



## Sprayer Options And Their Calibrations:

There are many different situations where spraying herbicides is the most cost-effective management practice to accomplish your goals. For this reason, there are different types of applications and methods to apply them. This document will identify some of the more common types of applications, the equipment that would be used, and how to calibrate equipment to ensure cost-effective accomplishment of said objectives. The plant species to be treated, its stage of growth, and equipment and labor available will determine what method is used.

**Note - Calibration is important for all spraying to prevent the waste of valuable herbicide and to accomplish prescribed goals. In my observation, some of the traditional agricultural spraying communities are not used to calibrating their sprayers because they have used the same equipment for an extended period of time and haven't needed to calibrate it since they purchased it. Others don't realize its importance because they are used to spraying glyphosate "ready products". Glyphosate is no longer patented and has become relatively cheap, compared to when it was first marketed. Currently, some farmers have a relaxed attitude toward spraying and aren't concerned with spraying a little too much or not enough as it will unlikely hurt their crop. Most probably err on the side of spraying too much.**

As with all management practices, spraying should be done under prescription. Considerations should include weather conditions, objectives, and resources available. To ensure adequate uptake of the herbicide by the plant, surfactants should always be used and spraying should only take place in dry conditions (to help hold the herbicide to the leaves long enough for uptake). Conditions should be sunny and warm so that plants are actively photosynthesizing, and calm (non-windy) to prevent the herbicide from drifting to other areas. Drift can cause you to kill non-target plants and prevent you from killing what you intended to.

### **Boom Sprayer**

Boom spraying is the most traditional method of spraying because they are ideal for rowcrop agriculture. Down-facing nozzles along either side of the booms spray a fan toward the ground. This reduces drift of herbicides across the field caused by wind. This method is useful as a broadcast spraying of open fields with relatively low-lying vegetation. Some sprayers have the ability to slightly adjust boom height to ensure appropriate application with minimal drift. There are multiple types of carriers (buggies, 3-point hitch, front-end mounted, etc.), but almost all utilize a tractor to pull and power the sprayer.

**Note – There are boom sprayers in smaller sizes appropriate for ATV or UTV use. However, a boomless-nozzle sprayer may have broader applications, and therefore be more desirable when limited to this size vehicle. Regardless of whether you are using a boom or boomless-nozzle sprayer, it is very difficult to maintain a constant speed on ATV/UTV-type vehicles. For this reason, the rate that you spray will be highly variable across the landscape, especially on rougher terrain.**

### **Boomless-Nozzle Sprayer**

Boomless-nozzle sprayers can be used as a broadcast spraying in the same manner as the boom sprayer. However, because nozzle sprays a fan up and out, it is more susceptible to drift. This can be accounted for by spraying on a calm day. The benefit to a boomless-nozzle is that if you will also be spraying fields that have taller vegetation (i.e. - advanced plant succession like blackberry, saplings, etc.), the sprayer can spray these types of vegetation as well. If finances are limited and you will be maintaining early-succession vegetation for wildlife management, this type of sprayer may provide more variety of applications than a boom sprayer.

### **Hand-Wand Sprayer (spot spraying)**

A hand-wand sprayer is simply a handheld nozzle or “gun” that is pointed by your reach. These are commonly added to boom and boomless-nozzle sprayers as a selectable outlet, but can also be stand-alone sprayers to be carried by hand or as a backpack. More expensive hand-wand sprayers (i.e. – orchard-style sprayers) may also be powered and be specially designed to be able to spray long distances (~ 50-75 ft.). The less expensive sprayers will be powered by a diaphragm pump that is powered by the battery on the vehicle. These spray at significantly lesser pressures and cannot spray as far.

These are used to spray saplings that are too tall for the boomless-nozzle and to spray very small sections of non-desirable vegetation (i.e. – small patches of bermudagrass, thistle, etc.). To ensure an effective kill of saplings and trees, it is recommended that you spray the top two-thirds of the canopy. If you cannot reach the canopy with the wand sprayer, you will need to use other methods to kill the tree.

