

# Appendix

## PESTICIDE EMERGENCIES

Paul Guillebeau, Extension Entomologist

POISON CONTROL CENTER (HUMAN OR ANIMAL)  
National Poison Control Hotline (Spanish speakers available)  
(800) 222-1222

SPILLS  
(800) 424-9300 (Chemtrec)  
(800) 241-4113 (Dept. of Natural Resources)

### Avoid emergencies/Prepare for emergencies.

1. Maintain a communication link at your pesticide storage and mix/load site.
2. NEVER handle 'DANGER' pesticides or fumigants alone.
3. Closely supervise fumigant use. Have protective clothing available in case a rescue is needed.
4. Maintain contact with anyone using a pesticide with the signal word 'DANGER'.
5. Keep Material Data Safety Sheets readily accessible for every pesticide you use.
6. Keep protective clothing readily available wherever pesticides are stored or handled.
7. Have water available to wash pesticides from skin or eyes.
8. Store and handle pesticides in areas where spills will be contained.
9. Assemble and maintain a spill kit wherever you handle pesticides.
10. Make sure that all employees understand how to handle pesticide emergencies.
11. Be familiar with the first aid instructions on the pesticide label.

**Symptoms of pesticide poisoning:** nausea, vomiting, diarrhea, cramps, headache, dizziness, weakness, confusion, sweating, chills, chest pains, difficulty breathing, unconsciousness. If you have any of these symptoms while you are handling pesticides, suspect pesticide poisoning.

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### FIRST AID FOR POISONING

1. Stop the pesticide exposure as quickly as possible.
  2. If the victim is not breathing, administer artificial respiration at once.
  3. Consult the pesticide labeling if possible. Directions for first aid will be on the front panel.
  4. Otherwise, follow these guidelines:
    - o **SKIN:** Drench skin as quickly as possible with plenty of water. Any moderately clean water can be used if not contaminated with pesticides. Remove contaminated clothing. Wash with soap if available. Dry victim and treat for shock. If skin is burned, cover with clean, loose bandage or cloth. Do not apply ointments to burned skin.
    - o **EYE:** Wash eye quickly but gently. Rinse eye with clean water for at least 15 minutes.
    - o **INHALED:** Move victim to fresh air. Warn other nearby people. Loosen clothing that restricts breathing. Administer artificial respiration if necessary.
    - o **SWALLOWED:** Rinse mouth with plenty of water. Give large amounts of water or milk (up to one quart) to drink. Consult the label before you induce vomiting. Do not give liquids or induce vomiting to anyone who is unconscious or convulsive.
  5. Take the pesticide label with you to the doctor or hospital. DO NOT transport pesticides in the passenger compartment of the vehicle.
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## Heat Stress

### Avoid heat stress.

1. Acclimate to hot weather or new strenuous activities slowly.
2. Drink plenty of water or sports drinks.
3. Take frequent breaks during hot weather.
4. Plan strenuous activities for the cooler part of the day.

**Symptoms of heat stress:** sweating, nausea, headache, confusion, loss of coordination, dry mouth, fainting. Severe heat stress (heat stroke) is VERY dangerous.

The EPA *Guide to Heat Stress in Agriculture* is available through your [local Extension office](#).

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## FIRST AID FOR HEAT STRESS

1. Move the victim to a cooler area immediately.
  2. Cool the victim as quickly as possible by splashing cool water on them or immersing them in cool water. Do not immerse anyone who is unconscious, convulsive, or confused.
  3. Remove all protective equipment or clothing that is keeping the victim too warm.
  4. If the victim is conscious, have them drink as much cool water as possible
  5. Keep the victim quiet. Get medical advice.
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## PESTICIDE SPILLS

### Assemble a spill kit.

1. Protective equipment indicated on pesticide label.
2. Absorbent material to soak up liquids (cat litter, sand, sawdust, dirt).
3. Scoop to pick up contaminated absorbent material.
4. Container for contaminated absorbent material (e.g., heavy duty plastic bag).

You may apply the contaminated absorbent material according to the pesticide label. Do not exceed labeled rates.

### Large spills, leaks, pesticide fires

Call Georgia DNR EPD Response Team **(800) 241-4113**  
CHEMTREC **(800) 424-9300**

### Spills on public roads or other public areas

**(404) 624-6077 (Metro Atlanta)**  
Local sheriff or police.  
Georgia State Patrol **\*GSP (\*477) on mobile phone**

### Smaller spills

1. DO NOT HOSE DOWN SPILLS!
2. Protect yourself and others.
3. Stop the spill sources.
4. Confine the spill with a dike of earth or other materials. Protect water sources.
5. Absorb liquids with cat litter, sand, earth, etc.
6. Scoop up contaminated materials. Store securely.
7. Neutralize contaminated site with bleach, activated charcoal, hydrated lime, or removing contaminated soil.
8. Absorb any liquids used during neutralizing.

9. Contaminated absorbent materials or soil may be land-applied according to the pesticide label.

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Questions and/or comments to: [bugman@uga.edu](mailto:bugman@uga.edu)

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PESTICIDE SAFETY AND OTHER PESTICIDE INFORMATION

## USE PESTICIDES SAFELY

Paul Guillebeau, Extension Entomologist

<u>Selecting and Purchasing the Pesticide</u>	<u>Applying the Pesticide</u>
<u>Transporting the Pesticide</u>	<u>Cleaning Equipment</u>
<u>Storing the Pesticide</u>	<u>Disposing of Excess Pesticides and Empty Containers</u>
<u>Mixing and Loading Pesticides</u>	

Pesticides are poisonous chemicals that can injure or kill nontarget plants and animals, including man if they are handled improperly. Follow these guidelines to minimize the risk of pesticides to human health and the environment.

