

# PESTICIDE SAFETY AND OTHER PESTICIDE INFORMATION

## USE PESTICIDES SAFELY

Paul Smith, Extension Entomologist

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)** (<http://ipm.ent.uga.edu>). 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. 'NEVER store pesticides in any food or drink container!'
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.

### 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. Keep the end of the hose above pesticide/water level.
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. Check your protective equipment before, during, and after a pesticide application for wear or damage.
4. Clear the area of other people and animals.
5. Avoid drift and run off. 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.
6. Be prepared for leaks, spills, or equipment failures.
7. 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.

# PROTECT HONEY BEES FROM PESTICIDES

Keith S. Delaplane, Extension Entomologist

Many crops cannot be economically produced unless there are large numbers of honey bees to pollinate them. In addition, honey bees produce more than \$50 million of honey and beeswax annually, and honey bee pollination accounts for over \$14 billion added value to American agriculture each year. Beekeeping in Georgia adds an estimated \$70 million annually to our state's economy.

Many pesticides are extremely hazardous to honey bees. But damage can be minimized if the pesticide user and the beekeeper cooperate and take proper precautions.

## The Pesticide User's Role

1. Use pesticides only when needed.
2. If possible, select one of the least hazardous pesticides from the following list, especially on flowering plants that attract bees.
3. Use the least hazardous method of application. Granules are usually harmless to honey bees. Sprays drift less than dusts and are less likely to kill bees in nearby areas. Whenever possible, minimize drift by applying pesticides with ground application equipment rather than with airplanes.
4. Do not apply pesticides when honey bees are active in the field. Applications in late evening or night are least likely to kill bees. Do not apply pesticides when plants are in flower unless it is absolutely necessary.
5. Avoid pesticide drift into apiaries or areas where crops or wild plants are flowering. With crops that require heavy pesticide applications, plant them in non-sensitive areas if possible.
6. Notify nearby beekeepers several days before you apply a pesticide.

## The Beekeeper's Role

1. Whenever possible, locate colonies away from areas of heavy pesticide use.
2. Post your name, address, and phone number conspicuously at your apiary and tell nearby farmers where your hives are located.
3. Know which pesticides are commonly used in your area and be prepared to confine or remove your bees if you are notified that a pesticide will be applied. Commonly used pesticides are grouped according to hazard in the following list.

If you cannot move hives in time to avoid a pesticide application, you can cover each hive with a plastic sheet at night and in the early morning to confine the bees and protect them from short-residual pesticides. However, heat builds up rapidly once the plastic is exposed to the sun and it must be removed. An alternative — wet burlap, can be used for a day or more. This may be impractical for large numbers of hives. Colonies that are repeatedly exposed to pesticides in Groups I or II of the list below should be relocated.

## Commonly Used Pesticides Grouped According To Their Relative Hazards To Honey Bees<sup>1</sup>

### Group I

#### Hazardous

abamectin (Agri-Mek, Avid)	clofentezine (Apollo)	endosulfan (Thiodan)	methidathion (Supracide)
acephate (Orthene, Address)	crotoxyphos (Cyodrin)	EPN	methiocarb (Mesurol)
aminocarb (Matacil)	cypermethrin (Ammo)	esfenvalerate (Asana)	methomyl (Lannate)
azinphosmethyl (Guthion)	cyfluthrin (Baythroid)	ethyl parathion (Parathion)	methyl parathion (Penncap-M)
benzene hexachloride (BHC. lindane)	cyhalothrin (Warrior)	fenpropathrin (Danitol)	mevinphos (Phosdrin) <sup>2</sup>
bifenthrin (Capture, Brigade)	cypermethrin (Ammo)	fenthion (Baytex)	monocrotophos (Azodrin)
carbaryl (Sevin, Sevin XLR- Plus)	deltamethrin (Decis)	fipronil	naled (Dibrom) <sup>2</sup>
carbofuran (Furadan)	diazinon (Diazinon, Spectracide)	hexythiazox (Savey)	oxamyl (Vydate >1 lb/A)
chlorpyrifos (Dursban, Lorsban)	dichlorvos (DDVP, Vapona)	imidacloprid (Provado)	permethrin (Ambush, Pounce)
chlorethoxyfos (Fortress)	dicrotophos (Bidrin)	indoxacarb (Avaunt)	phorate (Thimet EC)
	dimethoate (Cygon, Dimethoate, Rebelate)	lambda-cyhalothrin (Warrior)	phosmet (Imidan)
	emamectin (Proclaim)	malathion (Cythion ULV)	phosphamidon (Dimecron)
		methamidophos (Monitor)	

<sup>1</sup>List derived in part from Johansen, C.A. and Mayer, D.F. Pollination Protection. 1990, Wicwas Press; Bulletin E-5 3-W, Hunt, G.J., Purdue University; Environmental Entomology 33(5):1151-1154.

