

What would you do without herbicides?

Weed Control in Organic Systems

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What are weeds?

- **Dr. Beal, Michigan State University-**
“a plant out of place”
- **Ross and Lembi (1985)-** *“plants that are competitive, persistent, and pernicious. They interfere with human activities and as a result are undesirable”*
- **Unknown-** *“plants whose virtues have not yet been discovered”*

My weed definition

- **“Any organism that produces carotenoids and gets in my way”.....Greg Armel**



How do you separate benefits vs. detriments of wild plants.....are they all weeds?

- Yellow starthistle

- **Con:** Problem weed in pasture/rangeland, cereals, and other crops in Pacific northwest. Also, can cause the neurological disorder *nigropallidal encephalomalacia* in horses.
- **Pro:** Contributes \$150,000 - \$200,000 to honey industry because its pollen and nectar are incorporated in the diet of 150,000 bee colonies in California (Maddox et al. 1985)

- Downy brome

- **Pro:** Grown as a forage grass in certain areas of the world like the Pacific Northwest
- **Con:** 1) Can cause significant yield reductions (30 to 80%) to cereal crops like wheat.
2) When completing its life cycle dry plants can create a significant fire hazard.

- Countless examples of ornamental plants that have become aggressive weeds in other areas.....exotic invasives and noxious weeds
- Is there any type of plant that can never be considered a weed?



Yellow starthistle picture from Steve Dewey, Utah State, found at <http://www.invasive.org/browse/subject.cfm?sub=4390>



Pictures courtesy of the Virginia Tech Weed ID guide

Why Control Weeds?



- If not controlled certain weeds can....
 - **Compete with native plants, crops or ornamental plants for nutrients, water, and sunlight.**
 - Reduces US agriculture yields by 12% (\$36 billion in lost agricultural revenue) (USBC 1998)- \$4 billion spent annually on herbicides....an additional \$3 billion on management through cultural practices (Pimentel et al. 1999).
 - Also serve as hosts for viral, fungal, or insect pests of other plants.
 - Produce allelochemicals that can impact growth of certain species.
 - **Interfere with transportation and infrastructure**
 - Safety issues: railroads, roadway visibility, waterways, etc.
 - **Interferes with aesthetics and recreation**
 - **Can poison humans, livestock, wildlife, or pets.**
 - Allergans, rashes, oral poisoning, etc.
 - Old adage that does hold true.....1 year of letting it seed will give you 7 more years of fighting those weeds!!!!!!



Characteristics of annuals:

- **Adaptable to many environments**
- **Long seed life**
- **Variable seed dormancy habits**
- **Rapid growth**
- **High seed production**
- **Effective seed dispersal**

Single plant = 100,000 seeds



Characteristics of perennials:

- **Adaptable to many environments**
- **Long seed life**
- **Variable seed dormancy habits**
- **Regenerating parts**
- **Food storage**



Picture courtesy of the Virginia Tech Weed ID guide

Choice of tool depends on:

- **Weed composition**
- **Weed population**
- **Weather conditions**
- **Soil type**

Tools for the box:

- **Reduce weed pressure**
- **Diversify**
- **Cover cropping**
- **Feed the crop, not the weeds**
- **Selective cultivation**
- **Precise field prep**
- **Flaming**
- **Mulching**
- **Alternative products**
- **Timing, timing, timing**
- **Combinations**
- **Experimentation**

Reduce Weed Pressure

- **Compost carefully**
- **No seed threshold**
- **Maintain field edges**
- **Wash equipment between fields**



Diversify Crop Rotation

- **Different crops support different weed compositions and populations**
- **Shallow rooted vs. deep rooted**
- **Crop families**
- **Reduce pest pressure**

Cover Cropping

- **Weed suppression through:**
 - **Competition**
 - Oats
 - **Allelopathy**
 - Rye
 - Sweetpotatoes
 - Mustards
- **Provide thick stand:**
 - Seed at high rate
 - Drill, if possible
 - Irrigate
- **Added benefits**