1. **Use Integrated Pest Management (IPM).** IPM reduces dependence on pesticides by integrating nonchemical methods to help control or prevent damaging pest populations. Ask your county agent about IPM techniques that can be used for your situation.
2. **Apply pesticides only when they are needed.** Properly identify the pest and evaluate whether it will cause enough damage to justify a pesticide application. Your local extension office can help you identify and evaluate your pest problems.
3. **Choose the correct pesticide.** Refer to the pesticide label to make sure it is registered for the site you need to treat. This handbook and your local extension office can help you choose the right pesticide.
4. **FOLLOW THE LABEL DIRECTIONS!** Nearly all pesticide accidents are the result of not following all of the directions, restrictions, and precautions on the label. Avoid the temptation to use greater than the labeled rates; you increase your risk and you may injure or damage the site of application. Additionally, it is illegal to use any pesticide in a manner not prescribed on the label.
5. **Store pesticides safely.** Nearly 50% of U.S. households with a child under five years old have a pesticide stored within reach of children. Keep pesticides clearly labeled. The storage area should be clearly marked and locked if possible. Keep pesticides beyond the reach of children and animals. Do not store pesticides with food, feed, or clothing.
6. **Prevent pesticide drift and runoff.** Never apply pesticide when the wind is blowing more than 5 mph or when rain is imminent. Crops that receive regular pesticide applications should not be planted near bodies of water or near sensitive areas, such as schools or wildlife habitat.
7. **Wear the proper protective clothing.** If you wear the right protective equipment, your risk from pesticides is very small. The label will tell you what protective clothing you need.
8. **Measure pesticides carefully.** Do not mix more pesticide than you need. It is much easier to use pesticides than to dispose of them.

9. **Dispose of pesticide waste properly.** Empty containers that are properly rinsed can be recycled or placed in landfills. Excess pesticides and rinse water can be applied to labeled sites if you will not exceed labeled rates. Refer to the pesticide label for proper disposal.
10. **Wash your hands** before you eat, drink, use tobacco, or go to the restroom. Shower as soon as you can, washing your hair and fingernails. Wash your clothes before wearing them again.
11. **If you or someone else is exposed to a pesticide, take immediate action.** Remove any contaminated clothing. If pesticide is on the skin, wash immediately. If pesticide is in the eye, rinse with clean water for at least 15 minutes. If pesticide is swallowed, give large amounts of water or milk to drink. **DO NOT induce vomiting unless the label directs you to.** Never give liquids or induce vomiting if a person is unconscious or convulsive. If pesticide is inhaled, move victim to fresh air. Seek medical attention.

### Selecting and Purchasing the Pesticide

1. When you choose a pesticide, consider
  1. effectiveness
  2. hazard
  3. restrictions on use
  4. experience of the applicator
  5. required protective clothing, and
  6. equipment needed to apply the product.

You may want to choose a safer pesticide or formulation if the applicator is not well-trained.

2. You cannot use a restricted-use pesticide unless you or your supervisor are properly certified.

### Transporting the Pesticide

1. **NEVER** transport pesticides in the passenger section of a vehicle.
2. **NEVER** transport pesticides with food, feed, or other products that may come in contact with humans or animals.
3. **NEVER** leave pesticides unattended. You are responsible for any accidents that may occur while you are away.
4. Secure pesticide containers in the back of a truck to prevent breaks and spills. Protect paper/cardboard from moisture.
5. Transport pesticides in properly labeled packages.
6. Report spills on roadways immediately to the local authorities.

### Storing the Pesticide

1. Store pesticides in a locked and posted place that is accessible only to qualified personnel. Keep pesticides out of reach of children, unqualified people, or animals.

2. Store pesticides in their original containers with intact labels. **NEVER** place a pesticide in a food or beverage container.
3. Do not store pesticides with food, feed, or seed. Store pesticides at least 100 feet from wells and other waterways.
4. Make sure the storage place is fire-resistant (including a concrete floor), well ventilated, well lighted, locked, dry, protected from direct sunlight, and insulated against temperature extremes.
5. Check containers frequently for leaks or breaks. Transfer the contents of a damaged container into a labeled container that held exactly the same pesticide.
6. Immediately clean up any spills using the correct methods.
7. Store empty pesticide containers securely until proper disposal is available.

### **Mixing and Loading Pesticides**

1. **READ THE LABEL!** Make sure you understand all directions and precautions. Mix only the amount you need.
2. Keep an adequate supply of clean water and soap nearby.
3. Check your protective equipment for wear and leaks.
4. Know the early symptoms of pesticide poisoning.
5. Be sure that emergency equipment for spills and first-aid are readily available.
6. Keep unauthorized people and animals out of the mixing area.
7. Work in a well lighted and well ventilated area, preferably outdoors. Do not work alone.
8. Wear all of the protective equipment required by the pesticide label. Be sure you know how to use it properly.
9. Mix in an area where spills can be contained, at least 100 feet from wells and other waterways.
10. **NEVER** mix pesticides near a well or where other bodies of water may be contaminated. Be sure that the pesticide cannot back-siphon out of the spray tank.
11. **NEVER** eat, drink, or smoke while mixing pesticides.
12. **NEVER** mix or load pesticides at or above eye-level. Close containers that are not in use.
13. When you are mixing or loading, stand so that the wind does not blow pesticide on you.

### **Applying the Pesticide**

1. Calibrate your equipment regularly. Check for leaks, clogged nozzles, and excessive wear.

2. Wear the protective clothing indicated on the label.
3. Clear the area of other people and animals.
4. Avoid drift and runoff. Spray only when there is little or no wind. Do not spray when rain is imminent. Use the lowest spray pressure and largest nozzle orifices that are practical.
5. Be prepared for leaks, spills, or equipment failures.
6. Check the label to see what precautions are indicated. Post the area if required. Be sure that people entering the area during the re-entry interval are properly protected.