<sup>2</sup>Not all *Bacillus thuringiensis* insecticides are safe for bees. The label for XenTari® (Valent BioSciences), with active ingredient *B. thuringiensis aizawai*, reads "This product is highly toxic to honey bees exposed to direct treatment. Do not apply this product while bees are actively visiting the treatment area."

**PROTECT HONEY BEES FROM PESTICIDES (continued)**

**Group I**

**Hazardous (cont.)**

propoxur (Baygon)  
pyridaben (Pyramite)  
resmethrin (Synthrin)  
tebufenozide (Confirm)  
tralomethrin (Scout)  
zeta-cypermethrin (Fury, Mustang)

**Group II**

**Moderately Hazardous**

aldicarb (Temik)  
carbaryl (Sevin XLR formulation only)  
carbophenothion (Trithion)  
coumaphos (Co-Ral)  
cyromazine (Trigard)  
diatomaceous earth (Diatect)  
disulfoton (Di-Syston)  
DSMA  
emamectin benzoate (Proclaim)  
ethoprop (Mocap)  
fonofos (Dyfonate)  
malathion (Cythion, ULV <3 fl oz/A)  
methyl demeton (Metasystox)  
MSMA  
neem (Azatin, Neemix)  
oxamyl (Vydate <0.5 lb/A)  
oxydemeton-methyl (Metasystox R)  
paraquat  
perthane  
pymetrozine (Fulfill)  
pyriproxyfen (Esteem, Knack)  
ronnel (Co-Ral, Korlan)  
spinosad (SpinTor)  
temephos (Abate)  
terbufos (Counter)  
thiamethoxam (Actara, Platinum)  
thiodicarb (Larvin)

**Group III**

**Relatively Nonhazardous**

acetamiprid (Assail)  
allethrin (Pynamin)  
amitraz (Mitac)  
amitrole  
azadirachtin (Align)  
azoxystrobin (Abound)

*Bacillus thuringiensis* (Biobit, DiPel, Full-Bac, Javelin, MVP)<sup>3</sup>  
Beauveria (Mycotrol)  
benomyl (Benlate)  
binapacryl (Morocide)  
bordeaux mixture  
bromoxynil  
capsaicin (Hot Pepper Wax)  
captan  
carbaryl (Sevin G, Bait G)  
carbofuran (Furadan G)  
chloramben  
chlorbenzide (Mitox)  
chlorobenzilate (Acaraben)  
chlorothalonil (Bravo)<sup>4</sup>  
copper compounds (Kocide)  
copper oxychloride sulphate  
copper 8-quinolinolate  
copper sulfate (Monohydrated)  
cryolite (Cryolite, Kryocide)  
cyromazine (Trigard)  
dalapon  
dazomet (Mylone)  
demeton (Systox)  
dexon  
diazinon (Diazinon G)  
dicamba (Banvel D)  
dichlone (Phygon)  
dicofol (Kelthane)  
diflubenzuron (Dimilin)  
dinocap (Karathane)  
disulfoton (Di-Syston G)  
dodine (Cyprex)  
dyrene endothall  
EPTC (Eptam)  
ethion (Ethion)  
ethoprop (Mocap G)  
fenbutatin-oxide (Vendex)  
fenhexamid (Elevate)  
ferbam  
fluvalinate (Spur)  
folpet (Phaltan)  
Garlic Barrier  
genite 923  
glyodin (Glyoxide)  
kaolin (Surround)  
malathion (Malathion G)  
mancozeb (Dithane M-45)  
maneb (Dithane M-22)  
MCPA  
metaldehyde (Metaldehyde Bait)

methoxychlor (Marlate)  
metiram (Polyram)  
monuron (Telvar)  
myclobutanil (Rally)  
nabam (Parzate)  
nemagon  
nicotine sulfate  
oxythioquinox (Morestan)  
pentac  
propargite (Omite)  
pyrethrum  
pyrimidinamine (Vanguard)  
rotenone (rotenone)  
ryania  
silvex  
imazine (Princep)  
soap (M -Pede)  
sulfurtebufenozide (Confirm)  
TDE (Rhothane)  
tetradifon (Tedion)  
thioquinox (Eradex)  
thiram (Arasan)  
toxaphenetrichlorfon (Dylox)  
trifloxystrobin (Flint)  
zineb (Dithane)  
ziram  
2,4-D  
2,4-DB  
2,4,5-T