Influence of Tillage and Cover Crop on Weed Populations

<u>Tillage</u>	<u>Cover Crop</u>	<u>Weeds/ft²</u>
Conventional	None	12
None	None	5
None	Rye	0.9
None	Wheat	0.3
None	Barley	0.8

(Putnam et al., 1983)

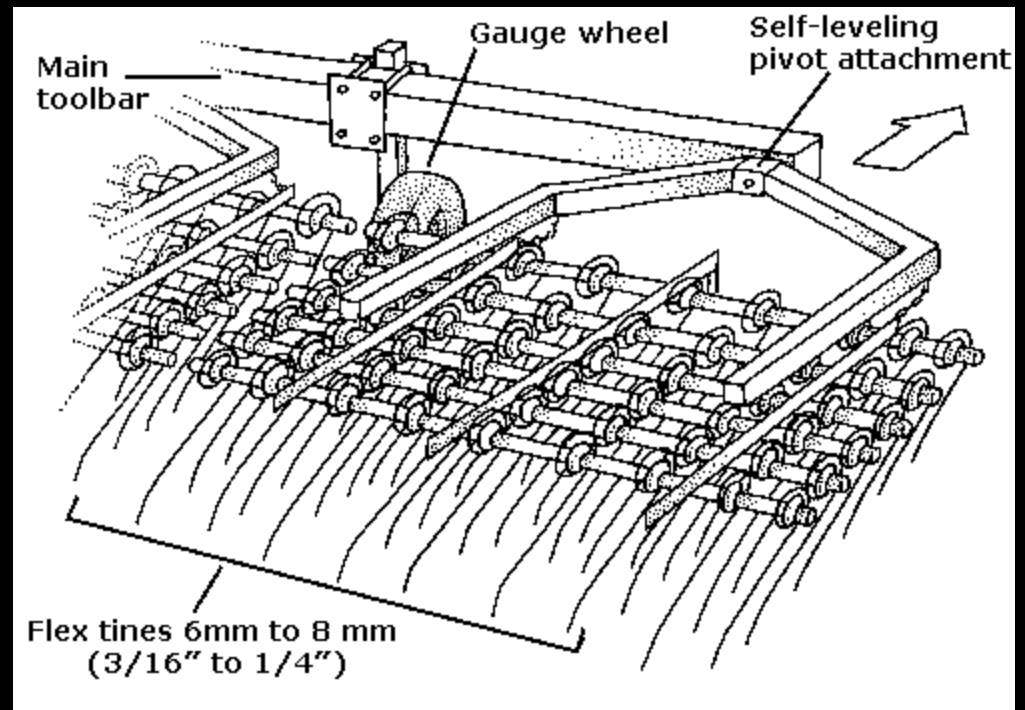


Feeding the Crop

- **Apply fertilizer near the row**
- **If using bagged organic fertilizers:**
 - **Band**
 - **Sidedress**
- **Avoid broadcasting nutrients for utilization by weeds**

Selective Cultivation

- Steel in the Field
- Choice of cultivation implement depends on:
 - Size of weeds
 - Size of crops
 - Experience
 - Resources
 - \$\$\$
 - Labor



Precision in Field Prep

- **Uniformity in row spacing**
- **Straight crop rows**
- **Adjusting equipment right the first time, for the whole season**





Flaming

- Can be used when soil too wet for cultivation
- No soil disturbance to stimulate weed emergence
- Also, added insect or disease control
- Exposure times of 65-130 milliseconds kill many annuals (Thomas, 1964)







Can the crops take the heat?