### **Cleaning Equipment**

1. Thoroughly clean mixing, loading, and application equipment inside and out after each use.
2. Wear protective clothing while you are cleaning equipment or repairing it during use.
3. Clean equipment in an area where drainage will not endanger man or the environment.

### **Disposing of Excess Pesticides and Empty Containers\***

1. Use excess pesticides according to label directions if possible. Otherwise follow label instructions for disposal.
2. Empty metal, plastic or glass containers should be pressure-rinsed or triple-rinsed. The rinse water should be directed into the spray tank. Properly rinsed containers can be placed in landfills or recycled. Contact your local extension office for recycling programs in your area.
3. Consult the label or your [local extension office](#) for other disposal information.

**\*See [Waste Disposal under Pesticide Legislation and Regulations](#) and [telephone numbers under information numbers](#).**

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Questions and/or comments to: [bugman@uga.edu](mailto:bugman@uga.edu)  
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## ABBREVIATIONS AND EQUIVALENTS

### FORMULATIONS<sup>1</sup>

a.i. = active ingredient	EC = emulsifiable concentrate	S = sprayable powder
AC = aqueous concentrate	EL = emulsifiable liquid	SC = spray concentrate
AS = aqueous suspension	F = flowable	SP = soluble powder
DF = dry flowable	FC = flowable concentrate	W = wettable powder
DG = dispersible granules	G = granules	WDL = water dispersible liquid
B = bait	L = liquid	WM = water miscible
D = dust	LC = liquid concentrate	WP = wettable powder
E = emulsifiable	M = microencapsulated	

<sup>1</sup> Numbers preceding abbreviations for liquid formulations equal pounds of active ingredient per gallon (e.g., 4EC = 4 lbs./gal. emulsifiable concentrate); numbers preceding abbreviations for solid formulations equal percent active ingredient by weight (e.g., 50WP = 50 percent wettable powder).

### METHOD OR TIME OF APPLICATION

CR = cracking stage	PEI = preemergence incorporated	PRE = preemergence
LV = low volume	PO = postemergence	PT = post transplant
NS = nonselective	POT = postemergence over-the-top	RCS = recirculating sprayer
PDS = postemergence directed spray	PP = preplant	ULV = ultra low volume <sup>2</sup>
PE = preemergence on surface	PPI = preplant soil incorporated	WICK = rope wick applicator

<sup>2</sup> Ultra low volume refers to a total spray volume of one/half gallon or less per acre.

### MEASURES AND EQUIVALENTS

tsp. = teaspoonful 1 teaspoonful = 4.9 milliliters	ft. = feet 1 ft. = 12 inches = 30.48 centimeters
Tbs. = tablespoonful 1 Tbs = 3 teaspoonfuls = 14.8 milliliters	yd. = yard 1 yd. = 3 feet = 91.44 centimeters
fl. oz. = fluid ounce 1 fl. oz. = 2 tablespoonfuls = 29.6 milliliters	mi. = mile 1 mi. = 5280 feet = 1609 meters (16.09 kilometers)
c. = cupful 1 c. = 8 fluid ounces = 236.6 milliliters	sq. in. = square inch 1 square inch = 6.45 square centimeters
pt. = pint(s) (1.04 lb. of water) 1 pt. = 2 cupfuls = 473.2 milliliters	sq. ft. = square feet 1 sq. ft. = 144 square inches = 929.03 square centimeters
pt./100 = pint(s) per 100 gallons 1 pt./100 = 1 teaspoonful per gallon	A. = acre 1 A. = 43560 square feet = 0.4047 hectare
qt. = quart(s) (2.09 lbs. of water) 1 qt. = 2 pints = 946.4 milliliters	cu. in. = cubic inch 1 cubic inch = 16.387 cubic centimeters



gal. = gallon(s) (8.35 lbs. of water)  
1 gal. = 4 quarts = 3.7854 liters

oz. = ounce  
1 ounce = 28.35 grams

lb. = pound  
1 lb. = 16 ounces = 453.59 grams

in. = inch  
1 in. = 1000 mils = 2.54 centimeters  
(25,400 microns)

cu. ft. = cubic feet  
1 cu. ft. = 1728 cubic inches = 0.0283 cubic  
meter

cu. yd. = cubic yard  
1 cu. yd. = 27 cubic feet = 0.7646 cubic meter

p.p.m. = parts per million  
1 p.p.m = 1000 p.p. billion = 1  
milligram/Kilogram<sup>3</sup>

p.s.i. = pounds per square inch  
1 p.s.i. = 70.3 grams per cubic centimeter

<sup>3</sup> 1 milligram/Kilogram or 1 p.p.m. is equal to 1 milligram/Liter of water.

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# PESTICIDE RATE AND DOSAGE CALCULATIONS

Paul Guillebeau, Extension Entomologist

<u>How to Calculate Pesticide Dilutions and Dosages For Large Areas</u>	<b>Pesticide Conversion Table for Large Areas</b>  <u>Liquid Formulations Table</u> <u>Wettable Powder Formulations Table</u> <u>Granules and Dusts Table</u>
<u>Converting Large Volume Recommendations to Small Volumes or Areas</u>	
<u>Conversion Tables for Small Areas Table</u>	

## How to Calculate Pesticide Dilutions and Dosages For Large Areas

Pesticides for use in sprays are generally available as wettable or soluble powders and as liquid concentrates. These must be diluted, usually with water, before use. Other diluents, such as deodorized kerosene, may be used for special applications.