## **Girdle and squirt, hack and squirt, tree-injection, basal application**

Girdle and squirt, hack and squirt, tree-injection, and basal application are slightly different types of individual tree herbicide applications when the tree is too tall to spray foliarly (leaves). The first three are applications to the cambium layer (layer underneath the bark) of the tree. Girdle and squirt is arguably the most effective of these, but also the most labor intensive. A two-man team, working in tandem makes this method much more time-efficient. In this method you cut two bands all the way around the tree with a chainsaw (just breaking through the outer bark layer), followed by squirting herbicide into the wounds. The hack and squirt method is similar, but less thorough, and therefore is less effective. Instead of using a chainsaw, you would use a hatchet and just wound the tree on a few sides and spray those wounds. Tree injection requires a specially designed device that could be used to inject herbicide into the cambium layer. Injector options include plungers, hatchets with injection holes, etc. Finally, basal area applications are the utilization of specially designed herbicides that are oil-based and designed to paint the base of the trunk. The oil holds the herbicides to the bark and saturates into the tree.

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# Boom Sprayer Calibration (1/128<sup>th</sup>-acre method)

1. **Clean and maintain the spray rig** (see “Rules for Use and Maintenance of TWRA Sprayers” and clean/inspect ALL nozzle components (spray tips, screens, and ensure washer is present and not dry rotted). THIS WILL SAVE YOU TIME!
2. **Determine How much water is released (Gallons Per Acre (GPA)) at the speed (RPM and Gear) the operator is comfortable on the field terrain:**
  - a. Determine how long of a course to use for calibration: Use the table provided on your TWRA/NRCS Calibration Cup. Most boom sprayers are setup on a 20” nozzle spacing. If this is the case, use a 204’ long course.

If you have some other nozzle spacing, use this table as a guideline:

<u>Nozzle Spacing</u>	<u>Length of Calibration Course</u>
15”	272’
18”	227’
20”	204’
22”	186’
24”	170’

- b. Measure and flag the predetermined course distance in the field. Use a portion of the field that is indicative to the terrain
    - c. **Time (seconds)** how long it takes to run the course at a speed (**RPM and gear**) the operator is comfortable with. Do this twice and average the times.
    - d. Park the sprayer, turn on the sprayer and use the calibration cup to **measure (ounces)** how much water that nozzle sprays in the time it took you to run the course. Repeat this so that at least one nozzle from the left boom, right boom, and the center is measured. If there is a wide variety of volumes clean the nozzles again, and you may consider measuring all of the nozzles. If the sprayer hasn’t been used in awhile, I’d definitely measure each nozzle.
    - e. **The average amount of water (ounces) per nozzle caught equals gallons per acre (GPA)**. Obviously, the more nozzles you measure the more accurate your calibration will be.
3. **Determine how much herbicide needs to be added to the tank to spray the prescribed rate of herbicide:**
  - a. Divide the tank capacity by gallons per acre to calculate the number of acres a full tank can spray
    - i. **Tank Capacity (gallons) ÷ GPA = Number of acres covered by one full tank**

- b. Multiply the recommended herbicide rate (pints/acre, ounces/acre, wt. oz. /acre, etc.) by the number of acres covered by a full tank.
    - i. **(recommended number of units of herbicide/acre) x number of acres covered by full tank = the amount of herbicide (per unit) to put in a full tank.**
4. If sprayer output adjustment is needed to spray the desired area more efficiently, options include:
- a. PSI adjustment (but should be between 30-40 for most boom-sprayers) = fine tuning
  - b. Tractor gear = major tuning
  - c. Tractor RPM = major tuning
  - d. Change size of nozzle tips = major tuning

**EXAMPLE**

1. Course Distance L = 204 ft. (20" nozzle spacing)
2. Time to run course in 2<sup>nd</sup> gear at 2000 RPM:
  - a. Trial 1 = 32 seconds
  - b. Trial 2 = 35 seconds
  - c. Average = 33.5 seconds
3. Amount of water caught in 33.5 seconds:
  - a. Nozzle 1 = 20 oz.
  - b. Nozzle 2 = 22 oz.
  - c. Nozzle 3 = 21 oz.
  - d. Average = 21 oz.
4. Determine GPA: 21 oz. = 21 GPA
5. Determine amount of herbicide needed:
  - a. Number of acres covered by a full tank = 300 gallon tank ÷ 21 GPA  
= 14.3 acres covered by a full tank
  - b. Amount of herbicide needed per tank:  
Recommended spray rate (2 qts. /acre) x 14.3 acres covered per tank = 28.6 qts.