- More injury in cabbage
- 4 kph most damaged 5 DAF



- Injury not evident 20 DAF



Weed Control 2002

- All flaming treatments more effective than control
- 5 DAF, weed control most effective in 4 & 8 kph



- 20-50 DAF, 4 kph provided better control than all other treatments, with nearly 70% control 50 DAF

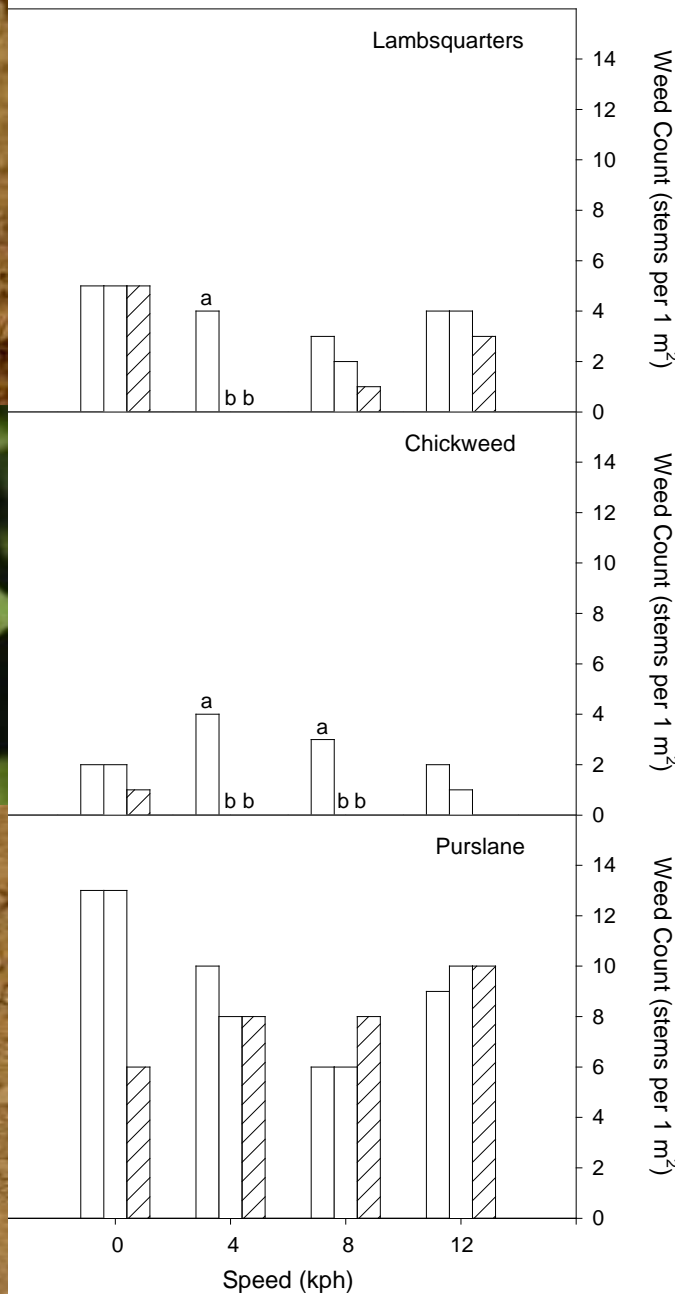
Weed Control 2003



- 5 DAF, 4 kph most effective in tomato with >70% control

- 15 DAF, control in the 4 kph treatment reduced to ~20%





Weed Control in Tomato

Preliminary

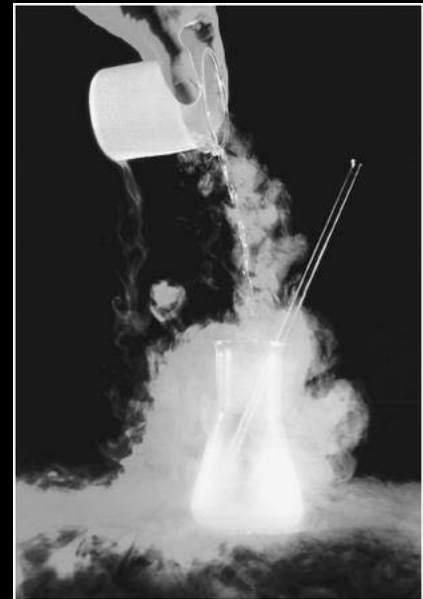
4 DAF

15 DAF

(Wszelaki et al., 2007)

Freeze those Weeds

- **Can cryogenic liquids kill weeds?**
 - Answer: yes
- **Can cryogenic liquids kill weeds safely and economically?**
 - Answer: maybe
- **Research continues.....**





Mulching

- Earlier crop production (7 to 21 days earlier)
- Higher yields per acre (2 to 3x higher)
- Cleaner produce
- More efficient use of water resources
- More efficient use of fertilizers
- Reduced soil and wind erosion
- Better management of certain pests
- Fewer weeds
- Reduced soil compaction
- Opportunity for efficient double or triple cropping

From 'What are the components of a plasticulture vegetable system?' by Bill Lamont, PSU, in HortTechnology, 1996.