The precise amount of water applied to an acre (or other given area) is immaterial as long as it falls within a recommended range, delivers the recommended amount of pesticide, provides adequate coverage, and does not result in excessive runoff or drift. If you know the area (acres, sq. ft., etc.) or units (trees, cows, etc.) covered by a given amount of spray you can determine the dosage or rate of active ingredient each receives by adding the proper quantity of pesticide to that amount of water. Dusts and granules are applied without dilution by the user. Therefore the amount applied per acre or unit is much more critical because you have no other way of controlling the dosage or rate of active ingredient.

The amount of active ingredient in liquid concentrates is expressed in pounds per gallon. In granules, dusts, wettable or soluble powders, and other solids it is nearly always expressed as percent by weight. Application rates are usually expressed as amount of pesticide product but sometimes they may be expressed as pounds of active ingredient or actual toxicant. Actual toxicant and active ingredient are practically synonymous.

1. To find the pounds of wettable powder (WP), dust (D) or granules (G) per acre to obtain the desired pounds of active ingredient (a.i.) per acre:

$$\text{lbs. of WP, D or G per acre} = \frac{\text{lbs. a.i. desired} \times 100}{\% \text{ a.i. in WP, D, or G}}$$

2. To find the pints of liquid concentrate per acre to obtain the desired pounds of active ingredient (a.i.) per acre: pints of liq.

$$\text{conc. per acre} = \frac{\text{lbs. a.i. desired} \times 8^*}{\text{lbs. a. i. per gallon of liq. conc.}}$$

\*If you want the answer in gallons, quarts, or fluid ounces substitute 1, 4, or 128 respectively for 8.

3. To find the amount of wettable powder (WP) or liquid concentrate to use in a given amount of spray:

$$\text{amt. of WP or liq conc.} = \text{no. of acres treated with amount of spray} \times \text{desired amount of WP or liq. conc. per acre}^*$$

\*Trees, animal, etc. can be substituted for acres.

4. To find the pounds of wettable powder needed to obtain a desired percentage of active ingredient in water:

$$\text{lbs. of WP} = \frac{\text{gals. of spray desired} \times \% \text{ a.i. desired} \times 8.3^{**}}{\% \text{ a.i. in WP}}$$

5. To find the gallons of liquid concentrate needed to obtain a desired percentage of active ingredient in water:

$$\text{gal. of liq. conc.} = \frac{\text{gals. of spray desired} \times \text{a.i. desired} \times 8.3^{**}}{\text{lbs. a.i. per gal. of liq. conc.} \times 100}$$

\*\*One gallon of water weighs approximately 8.3 pounds. If another diluent is used the weight per gallon of the other diluent should be substituted for 8.3.

## Pesticide Conversion Table for Large Areas

### LIQUID FORMULATIONS Amount of Commercial Product to Add to Spray Tank for Each Acre Treated

Desired Rate Per Acre of Active Ingredient, Lbs.																
FORMULATION LBS./GAL. ACTIVE INGRED.	0.12	0.2	0.3	0.4	0.5	0.6	0.75	1.0	1.12	1.5	2.0	2.5	3.0	4.0	6.0	9.0
1.5	10 oz	17 oz	26 oz	34 oz	43 oz	51 oz	64 oz	85 oz	96 oz	128 oz	171 oz	213 oz	256 oz	341 oz	512 oz	768 oz
2.0	8 oz	13 oz	19 oz	26 oz	32 oz	38 oz	48 oz	64 oz	72 oz	96 oz	128 oz	160 oz	192 oz	256 oz	384 oz	576 oz
3.0	5 oz	9 oz	13 oz	17 oz	21 oz	26 oz	32 oz	43 oz	48 oz	64 oz	85 oz	107 oz	128 oz	171 oz	256 oz	384 oz
4.0	4 oz	6 oz	10 oz	13 oz	16 oz	19 oz	24 oz	32 oz	36 oz	48 oz	64 oz	80 oz	96 oz	128 oz	192 oz	288 oz
6.0	2.6 oz	4.3 oz	6.4 oz	9 oz	11 oz	13 oz	16 oz	21 oz	24 oz	32 oz	43 oz	53 oz	64 oz	85 oz	128 oz	192 oz

6.7	2.3 oz	3.8oz	5.7 oz	7.6oz	9.6 oz	11.5oz	14.3 oz	19.1 oz	21 oz	29 oz	38 oz	48 oz	57 oz	76 oz	115 oz	172 oz
7.0	2.2 oz	3.7 oz	5.5 oz	7.3 oz	9.1 oz	11 oz	13.7 oz	18 oz	20 oz	27 oz	37 oz	46 oz	55 oz	73 oz	110 oz	165 oz
8.0	2 oz	3.2 oz	4.8 oz	6.4 oz	8 oz	9.6 oz	12 oz	16 oz	18 oz	24 oz	32 oz	40 oz	48 oz	64 oz	96 oz	144 oz

**WETTABLE POWDER FORMULATIONS**  
Pounds of Commercial Product to Add to Spray Tank for Each Acre Treated

FORMULATION PERCENT ACTIVE INGRED.	Desired Rate Per Acre of Active Ingredient, Lbs.																
	0.2	0.3	0.4	0.5	0.6	0.75	0.8	1.0	1.2	1.5	2.0	2.5	3.0	4.0	5.0	8.0	10.0
50	0.4	0.6	0.8	1.0	1.2	1.5	1.6	2.0	2.4	3.0	4.0	5.0	6.0	8.0	10.0	16.0	20.0
75	0.27	0.4	0.54	0.67	0.8	1.0	1.06	1.33	1.6	2.0	2.6	3.3	4.0	5.33	6.6	10.66	13.33
80	0.25	0.38	0.50	0.62	0.75	0.93	1.0	1.2	1.5	1.9	2.5	3.1	3.8	5.0	6.2	10.0	12.5