<sup>1</sup>List derived in part from Johansen, C.A. and Mayer, D.F. Pollination Protection. 1990, Wicwas Press; Bulletin E-5 3-W, Hunt, G.J., Purdue University; Environmental Entomology 33(5):1151-1154.

<sup>2</sup>Mevinphos (Phosdrin\*), naled (Dibrom\*), and TEPP have short residual activity and kill only the bees contacted at time of treatment or shortly thereafter. They are usually safe to use when bees are not in flight; they are not safe to use around colonies.

<sup>3</sup>Not all *Bacillus thuringiensis* insecticides are safe for bees. The label for XenTari® (Valent BioSciences), with active ingredient *B. thuringiensis aizawai*, reads "This product is highly toxic to honey bees exposed to direct treatment. Do not apply this product while bees are actively visiting the treatment area."

<sup>4</sup>New data (2011) suggest that chlorothalonil fungicide expresses toxicity in honey bee brood in the context of crop applications at time of bloom. Additionally, lethal synergies occur between this product and the miticide fluvalinate used to control varroa mite in bee hives. Beekeepers should manage hives to avoid exposure to chlorothalonil.

# NAMES, CLASSIFICATION AND TOXICITY OF PESTICIDES

Paul Smith, Extension Entomologist

The tables on the following pages of this section will help you to identify specific pesticide active ingredients and give you an indication of their toxicities.

**NAMES.** The chemical names of pesticide active ingredients are usually so long and complex that they are generally used only in the active ingredient statement on the pesticide label and in scientific or technical publications. The common name of a pesticide active ingredient is one that is commonly used and has usually been approved by an appropriate scientific group. The trade name of a pesticide active ingredient is a copyrighted name used by its producer. A pesticide active ingredient will usually have only one common name but it may have several trade names. For example, glyphosate is the common name for the chemical name isopropylamine salt of N-(phosphonomethyl) glycine, the active ingredient in Roundup. The trade names listed in the tables are capitalized and bear an asterisk(\*). These trade names should not be confused with the brand names used by formulators and distributors of pesticide products.

**CLASSIFICATION.** Insecticides, herbicides, fungicides and other pesticides are primarily classified on the basis of their chemical structure or origin. The inorganic pesticides are those which contain no carbon in their chemical structure. The organic pesticides, those that contain carbon, are usually synthetic but some are obtained from natural sources such as plants or microorganisms. Some synthetic organic pesticides such as the pyrethroids, or synthetic pyrethrins, are based on naturally occurring chemicals.

**TOXICITY.** The Environmental Protection Agency uses the results of acute toxicity studies on test animals, usually rats and rabbits, to place pesticides in toxicity categories (I-IV) which determine what signal word must appear on the label. Although inhalation toxicity, eye corrosiveness and skin corrosiveness studies are also used, results of acute dermal and acute oral toxicity studies are more publicized and usually more important.

The below table shows the signal words that must appear on the pesticide label for each toxicity category and the range of the oral and dermal medianlethal doses (LD<sub>50</sub>) for each category. A pesticide that falls into category I only because of eye or skin corrosiveness must bear "Danger" but not "Poison" nor the skull and crossbones symbol on its label.

The LD<sub>50</sub> is the dose of a substance at which one-half of the exposed test animals are killed. It is based on the body weight of the animal and is expressed in milligrams of the substance per kilogram of animal (mg/kg). One mg/kg is equivalent to 1 part per million (ppm). The lower the LD<sub>50</sub>, the greater the toxicity. Although most LD<sub>50</sub> values that are readily available in publications are for the pesticide active ingredient or actual toxicant, the signal word on each pesticide product is determined by the toxicity of that particular formulation. Formulated pesticides are usually, but not necessarily, less toxic than the active ingredient. The toxicity categories given in the following tables are based solely on the accompanying LD<sub>50</sub> values which, unless stated otherwise, are for the active ingredient. EPA would not necessarily assign the same category shown in the tables.