Plastic- What does it do?

- **Changes the micro-climate of the soil**
- **Or the ability to absorb or reflect the sun's heat**
- **Can be used to warm soil earlier in the Spring/maintain warmth in Fall**
- **Cool down soil in Summer**
- **Mulch color determines how it will change the environment**

How do you
dispose of it?

Bio- or Photodegradable Mulches:

- **Made with plant starches**
- **Broken down by microbes or the sun**
- **More expensive than plastics**
- **Easier disposal than plastics**
- **Sometimes do not hold up throughout the season → weed problems popping up later in season**
- **Technology rapidly developing**



0.8 mil Mater Bi



50 days



75 days

Paper Mulch

- Can provide similar benefits to plastic mulch
- Can improve yields
- Recycled paper available for low cost
- Adheres well to soil when wet
- Sometimes breaks down too soon



Whatever the color or type...

- **Apply mulch after fields have been leveled, smoothed, and fertilized, and when there is good soil moisture**
- **With black mulch, uniform soil contact is essential as the soil is warmed by heat conduction**
- **Apply film with a mechanical mulch layer**
- **Hand application can be difficult and time consuming**

Alternative Products

- www.omri.org
- Corn gluten meal
- Herbicidal soaps
- Vinegar
- Clove oil



Organic herbicides....do they actually work

- **Common short answer.....yes with an if.....no with a but.....**

Common Organic Materials Used as Herbicides

- **Table salt**

- Safe to celery and asparagus
- Difficult to remove from soil and herbicidal to many crops.

- **Clove Oil**

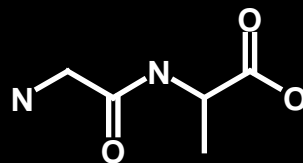
- **Cinnamon**

- **Vinegar**

- **Lemon/Lime juice**

- **Corn gluten meal**

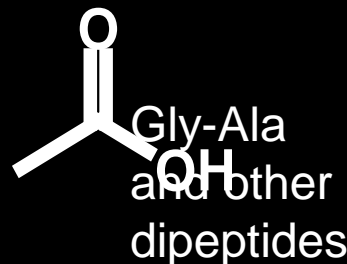
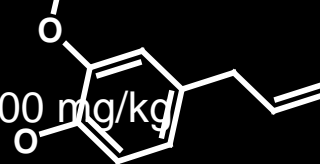
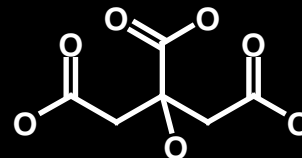
- Discovered at Iowa State
- 12-30 lbs/1000 sq ft. controls grasses and certain small seeded broadleaf weeds
- Generally multiple years of use create the most lasting impact.
- May cause respiratory allergies in some people
- Trade name(s): Dynaweed, Dynaweed, Safe 'N Simple, Earth Friendly, W.O.W.!, Corn Gluten Meal Herbicide, Concern-Weed Prevention Plus, Luscious Lawn Corn Gluten, Propac, other.