**GRANULES AND DUSTS**  
Pounds of Commercial Product to Apply Per Acre

FORMULATION PERCENT ACTIVE INGREDIENT	Desired Rate Per Acre of Active Ingredient, Lbs.					
	1	2	3	4	5	10
2.5	40	80	120	160	200	400
5.0	20	40	60	80	100	200
10.0	10	20	30	40	50	100
15.0	6.6	13.3	20	26.6	33.3	66.6
20.0	5	10	15	20	25	50

## Converting Large Volume Recommendations to Small Volumes or Areas

Frequently, pesticide recommendations are given only for large volume applications, i.e. amount per 100 gallons or per acre, but only a small amount is needed. Conversion of liquids to smaller quantities is relatively easy and precise because suitable equipment such as measuring spoons are readily available. Scales sensitive enough to handle small quantities of solid materials are not widely available and it is often more practical to use volumetric measures. Various conversion tables have been prepared on the premise that there are 200 to 300 teaspoons (roughly 2 to 3 pints) per pound of solid pesticide product. These tables are grossly inaccurate because of the wide variation in bulk density among solid pesticide formulations. For instance, a pint of almost any insecticide wetable powder will weigh much less than a pint of fungicide that has a high metal content. Greater accuracy can be obtained if one first determines the weight of a given volume of the solid material and then calculates the volumetric measure. This will usually provide acceptable accuracy but it is still not as accurate as actually weighing a solid formulation. When coupled with a little simple and obvious arithmetic the following formulas will enable you to convert large volume recommendations to smaller quantities.

1. To find the amount of liquid concentrate per gallon when label recommendations are given in pints per 100 gallons:

$$\begin{aligned} \text{teaspoons/gallon} &= \text{recommended pints per 100 gallons} \times 1^* \\ &\text{or} \\ \text{teaspoons/gallon} &= \text{recommended pints per 100 gallons} \times 0.96 \\ &\text{or} \\ \text{milliliters/gallon} &= \text{recommended pints per 100 gallons} \times 4.73^* \end{aligned}$$

2. To find the amount of wettable powder (WP) or other solid formulation per gallon when label recommendations are given as pounds per 100 gallons:

$$\begin{aligned} \text{teaspoons/gallon} &= \text{recommended lbs./100 gals.} \times \text{cupfuls in 1 lb. of formulation} \times 0.053^* \\ &\text{or} \\ \text{teaspoons/gallon} &= \text{recommended lbs./100 gals.} \times \text{Tbs. in 1 ounce of formulation} \times 0.53^* \\ &\text{or} \\ \text{grams/gallon} &= \text{recommended lbs./100 gals} \times 4.54^* \end{aligned}$$

3. To find the amount of liquid concentrate to apply per 1,000 square feet when label recommendations are given as pints per acre:

$$\begin{aligned} \text{teaspoons/1,000 sq. ft.} &= \text{recommended pints/acre} \times 2.20^* \\ &\text{or} \\ \text{milliliters/1,000 sq. ft.} &= \text{recommended pints/acre} \times 10.9^* \end{aligned}$$

4. To find the amount of dust (D), granules (G) or wettable powder (WP) to apply per 1,000 square feet when label recommendations are given as pounds per acre:

$$\begin{aligned} \text{lbs./1,000 sq. ft.} &= \text{recommended lbs./acre} \times 0.023^* \\ &\text{or} \\ \text{Tbs/1,000 sq. ft.} &= \text{recommended lbs./acre} \times \text{cupfuls in 1 lb. of formulation} \times 0.37^* \\ &\text{or} \\ \text{Tbs/1,000 sq. ft.} &= \text{recommended lbs./acre} \times \text{Tbs. in 1 lb. of formulation} \times 0.023^* \\ &\text{or} \\ \text{grams/1,000 sq. ft.} &= \text{recommended lbs./acre} \times 10.4^* \end{aligned}$$

**\*These values have been rounded off to facilitate calculations.**

## Conversion Tables for Small Areas

**LIQUID FORMULATIONS<sup>1</sup>**  
**Amount of Commercial Product to Add to Spray Tank to Treat 1000 Sq. Ft.**

FORMULATION LBS./GAL. ACTIVE INGREDIENT	Desired Rate per Acre of Active Ingredient, Lbs.							
	0.25	0.5	1.0	2.0	4.0	8.0	10.0	12.0
0.5	3 Tbs <sup>1</sup> (43.4) <sup>3</sup>	3 oz <sup>2</sup> (86.8)	6 oz (173.7)	11 oz 1 Tbs (347.4)				
1.0	1 Tbs 1 tsp (21.7)	3 Tbs (43.4)	3 oz (86.8)	5 oz 1 Tbs (173.7)				

2.0	2 tsp (10.8)	1 Tbs 1 tsp (21.7)	3 Tbs (43.4)	3 oz (86.8)	5 oz 1 Tbs (173.7)	11 oz 1 Tbs (342.4)		
4.0	1 tsp (5.4)	2 tsp (10.8)	1 Tbs 1 tsp (21.7)	3 Tbs (43.4)	3 oz (86.8)	6 oz (173.7)	7 oz 2 tsp (217.1)	8 oz 4 tsp (260.6)
<sup>1</sup> approximate values				<sup>2</sup> refers to level measure				
<sup>3</sup> figure in parentheses refers to milliliters								

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Pesticide Safety and Other Pesticide Information

## CALIBRATION OF BACKPACK SPRAYERS 1000 Ft<sup>2</sup> Method

Paul E. Sumner, Extension Engineer

Backpack sprayers are often used to treat ornamental or small areas of turf. Herbicide recommendations are based amount per acre and amount per 1000 ft<sup>2</sup>. Regardless of the type of sprayer used to apply herbicides, the speed, pressure and nozzle height must be kept constant for accurate application. The backpack sprayer may require some modification so that it is better suited for application. A pressure gauge mounted on the tank side of the shutoff valve will allow continuous monitoring of the tank pressure, which must remain uniform. Optimum pressure control can be achieved by inserting a pressure regulator between the pressure gauge and nozzle. To prevent dripping after the shutoff valve is closed, use a quick, positive pressure shutoff valve or a strainer with a check valve. Nozzle clogging, a problem associated with the use of wettable powders (as well as DF and WDG formulations) can be reduced by inserting a 50 mesh in-line strainer and keeping the solution constantly agitated. The following is a procedure of 1000 ft<sup>2</sup>.