TOXICITY CATEGORY	SIGNAL WORDS REQUIRED ON LABEL BY EPA	ORAL LD <sub>50</sub> (mg/kg)	DERMAL LD <sub>50</sub> (mg/kg) 24 HR. EXPOSURE	ORAL DOSAGE TO KILL AN ADULT*
I. Highly Toxic	DANGER, POISON, Plus Skull & Crossbones symbol	0 to 50	0 to 200	A few drops to 1 tsp
II. Moderately Toxic	WARNING	50 to 500	200 to 2,000	1 tsp. to 2 Tbsp.
III. Slightly Toxic	CAUTION	500 to 5,000	2,000 to 20,000	1 oz. to 1 pt. (1 lb.)
IV. Low Toxicity	CAUTION	>5,000	>20,000	1 pt. (1 lb.) or more

Toxicity categories and signal words on the pesticide label are based on acute toxicity studies, but sub-acute and chronic toxicity studies are also conducted. Acute toxicity involves the short-term response of the test animal to a single large exposure to the pesticide. Sub-acute toxicity refers to the response of the animal to repeated or continuous exposure to smaller doses over less than one-half of its normal life span. In chronic toxicity studies exposures are repeated or continued for longer than one-half of the animal's life span.

\*Less for child/pet

**You should not keep or use pesticides with the words DANGER-POISON on the label. Contact Paul Smith 706-542-2264 (pfsmith.uga.edu) for information about disposal.**

# PESTICIDE RATE AND DOSAGE CALCULATIONS

Paul Smith, Extension Entomologist

## 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 concentration 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:

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

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 RATE AND DOSAGE CALCULATIONS (continued)**

**Pesticide Conversion Table for Large Areas**

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

FORMULATION LBS./GAL. ACTIVE INGREDIENT	Desired Rate Per Acre if Active Ingredient, Lbs.															
	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1	1.1	1.5	2	2.5	3	4	6	9
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	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	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	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	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	3.8 oz	5.7 oz	7.6 oz	9.6 oz	11.5 oz	14.3 oz	19.1 oz	21 oz	29 oz	38 oz	48 oz	57 oz	76 oz	115 oz	172 oz
7	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	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**

% ACTIVE INGREDIENT	Desired Rate Per Acre if Active Ingredient, Lbs.																
	0.2	0.3	0.4	0.5	0.6	0.8	0.8	1	1	2	2	3	3	4	5	8	10
50	0.4	0.6	0.8	1	1.2	1.5	1.6	2	2	3	4	5	6	8	10	16	20
75	0.3	0.4	0.5	0.7	0.8	1	1.1	1.3	2	2	3	3	4	5.3	6.6	10.7	13.33
80	0.3	0.4	0.5	0.6	0.8	0.9	1	1.2	2	2	3	3	4	5	6.2	10	12.5

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

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

## PESTICIDE RATE AND DOSAGE CALCULATIONS (continued)

### 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 wettable 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:  
 $\text{teaspoons/gallon} = \text{recommended pints per 100 gallons}$   
 OR  
 $\text{milliliters/gallon} = \text{recommended pints per 100 gallons} \times 4.73^*$
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:  
 $\text{teaspoons/gallon} = \text{recommended lbs./100 gals.} \times \text{cupful in 1 lb. of formulation} \times 0.053^*$   
 OR  
 $\text{teaspoons/gallon} = \text{recommended lbs./100 gals.} \times \text{Tbs. in 1 ounce of formulation} \times 0.53^*$   
 OR  
 $\text{grams/gallon} = \text{recommended lbs./100 gals} \times 4.54^*$
3. To find the amount of liquid concentrate to apply per 1,000 square feet when label recommendations are given as pints per acre:  
 $\text{teaspoons/1,000 sq. ft.} = \text{recommended pints/acre} \times 2.20^*$   
 OR  
 $\text{milliliters/1,000 sq. ft.} = \text{recommended pints/acre} \times 10.9^*$
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:  
 $\text{lbs./1,000 sq. ft.} = \text{recommended lbs./acre} \times 0.023^*$   
 OR  
 $\text{Tbs/1,000 sq. ft.} = \text{recommended lbs./acre} \times \text{cupful in 1 lb. of formulation} \times 0.37^*$   
 or  
 $\text{Tbs/1,000 sq. ft.} = \text{recommended lbs./acre} \times \text{Tbs. in 1 lb. of formulation} \times 0.023^*$   
 or  
 $\text{grams/1,000 sq. ft.} = \text{recommended lbs./acre} \times 10.4^*$