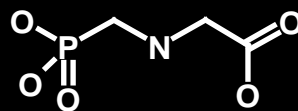
Eugenol- LD₅₀ 2680 mg/kg

acetic acid- LD₅₀ 3310 mg/kg

citric acid- LD₅₀ 11,700 mg/kg



NaCl



Roundup (glyphosate) LD₅₀ 5,600 mg/kg

Advantages/Disadvantages to Contact Organic herbicides

- Advantages 1) Vinegar (20% acetic acid solution), clove oil, and lime/lemon juice alone and/or in combinations have demonstrated the potential for 80-100% control of topgrowth control of key weeds. Activity generally appears within 2 hr after treatment. 2) No residual activity, therefore, crops can be planted very soon behind applications. 3) Because they are “natural” there is a perception they are safer than synthetic pesticides.
- Disadvantages 1) Non-selective to crops 2) No residual activity to stop secondary flushes of weeds 3) Rapid response to weeds is only temporary...complete regrowth can appear within 3 weeks after treatment 4) materials are extremely caustic.....improper applications can lead to severe eye injuries (especially with vinegar). 5) No lasting control of perennial weeds.

Timing, timing, timing

- **The younger you can catch the weeds the better**
- **“White thread” stage**
- **You can’t plan the weather, so have more than one option at all times!**

Combinations

- **One tool may not do the job alone**
- **Combinations can provide greater efficacy**
- **Anticipate!**
- **Know your problem weeds!**
- **Know what is effective!**

Experimentation

- **What works for your neighbor may not work on your farm!**
- **Start small**
- **Compare your combinations side-by-side**
- **Leave a “control” or untreated row**
- **Be on the lookout for new things!**



Does it belong
in the toolbox?

Resources

- Grubinger, 2007, Ten Steps Toward Organic Weed Control, www.uvm.edu/vtvegandberry/factsheets/orgweedcontrol.html
- Sustainable Agriculture Research and Education Program, www.sare.org
 - Steel in the Field
 - Managing Cover Crops Profitably

Resources

- **Appropriate Technology Transfer for Rural Areas, www.attra.ncat.org**
- **Pfeiffer, 1970, Weeds and What They Tell You, Biodynamic Farming Association**
- **The Organic Weed Management Website, <http://www.css.cornell.edu/weedeco/WeedDatabase/index2.html>**

Thank you!

Questions?

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**Plant
Sciences**
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Homeowner Herbicide Calibration

Determining the Application Rate of the Sprayer

Introduction

You are planning a trip across the state and need to know how much gas you will need.

First, you figure out how many miles per gallon your car uses. Then you figure out how many miles to your destination.

From there, you can figure out how much gas you need.

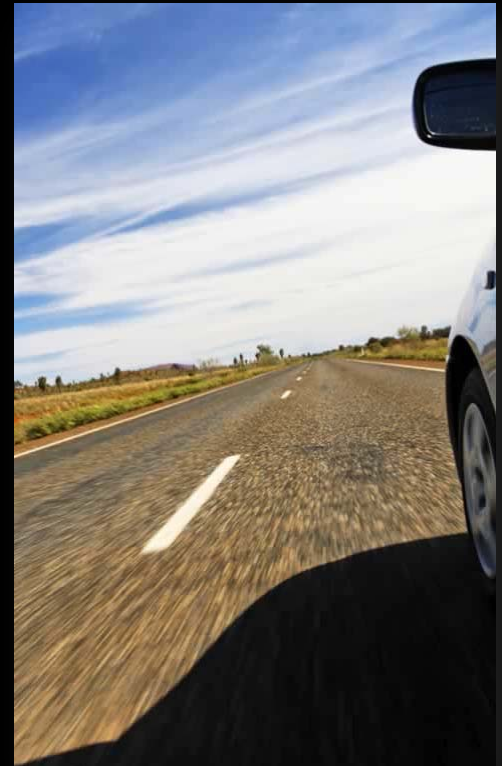


Introduction

Calculating the amount of herbicide you need follows close to the same process.

First, you figure out how many ounces per acre your backpack sprayer uses. Then you read what the label rate is for the herbicide.

