two trees:

3 oz x 2 = 6 oz

A total of 6 ounces of the pesticide product will need to be applied to the soil surrounding the two trees.

6. Next, determine how much added sizes of the plants. Mix the pesticides, following the label rate instructions, in a bucket containing the measure amount of water.



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Questions? Comments? E-mail them to ucipm@ucdavis.edu.