\*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 if Active Ingredient, Lbs.							
	0.25	0.5	1	2	4	8	10	12
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	1 Tbs 1 tsp (21.7)	3 Tbs (43.4)	3 oz (86.8)	5 oz 1 Tbs (173.7)				
2	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	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

# AIRBLAST SPRAYER CALIBRATION FOR ORCHARD AND VINEYARD

Paul E. Sumner, Extension Engineer

Calibrations is the process of measuring and adjusting the gallons per acre of spray actually applied. Sprayers need to be calibrated to meet the coverage needs of the orchards to be sprayed and to facilitate precise dosing of each material. A sprayer should be set up to apply a gallon per acre rate at a desired speed and pressure. In-orchard calibration frequently indicates a need for adjustments to achieve the target gallons per acre.

**Speed** of travel of a sprayer is a vital factor in obtaining the number of gallons of spray per acre desired. Change in gallons per acre (GPA) applied is inversely proportional to the change in speed. If speed is doubled, the gallons per acre will be halved. Thus, if nozzles have been installed and pressure set to provide a gallon per acre rate at a certain speed, the sprayer should apply the GPA rate at the speed.

To determine the travel speed, measure a known distance. Use fence posts or flags to identify this distance. A distance over 100 feet and a tank at least half full are recommended. Travel the distance determined at your normal spraying speed and record the elapsed time in seconds. Repeat this step and take the average of the two measurements. Use the following equation to determine the travel speed in miles per hour.

$$\text{Travel Speed (MPH)} = \frac{\text{Distance (feet)} \times 0.68}{\text{Time (seconds)}}$$

(0.68 is a constant to convert feet/second to miles/hour)

## Calculating Gallons per Minute (GPM) Output

The gallons per minute output required for a sprayer traveling along both sides of each row spraying from one side for a desired gallon per acre rate can be calculated with the following equation:

$$\text{GPM (required)} = \frac{\text{GPA (required)} \times \text{MPH (determined)} \times \text{Row Spacing (feet)}}{990 \text{ (spraying one side)}}$$

(If one pass is made between rows spraying from both sides of the sprayer, use 495 as constant.)

GPA = Gallons per Acre

MPH = Miles per Hour

## To check actual GPM output:

1. Fill sprayer with water. Note the level of fill. If a material with considerably different flow characteristics than water is to be sprayed fill the sprayer with this material.
2. Operate the sprayer at the pressure that will be used during application for a measured length of time. A time period of several minutes will increase accuracy over a time period of 1 minute. A suggested time is 5 - 10 minutes.
3. Measure the gallons of liquid required to refill sprayer to the same level it was prior to the timed spray trial with the sprayer in the same position as when it was filled initially. The actual GPM can be calculated as follows:

$$\text{GPM (actual)} = \frac{\text{Gallons to refill sprayer tank}}{\text{minutes of spray time}}$$

4. Calculate the GPA being applied spraying from one side on both sides of row by the sprayer.

$$\text{GPA (actual)} = \frac{\text{GPM (actual)} \times 990 \text{ (spraying one side)}}{\text{MPH} \times \text{Row Spacing (feet)}}$$

If the actual GPA is slightly different from the required GPA, the actual GPA can be increased or decreased in increasing or decreasing spray pressure on sprayer models that have provisions for adjusting pressure. Only small output changes should be made by adjusting pressure. Major changes in output should be done by changing nozzles or ground speed.

## Nozzle Setup

Nozzle arrangement and air guide or director vane settings should place most of the spray in the top half of the plants, where most of the foliage and fruit are located. Airblast sprayers are typically set up to apply 2/3 to 3/4 to the spray to the top half, and 1/4 to 1/3 to the bottom half. This targeted spraying is accomplished by placing more or larger nozzles on manifolds in the area that supplies spray to the upper half of the trees and setting the air directors on the fan outlet to direct the air stream accordingly. Plant growth and target pest habits should be considered in determining the setup for specific applications.