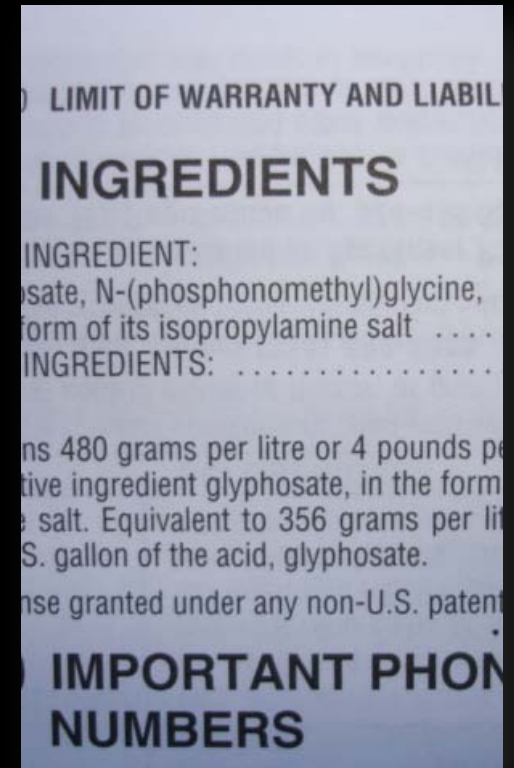
From there, you can figure out how much herbicide goes in your sprayer.



Introduction

This tutorial will help you figure out how many ounces per acre your backpack sprayer uses. We will show you the 1/128 of an acre method.

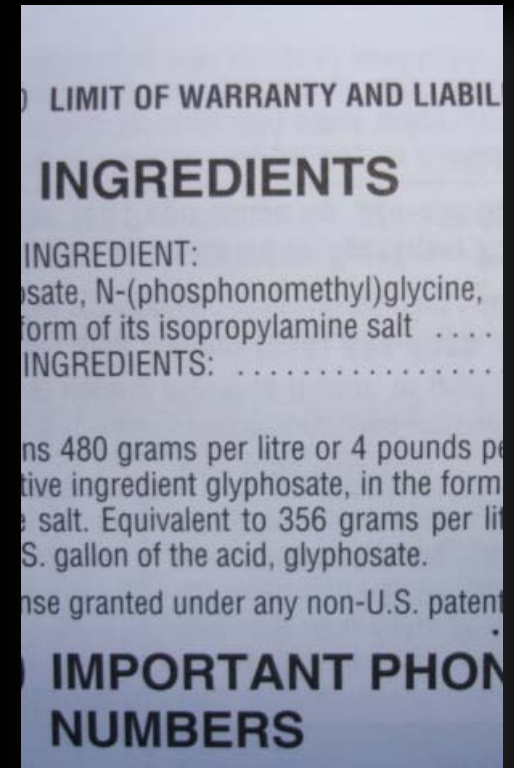
This is an important method as most herbicides recommend spraying their product at a certain amount per acre.



Introduction

To do this you will:

- 1) measure an area that is $1/128$ of an acre,**
- 2) do a practice spray with water, and**
- 3) calculate the application rate by how much water you used.**



Step-by-Step

1) Measure 1/128 of an acre



Measure an area equal to 340 square feet.

For example:

- **A square area measuring 18.5 feet X 18.5 feet**
- **A rectangle measuring 10 feet X 34 feet**

The important thing to remember is that your area should equal 340 square feet!

Step-by-Step

2) Fill your sprayer with enough water to spray the area



—Open the sprayer's container and fill it with water only.

—

Tip:

When performing this step —

Make sure your sprayer is clean!

Step-by-Step

3) Time yourself spraying the area



–A stopwatch or a watch with a second hand will be useful for this step.

–Make sure to maintain constant pressure and walking speed. With hand-pumped sprayers this may take some practice.

Tip:

To get even coverage of the area —

Wet the leaf surface slightly (try to avoid water running off the leaf)!

Step-by-Step

4) Refill your sprayer with water



–Using the same pressure you used to spray your 340 square foot area, spray into a container that measures fluid ounces.

–Do this for the same number of seconds it took you to spray the area you sprayed in the previous step.

Tip:

To measure fluid ounces, you can use a large graduated cylinder or large pitcher with liters or quarts marked.

–Click the Resource button to access a web site for easy conversion.

Step-by-Step

5) You have your rate!