**Step 1.** Measure the length and width of the test area to be sprayed. Then calculate the area to be covered.

$$\text{Test Area is: length } \underline{\hspace{2cm}} \text{ ft X width } \underline{\hspace{2cm}} \text{ ft = } \underline{\hspace{2cm}} \text{ ft}^2$$

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

$$\text{Volume (ounces) per test area } \underline{\hspace{2cm}}$$

**Step 3.** Find the label rate of material to be applied per 1000 ft<sup>2</sup>.

$$\text{Rate } \underline{\hspace{2cm}} \text{ per 1000 ft}^2$$

$$\text{Step 4. } \frac{1000 \text{ ft}^2 \times \text{ounces per test area}}{\text{Test Area (ft}^2)} = \text{Volume (ounces) per 1000 ft}^2$$

**Step 5.** Calculate the area covered per tank as follows:

$$\frac{\text{Tank volume (ounces) x 1000 ft}^2}{\text{Volume per 1000 ft}^2} = \text{Area covered per tank (ft}^2)$$

**Step 6.** Calculate amount of material to add to tank.

Solutions derived from the above may need to be converted to a smaller unit in order to accurately measure the pesticide accurately. The following conversion will help simplify this problem.

**Conversions:**

**Volume**

gallon x 128 = fluid ounces (fl oz)  
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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## CALIBRATION METHOD FOR GRANULAR APPLICATIONS

Paul E. Sumner, Extension Engineer

Applicators used in granular applications should be calibrated to insure uniformity and accuracy of the application. A more accurate and uniform application can reduce the quantity of an active ingredient required for a given degree of control, which benefits the environment as well as the producer.

Several factors influence the amount of granular material applied to a given area. Granular material is usually metered with an adjustable orifice. The amount of material that flows through the orifice per revolution relies on orifice opening size and may rely on rotor speed. A wide variation in product characteristics, such as size, density, and shape, requires that a calibration be made for every chemical applied. Also changes in climatic conditions, such as temperature and humidity, can result in a different flow rate.

**CAUTION: Calibration is done using the chemical to be applied. Protective equipment, such as rubber gloves, etc. should be used to avoid contact with the chemicals to be applied.**

Granular application is usually done in combination with another operation, such as planting or cultivating. The applicator may be ground driven or driven with a small electric motor. The following procedure will give the pounds (total weight) of material applied per acre broadcast or row basis as indicated. A weight scale incremented in ounces is required for this procedure.

Step 1. Determine type of application to be made and select appropriate procedure from Table 1. Example - Broadcast - Procedure A.

**Table 1. Corresponding procedures for different spray applications.**

Type of Application	Procedure	Coverage Basis (Volume of Application)
Broadcast	A	Broadcast (lbs/acre)
Band	B	Broadcast (lbs/acre of band)
Row (See note)	C (Use this procedure when rates are given for row treatment)	Row (lbs/acre of row)
<b>Note:</b> Determine and use average row spacing for modified row patterns. Use width of area covered per row as row spacing in skip row patterns for broadcast rates		

Step 2. Using procedure A, B, or C below as selected in Step 1, determine appropriate calibration distance from Table 2.

(A) Broadcast Application: Outlets must be evenly spaced. Measure outlet spacing. Find this spacing in left column of Table 2 and read the corresponding calibration distance. Example - for a 19" spacing the distance would be 214.9 feet.

(B) Band Application: Measure band width. Find this band width in the left column of Table 2 and read the corresponding calibration distance. Example - for a 12" band, the distance

would be 340.3.

(C) Row Application: Measure row spacing for evenly spaced rows. Find this row spacing in the left column of Table 2 and read the corresponding calibration distance from the column on the right. Example - for a 38" row spacing, the distance would be 107.5 feet.

**CAUTION: AGRICULTURAL CHEMICALS CAN BE DANGEROUS. IMPROPER SELECTION OR USE CAN SERIOUSLY INJURE PERSONS, ANIMALS, PLANTS, SOIL, OR OTHER PROPERTY.**

**BE SAFE: SELECT THE RIGHT CHEMICAL FOR THE JOB. HANDLE IT WITH CARE. FOLLOW THE INSTRUCTIONS ON THE CONTAINER LABEL AND INSTRUCTIONS FROM THE EQUIPMENT MANUFACTURER.**

Step 3. Measure and mark calibration distance in a typical portion of the field to be applied.

Step 4. With all attachments in operation (harrows, planters, etc.) and traveling at the desired operating speed, determine the number of seconds it takes to travel calibration distance. Be sure machinery is traveling at full operating speed the full length of the calibration distance. Mark or make note of engine RPM and gear. Machine must be operated at same speed for calibration.

Step 5. **Multiply the number seconds required to travel calibration distance by 8.** This is the number of seconds to collect.

Step 6. With applicator sitting still and operating at same speed as used in Step 4, adjust gate openings to desired setting. Check uniformity of outlets across the swath or rows. Collect from each outlet for a known time period. Each outlet should be within 5 percent of the average outlet output.