# CALIBRATION METHOD FOR HYDRAULIC BOOM AND BAND SPRAYERS, AND OTHER LIQUID APPLICATORS

Paul E. Sumner, Extension Engineer

The procedure below is based on spraying 1/128 of an acre per nozzle or row spacing and collecting the spray that would be released during the time it takes to spray the area. Because there are 128 ounces of liquid in 1 gallon, this convenient relationship result in ounces of liquid caught being directly equal to the application rate in gallons per acre.

Calibrate with clean water when applying toxic pesticides mixed with large volumes of water. Check uniformity of nozzle output across the boom. Collect from each for a known time period. Each nozzle should be within 10 percent of the average output. Replace with new nozzles if necessary. When applying materials that are appreciably different from water in weight or flow characteristics, such as fertilizer solutions, etc., calibrate with the material to be applied. Exercise extreme care and use protective equipment when active ingredient is involved.

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

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

Type of Application	Procedure	Coverage Basis
	Herbicide, Insecticide, Nematicide, Fungicide, or Liquid Fertilizer	
Broadcast	A	Broadcast (gal/ acre)
Band	B	Broadcast (gal/acre of band)
Row (See note)	C (Use this procedure when rates are given for row treatment)	Row (gal/acre of row)

**Note:** Determine and use average row spacing for modified row patterns. Use width of area covered per row as row spacing in skip row patterns.

**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 or nozzles must be evenly spaced. Measure outlet (nozzle, etc.) 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. (See note above for modified and skip rows.)

**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 sprayed.

**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.** With sprayer sitting still and operating at same throttle setting or engine R.P.M. as used in Step 4, adjust pressure to the desired setting. Machine must be operated at same pressure used for calibration.

**Step 6.** For procedure (A) Step 2, broadcast application, collect spray from one nozzle or outlet for the number of seconds required to travel the calibration distance.

For procedure (B) Step 2, band application, collect spray from all nozzles or outlets used on one band width for the number of seconds required to travel the calibration distance.

For procedure (C) Step 2, row application, collect spray from all outlets (nozzles, etc.) used for one row for the number of seconds required to travel the calibration distance.

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 nozzle spacing, multiply calibration distance by a factor (for example, 2); then, divide the fluid amount collected by the same factor for GPA. For narrow nozzle spacings with long calibration distances, divide calibration distance by a factor (for example, 4); then, multiply the fluid amount collected by the same factor for GPA.

**Step 7.** Measure the amount of liquid collected in fluid ounces. The number of ounces collected is the gallons per acre rate on the coverage bas is indicated in Table 1. For example, if you collect 18 ounces, the sprayer will apply 18 gallons per acre. Adjust applicator speed, pressure, nozzle size, etc. to obtain recommended rate. If speed is adjusted, start at Step 4 and recalibrate. If pressure or nozzles are changed, start at Step 5 and recalibrate.

**Step 8.** To determine amount of pesticide to put into a sprayer or applicator tank, divide the total number of gallons of mixture to be made (tank capacity for a full tank) by the gallons per acre rate from Step 7 and use recommended amount of pesticide for this number of acres.

#### Band Application

Use the recommended **broadcast** pesticide rates to make tank mixtures for band applications when calibrating with procedure (B) of this method. The number of gallons/acre determined in Step 7 is the gallons that will be applied to each acre of actually treated band.

To determine the gallons of spray mixture required to make a band application on a field, the number of acres that will be in the actually 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 actually 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". The untreated band width is (36" - 12") = 24". Acres actually treated will be 12" divided by (12" + 24") times 30 acres equals 10 acres. The amount of mixture required will be 10 times the number of gallons per acre from Step 7. The amount of chemical required will be 10 times the recommended broadcast rate for one acre.

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

#### Calculating Formulation Requirements For Active Ingredient Rates.

To determine amount of liquid pesticide required for a rate given in pounds of active ingredient per acre, divide recommended rate by pounds active ingredient per gallon stated on label. Example – Pesticide label states 4 lbs. active ingredient per gallon and recommends 1/2 pound active ingredient per acre. Amount of pesticide required: 1/2 lb./A divided by 4 lb./gal. = 1/8 gal./A.