Useful conversion factors and formulas:

16 oz. = 1 pint  
 2 pints = 1 quart  
 32 oz. = 1 quart  
 4 quarts = 1 gallon  
 128 oz. = 1 gallon

1. Acres/tank =  $\frac{\text{gallons in tank}}{\text{GPA}}$
2. Amount of herbicide = (Acres/tank) x (recommended rate/acre)  
to add to tank

# Boomless Sprayer Calibration (1/8<sup>th</sup>-acre method)

1. **Clean and maintain the spray rig** (see “Rules for Use and Maintenance of TWRA Sprayers” and clean/inspect ALL nozzle components (spray tips, screens, and ensure washer is present and not dry rotted). THIS WILL SAVE YOU TIME!
2. **Determine How much water is released (Gallons Per Acre (GPA)) at the speed (RPM and Gear) the operator is comfortable on the field terrain:**

- a. Measure effective swath width
- b. Determine calibration course length

<u>Swath Width</u>	<u>Length of Calibration Course</u>
35'	156'
40'	136'
45'	121'
50'	109'

**Note - To determine the length of calibration course for a swath width not listed, divide 5,445 square feet (1/8 acre) by the swath width in feet. Example – Calibration distance for 32' swath width = 5445 divided by 32 = 170'**

- c. Measure and flag the predetermined course distance in the field. Use a portion of the field that is indicative to the terrain
  - d. Drive the course in the **gear and RPM** you will use when actually spraying. Record the **time in seconds**. Do this twice and average the time.
  - e. Park the tractor and maintain the same RPM
  - f. Turn on the sprayer and use a cup and bucket to catch the water for exactly the same number of seconds required to drive the calibration course.
  - g. **Pints caught (1/8<sup>th</sup> gallon) = gallons per acre (GPA)**
3. **Determine how much herbicide needs to be added to the tank to spray the prescribed rate of herbicide:**
    - a. Divide the tank capacity by gallons per acre to calculate the number of acres a full tank can spray
      - i. **Tank Capacity (gallons) ÷ GPA = Number of acres covered by one full tank**
    - b. Multiply the recommended herbicide rate (pints/acre, ounces/acre, wt. oz. /acre, etc.) by the number of acres covered by a full tank.
      - i. **(recommended number of units of herbicide/acre) x number of acres covered by full tank = the amount of herbicide by unit to put in a full tank.**
  4. If sprayer output adjustment is needed to spray the desired area more efficiently, options include:
    - a. PSI adjustment (but should be between 30-40 for most boom-sprayers) = fine tuning
    - b. Tractor gear = major tuning

c. Tractor RPM = major tuning

d. **OR if on an ATV/UTV (speed)** = major tuning. Broadcast spraying on an ATV/UTV is VERY difficult because of lack of constant speed control.

**EXAMPLE**

1. Course Distance L = 156 ft. (35' swath width)

2. Time to run course in 2nd gear at 2000 RPM:

- a. Trial 1 = 26 seconds
- b. Trial 2 = 24 seconds
- c. Average = 25 seconds

3. Amount of water (pints) caught in 25 seconds:

- a. Trial 1 = 260 oz.
- b. Trial 2 = 270 oz.
- d. Average = 265 oz.
- e. Convert oz. to pints:  $265 \text{ oz.} \div 16 = 16.6 \text{ pints}$

4. Determine GPA:  $16.6 \text{ pints} = 16.6 \text{ GPA}$

5. Determine amount of herbicide needed:

- a. Number of acres covered by a full tank =  $60 \text{ gallon tank} \div 16.6 \text{ GPA}$   
= 3.6 acres covered by a full tank
- b. Amount of herbicide needed per tank:  
Recommended spray rate (2 qts. /acre) x 3.6 acres covered per tank = 7.2 qts.

Useful conversion factors and formulas:

16 oz. = 1 pint  
2 pints = 1 quart  
32 oz. = 1 quart  
4 quarts = 1 gallon  
128 oz. = 1 gallon

1. Acres/tank =  $\frac{\text{gallons in tank}}{\text{GPA}}$
2. Amount of herbicide = (Acres/tank) x (recommended rate/acre)  
to add to tank
3. Area (acres) =  $\frac{\text{Length (ft.)} \times \text{Width (ft.)}}{43,560 \text{ ft.}^2/\text{acre}}$