**Table 2. Calibration distances with corresponding widths.**

Row Spacing, Outlet Spacing or Band Width (Whichever Applies) (Inches)	Calibration Distance (feet)
48*	85.1
46	88.8
44	92.8
42	97.2
40	102.1
38	107.5
36	113.4
32	127.6
30	136.1
24	170.2
20	204.2
19	214.9
18	226.9
14	291.7
12	340.3
10	408.4
8	510.5

**To determine distance for spacing or band width not listed, divide the spacing or band width expressed in feet into 340.3. Example: for a 13" band the calibration distance would be 340 divided by 13/12 = 314.1.**

\* To increase calibration accuracy for a wide outlet spacing, multiply calibration distance by a factor (for example, 2); then, divide Step 8 material collected by the same factor for pounds per acre. For narrow spacings with long calibration distances, divide calibration distance by a factor (for example, 4); then, multiply Step 8 by the same factor for pounds per acre. Keep in mind that application accuracy will decrease when factoring narrow outlet or band spacings.

Step 7.\*\*For procedure (A), Step 2, broadcast application, collect from one outlet for the number of seconds indicated in Step 5.

For procedure (B), Step 2, band application, collect from all outlets used on one band width for the number of seconds indicated in Step 5.

For procedure (C), Step 2, row application, collect from all outlets used for one row for the number of seconds indicated in Step 5.

**\*\* For ground driven equipment, multiply the calibration distance by 8 and collect from each outlet while traveling the calibration distance.**

Step 8. Weigh the amount of material collected in ounces. **The number of ounces collected is the pounds per acre rate** on the coverage basis indicated in Table 1. For example, if you collect 18 ounces using procedure (A) or (B), the applicator will apply 18 pounds per acre on a broadcast coverage basis. Adjust applicator speed, gate opening, etc. to obtain recommended rate.

Step 9. Applicators should be checked for proper calibration every 4-8 hours of use. Simply repeat steps 7 and 8. If there is a difference of more than 5 percent of original calibration, check the system.

### Band Application

To determine the pounds of material required to make a band application on a field, the number of acres that will be in the actual treated band must be determined. When all treated bands are the same width and all untreated bands are the same width, which is usually the case, the acres in the actual treated band can be calculated by placing the width of the treated band over the sum of the widths of the treated band and the untreated band, and multiplying this fraction times the number of acres in the field. Example - How many acres will actually be treated in a 30 acre field if a 12" band of chemical is applied over the drill of rows spaced 36" apart. The treated band width is 12 inches. The untreated band width is (36" - 12") = 24". Acres actually treated will be 12 inches divided by (12" + 24") times 30 acres equals 10 acres. The amount of material required for the 30 acre field will be 10 times the number of pounds per acre from Step 8.

Check rate recommendations carefully as to type of application, broadcast, band or row, and type of material specified, formulated product, active ingredient, etc.

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# Landscape

Tables 31 through 36 are designed to aid landscape professionals and homeowners in determining number of plants at various spacing, cubic yards of soil needed at various depths and areas, areas covered in square feet at various depths, time needed to trim lawns, and the volume of water delivered as affected by the size of irrigation hose.

**Table 31. Estimated number of plants to fill 100 ft<sup>2</sup> of bed area for square (row) and triangular (equilateral) planting patterns using 4- to 14-inch spacing distances<sup>1</sup>**

Planting Pattern	Inches between rows of plants (Y)	Inches between plants (X) within rows	Estimated number of plants per 100 ft <sup>2</sup>
<b><u>Square</u></b>			
For square spacing, the distance between plants within rows (x) equals the distance between rows (Y)	4	4	900
	6	6	400
	8	8	225
	10	10	144
	12	12	100
	14	14	74
<b><u>Triangular</u></b>			
For triangular spacing, the distance between plants within rows and between rows both equal X, and the distance between rows (Y) equals 0.886 X.	3.46	4	1039
	5.20	6	462
	6.93	8	260
	8.66	10	166
	10.39	12	115
	12.12	14	85

<sup>1</sup> Adopted from Bailey, D.A., and M.A. Powell. 1999.

**Table 32. Volume of water delivered -- by size of hose**  
(Gallons per Minute in Bold Face)

Water Pressure (lbs)	Hose Diameter						
	3/8"	13/32"	7/16"	1/2"	9/16"	3/4"	5/8"
<b>30</b>	2.6	3.2	3.8	5.3	7.2	9.3	14.5
<b>40</b>	3.5	4.2	5.0	7.0	9.4	12.2	19.0
<b>50</b>	4.3	5.2	6.3	8.8	11.8	15.3	24.0
<b>60</b>	5.2	6.2	7.5	10.5	14.1	18.3	28.5
<b>70</b>	6.0	7.3	8.7	12.2	16.2	21.0	32.7
<b>80</b>	6.8	8.3	9.9	13.9	18.5	24.0	37.3

NOTE: Table based on 50-foot hose length; for 25 feet, multiply by 1.40; for 75 feet, multiply by 0.80.