To determine amount of wettable powder required for a rate given in pounds active ingredient per acre, divide recommended rate by percent active ingredient stated on label. Example – Pesticide label states powder is 50% active ingredient. Two pounds of active ingredient is recommended per acre. Amount of pesticide powder required: 2 lbs. AI/A divided by 0.5 AI/lb. = 4 lbs./A.

# CALIBRATION METHOD FOR BOOMLESS BROADCAST SPRAYERS

Paul E. Sumner, Extension Engineer

All sprayers should be calibrated often to ensure that pesticide is being applied at the correct rate. Most broadcast applications are made with a boom arrangement where the nozzle tips are spaced evenly along the boom. However, in some situations this may be impossible or undesirable, so a cluster nozzle or a single nozzle with a wide spray pattern may be used.

Calibrate with clean water when applying toxic pesticides mixed with large volumes of water. When applying materials that are appreciably different from water in weight or flow characteristics, such as fertilizer solutions, etc., calibrate with the material to be applied. Exercise extreme care and use protective equipment when active ingredient is involved.

The following instructions outline a simple method to calibrate a boomless broadcast sprayer.

**Step 1.** Determine spray width. The spray width is the distance between successive passes through a field. This is usually given in the manufacturers' literature for a specific nozzle. If you are unable to find this in the catalogs, use 80 to 85 percent of the wetted spray width.

**Step 2.** Using the spray width in Step 1, determine the calibration distance from Table 1.

**Step 3.** Measure and mark calibration distance on typical terrain to be sprayed.

**Step 4.** With all attachments in operation and traveling at the desired operating speed, determine the number of seconds it takes to travel the 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.** With sprayer sitting still and operating at same throttle setting or engine R.P.M. as used in Step 4, adjust pressure to the desired setting. Machine must be operated at same pressure used for calibration.

**Step 6.** Collect spray from all nozzles or outlets for the number of seconds required to travel the calibration distance.

**Table 1. Calibration distances with corresponding widths.**

Swath Width (feet)	Calibration Distance (feet)
40	85.1
38	89.5
36	89.5
32	106.3
30	113.4
28	121.5
24	141.8
20	170.2
18	189
16	212.7
12	283.6
10	340.3
8	425

To determine distance for swath width not listed, divide the swath width expressed in feet into 340.3 and multiply by 10. Example – for 13 feet swath the calibration distance would be 340.3 divided by 13 multiplied by 10 = 261.8.

**Step 7.** Measure the amount of liquid collected in fluid ounces.

**Step 8.** Divide the total number of fluid ounces by 10 to obtain gallons per acre applied. For example, if you collect 180 ounces, the sprayer will apply 18 gallons per acre. Adjust applicator speed, pressure, nozzle size, etc. to obtain recommended rate. If speed is adjusted, start at Step 3 and recalibrate. If pressure or nozzles are changed, start at Step 5 and recalibrate.

**Step 9.** To determine amount of pesticide to put into a sprayer or applicator tank, divide the total number of gallons of mixture to be made (tank capacity for a full tank) by the gallons per acre rate from Step 8 and use recommended amount of pesticide for this number of acres.

**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.**

# CALIBRATION METHOD FOR GRANULAR APPLICATIONS

Paul E. Sumner, Extension Engineer

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)

**Note:** 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 (harrow, 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.

**CALIBRATION METHOD FOR GRANULAR APPLICATIONS (continued)**

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

<b>Row Spacing, Outlet Spacing or Band Width (Whichever Applies) (Inches)</b>	<b>Calibration Distance (feet)</b>
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” a part. 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.

# 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 wetttable 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.

Test Area is: length \_\_\_\_\_ ft X width \_\_\_\_\_ ft = \_\_\_\_\_ ft<sup>2</sup>

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

Volume (ounces) per test area \_\_\_\_\_

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

Rate \_\_\_\_\_ per 1000 ft<sup>2</sup>

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

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

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

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

$$\frac{\text{Area per tank (ft}^2) \times \text{Label rate per 1000 ft}^2}{1000} = \text{Amount to add (rate units)}$$

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)

tsp x 3 = Tablespoons (Tbs)

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)

# CALIBRATING TURFGRASS SPRAYERS (GALLONS PER 1000 FT<sup>2</sup>)

Paul E. Sumner, Extension Engineer

Low-pressure boom sprayers are used frequently for applying chemicals on large areas such as golf courses and recreational areas. Application rates for turf are normally given in gallons per 1000 sq. ft. Calibrating a boom sprayer is not as difficult as it sounds. Calibrate your sprayer often to compensate for nozzle wear, pump wear and speed changes.