–The amount of fluid ounces you catch in the container is the number of gallons per acre you are spraying.

–For example, if you spray the area in 28 seconds, you spray into a container for 28 seconds.

–If you collect 20 fluid ounces, then you are spraying 20 gallons per acre.

Tip:

If you collect X fluid ounces, you are spraying X gallons per acre.

Summary



Because you figured out how many fluid ounces you applied to $1/128$ of an acre, you now know how many gallons per acre you are spraying.

You can use this calibration rate to calculate how much herbicide to put in your sprayer to apply the appropriate amount.

To learn how to do this, please go on to the next tutorial titled “Determining the Amount of Herbicide”.

Homeowner Herbicide Calibration

Determining the Amount of Herbicide

Introduction

In the previous tutorial, you learned how to calculate the calibration rate or, how many fluid ounces your backpack sprayer sprayed per acre.

Knowing the amount per acre is important as most herbicides recommend spraying their product as a certain amount per acre.

This amount is usually in fluid ounces, but can be in pints or quarts.



Introduction

This tutorial will show you how to calculate how much herbicide product to add to your sprayer based on the labeled rate and your calibration rate.

Remember, all of these steps lead to:

- **saving money,**
- **less potential damage to your plants, and**
- **helping to keep excess chemicals out of the environment.**



Step-by-Step

How much mix do you need?



First, you must decide how much herbicide solution you want to mix:

- Two gallons at a time is a good place to start.
- You can adjust the starting amount as you get to know your spraying area.

Tip:

Always **under-estimate** how much you will need, this will lessen wasted product.

Step-by-Step

How many acres will you be able to treat?



In our previous tutorial, we calculated that the backpack sprayer sprayed 20 gallons per acre.

If 20 gallons treats 1 acre then:

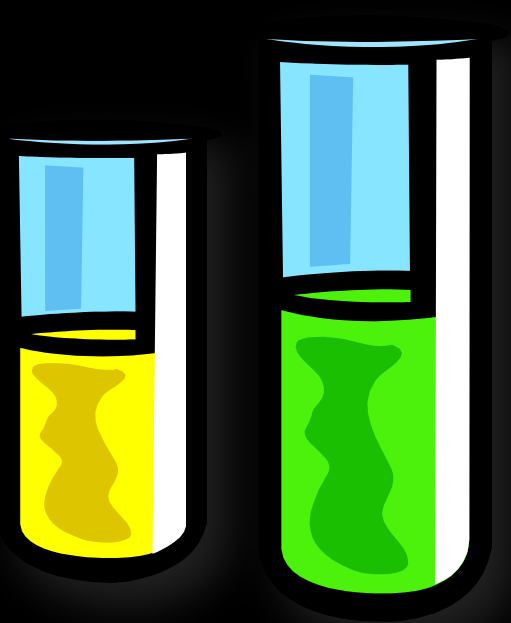
2 gallons will treat 0.1 acres.

10% of 20 gallons = 2 gallons

10% of 1 acre = 0.1 acre

Step-by-Step

How much herbicide?



For example, a well-known herbicide product's label says you need to apply 32 fluid ounces per acre.

You need to add 3.2 fluid ounces of this product to 2 gallons of water in your sprayer.

$32 \text{ fluid ounces} \times 0.1 \text{ acres} = 3.2 \text{ fluid ounces}$

Step-by-Step

What about pints or quarts?



Sometimes a herbicide will give a rate in pints or quarts. If this is the case, you just need to convert the pints or quarts to fluid ounces.

1 pint = 16 fluid ounces

1 quart = 32 fluid ounces

So if the herbicide requires 1.5 pints per acre, you multiply 1.5 by 16 fluid ounces:

$1.5 \text{ pints} \times 16 \text{ fluid ounces} = 24 \text{ fluid ounces}$

Summary



Now you are able to use the calibration rate of your backpack sprayer to determine the amount of herbicide product to mix with water in your backpack sprayer.

If you have a question that this tutorial series on calibration could not answer, please contact your local Extension office. You can find your local office by clicking the above Resource button.