**Table 33. Number of plants per acre at various spacing**

Distance Apart	No. of Plants	Distance Apart	No. of Plants	Distance Apart	No. of Plants
3 x 3 inches	696,690	4 x 4 feet	2,722	13 x 13 feet	257
4 x 4 inches	392,040	4½ x 4½ feet	2,151	14 x 14 feet	222
6 x 6 inches	174,240	5 x 1 feet	8,712	15 x 15 feet	193
9 x 9 inches	77,440	5 x 2 feet	4,356	16 x 16 feet	170
1 x 1 foot	43,560	5 x 3 feet	2,904	16½ x 16½ feet	160
1½ x 1½ feet	19,360	5 x 4 feet	2,178	17 x 17 feet	150
2 x 1 feet	21,780	5 x 5 feet	1,742	18 x 18 feet	134
2 x 2 feet	10,890	5½ x 5½ feet	1,417	19 x 19 feet	120
2½ x 2½ feet	6,960	6 x 6 feet	1,210	20 x 20 feet	108
3 x 1 feet	14,620	6½ x 6½ feet	1,031	25 x 25 feet	69
3 x 2 feet	7,260	7 x 7 feet	881	30 x 30 feet	48
3 x 3 feet	4,840	8 x 8 feet	680	33 x 33 feet	40
3½ x 3½ feet	3,555	9 x 9 feet	537	40 x 40 feet	27
4 x 1 feet	10,890	10 x 10 feet	435	50 x 50 feet	17
4 x 2 feet	5,445	11 x 11 feet	360	60 x 60 feet	12
4 x 3 feet	3,630	12 x 12 feet	302	66 x 66 feet	10

**Table 34. Times required to mow or trim lawn areas**

		In Minutes Per 1000 Square Feet - Or - Minutes Per Acre (Numbers Rounded Up To The Nearest Minute)								
Speed Is		And Width of Cut**Is								
Miles Per Hour	Feet Per Minute	6"	12"	18"	24"	36"	48"	60"	72"	
.25	22	91	46	31	23	16	12	10	8	
.5	44	46	23	16	12	8	6	5	4	
1.0	88	23	12	8	6	4	3	3	2	
1.25	110	19	10	7	5	4	3	2	66	
1.50	132	16	8	6	4	3	2	66	55	
1.75	154	13	7	5	4	3	71	57	48	
2.0	176	12	6	4	3	2	62	50	42	
2.5	220	10	5	3	3	66	50	40	33	
3.0	264	8	4	3	83	55	42	33	28	
3.5	308	7	4	95	71	48	36	29	24	
4.0	352	6	3	83	62	42	31	25	21	
4.5	396	6	110	74	55	37	28	22	19	
5.0	440	198	99	66	50	33	25	20	17	
5.5	484	180	90	60	45	30	23	18	15	
6.0	528	165	83	55	42	28	21	17	14	
8.0	704	124	62	42	31	21	16	13	11	

\*Time=Min./1000 sq. ft. above this Line (between yellow and green)

\*Time=Min./Acre below this Line (between yellow and green)

\*\*These figures are for effective width of cut, that is, width of blade less operational overlap averages = 4" to 10"

**Some Average Speeds**

Slow Walk - Pushing Mower	150'/Min.
Slow Walk	200'/Min.
Fast Pushing Mower	250'/Min.
Modest Riding Yard Mower	275'/Min.

Fast Brisk Walk 300'/Min.  
 Good Riding Yard Mower 300'-350'/Min.  
 Tractor-Towed Riding Mower 6-7 M.P.H.

1 Acre = 43,560 sq ft; 1 mile = 5,280 lin ft

**Table 35. Cubic yards of soil needed at various depths and areas**

		Areas in 1,000 Sq. Ft. and Acres													
		½	1	2	3	4	5	6	7	8	9	10	½A	1A	2A
1	2	3	6	9	12	15	17	22	25	28	31	67	134	269	
2	3	6	12	19	25	31	37	43	49	56	62	134	269	538	
3	5	9	19	28	37	46	56	65	74	83	93	202	403	807	
4	6	12	25	37	49	62	74	86	99	111	124	269	538	1076	
5	8	15	31	46	62	77	93	108	124	139	154	336	672	1344	
6	9	19	37	56	74	93	111	130	148	167	185	403	807	1613	
7	11	22	43	65	86	108	130	151	173	194	216	471	941	1882	
8	12	25	49	71	99	124	148	173	198	222	247	538	1076	2151	
9	14	28	56	83	111	139	167	194	222	250	278	605	1210	2420	
10	15	31	62	93	124	154	185	216	247	278	309	672	1344	2688	
11	17	34	68	102	136	170	203	238	272	306	340	739	1479	2858	
12	19	37	74	111	148	185	222	259	296	333	370	807	1613	3227	

**Table 36. Areas covered in square feet at various depths**

		Depth in Inches					
		1	2	3	4	5	6
1		324	162	108	81	65	54
2		648	324	216	162	130	108
3		972	486	324	243	195	162
4		1296	648	432	324	260	216
5		1620	810	540	405	324	270
6		1944	972	648	486	390	324
7		2268	1134	756	567	455	378
8		2592	1296	864	648	520	432

**Table 37. Temperature conversion**

Fahrenheit	Centigrade (Celsius)	Centigrade (Celsius)	Fahrenheit
0	-17.8	-30	-22.0
5	-15.0	-25	-13.0
10	-12.2	-20	-4.0
15	-9.4	-15	5.0
20	-6.7	-10	14.0
25	-3.9	-5	23.0
30	-1.1	0	32.0
35	1.7	5	41.0
40	4.4	10	50.0

45	7.2	15	59.0
50	10.0	20	68.0
55	12.8	25	77.0
60	15.6	30	86.0
65	18.3	35	95.0
70	21.1	40	104.4
75	23.9	45	113.0
80	26.7	50	122.0
85	29.4	55	131.0
90	32.2	60	140.0
95	35.0	80	176.0
100	37.8	100	212.0

**NOTES:** 1) To convert temperature in degrees from Centigrade (Celsius) to temperature in degrees Fahrenheit: Multiply Centigrade temperature by **1.8** and add **32**. 2) To convert temperature in degrees Fahrenheit to temperature in degrees Centigrade (Celsius): Subtract **32** and multiply by **0.55**.