Calibrate with clean water. Check uniformity of nozzle output across the boom. Collect from each for a known time period. Each nozzle should be within 10 percent of the average output. Replace with new nozzles if necessary. When applying materials that are appreciably different from water in weight or flow characteristics, such as fertilizer solutions, etc., calibrate with the material to be applied. Exercise extreme care and use protective equipment when active ingredient is involved..

## Step 1. Determine the Effective Swath Width (W) per Nozzle

For boom spraying, the effective spray width of each nozzle (W) is equal to the distance in inches between two nozzles.

## Step 2: Determine Travel Speed (MPH)

To determine the travel speed, measure a known distance. Use fence posts or flags to identify this distance. A distance over 200 feet and a tank at least half full are recommended. Travel the distance determined at your normal spraying speed and record the elapsed time in seconds. Repeat this step and take the average of the two measurements. Use the following equation to determine the travel speed in miles per hour:

$$\text{Travel speed (MPH)} = \frac{\text{Distance (feet)} \times 0.68}{\text{Time (seconds)}}$$

(0.68 is a constant to convert feet/second to miles/hour)

## Step 3. Determine Nozzle Flow Rate (GPM)

With the sprayer parked, operate the sprayer at the same pressure level and catch the output from each nozzle in a measuring container for one minute (or collect output for half a minute and then double the ounces collected) to determine the nozzle flow rate in ounces per minute (OPM) Then, convert the final average output in OPM to gallons per minute (GPM) using the following equation:

$$\text{GPM} = \text{OPM}/128 \text{ (1 Gallon} = 128 \text{ ounces)}$$

## Step 4. Determine the Actual Application Rate in Gallons per Gal/1000 sq ft

Use the following equation to determine the gallons per acre application rate:

$$\text{Gallons per } 1000 \text{ ft}^2 = \frac{136 \times \text{gpm (per nozzle)}}{\text{MPH} \times W}$$

GPM: average nozzle flow rate in gallons per minute

MPH: travel speed in miles per hour

W: distance between two nozzles in inches

136 a constant to convert units to gallons/1000 ft<sup>2</sup>

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

$$\frac{\text{Tank Volume (gallons)} \times 1000}{\text{Application Rate (gallons per } 1000 \text{ ft}^2)} = \text{Area covered per tank (ft}^2)$$

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

$$\frac{\text{Area covered per tank (ft}^2) \times \text{Material rate per } 1000 \text{ ft}^2}{1000} = \text{Amount to add (rate units)}$$

# HAND SPRAYER CALIBRATION FOR ORNAMENTAL AND TURF

Paul E. Sumner, Extension Engineer

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 calculate the area to be covered.

Bed Area is: length \_\_\_\_\_ X width \_\_\_\_\_ = \_\_\_\_\_ ft<sup>2</sup>

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

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

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

6. Total solution to prepare is:

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

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

## 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)

tsp x 3 = Tablespoons (Tbs)

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)

## **ATTENTION!**

### **PESTICIDE PRECAUTIONS**

1. Observe all directions, restrictions and precautions on pesticide labels. It is dangerous, wasteful and illegal to do otherwise.
2. Store all pesticides in original containers with labels intact and behind locked doors. **“KEEP PESTICIDES OUT OF THE REACH OF CHILDREN.”**
3. Use pesticides correct label dosages and intervals to avoid illegal residues or injury to plants and animals.
4. Apply pesticides carefully to avoid drift or contamination of non-target areas.
5. Surplus pesticides and containers should be disposed of in accordance with label instructions so that contamination of water and other hazards will not result.
6. Follow directions on the pesticide label regarding restrictions as required by State and Federal Laws and Regulations.
7. Avoid any action that may threaten an Endangered Species or its habitat. Your county extension agent can inform you of Endangered Species in your area, help you identify them, and through the Fish and Wildlife Service Field Office identify actions that may threaten Endangered Species or their habit.

# INDEX

Specific insects, diseases, and weeds are found by the plants or crop with which they are associated. For example, aphids on peanuts are found by looking under “peanut insect control” and turning to the page indicated. Pest of animals are found by looking under the animal with which they are associated. Household, structural, public health, recreational pests and vertebrate pests are found by looking up the specific pest.

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