



**MISSISSIPPI STATE
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EXTENSION SERVICE**



Forage Production Newsletter

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Sprayer Calibration

Introduction: The technique of sprayer calibration has been around since the advent of the first machine driven sprayer. Growers could at one time get by with inadequate calibration but not today with the advent of new chemistries that are applied at rates as low as 0.3 ounces per acre and cost \$200.00 for a 16.0 ounce bottle. It has become evident that many growers and Extension Agents do not know how to calibrate or its importance. Calibration allows the proper amount of chemical to be applied across an acre and makes us a good steward of our resources. Simply it allows one to know how much chemical to add to the tank. If one does not know how much water the sprayer is putting out per acre there is no way in torment to know how much product to add to the tank per fill-up and if anyone thinks they can they are dead wrong. If you guess there are several repercussions that include applying too much chemical, applying too little chemical, wasting money, causing damage to the forage, not killing targeted weeds and building weed resistance. Yes, improper calibration or worst yet no calibration can cause many financial woes. Often, we see sprayers with two or more types of spray nozzles, clogged tips, pumps that don't work properly, severely damaged forages, weed escapes and wasted time and money and all result from the lack of calibration. Anything new can be fearful especially when there is a possibility of making a mistake that can damage a crop. However, our fears can't control us and we must make an assertive attempt to do what is right or at least ask reputable people. When I began calibrating sprayers many years ago I was fearful, but my friend and mentor, Mr. James Wiley Nelms, explained to me that when calibrating to break everything into a factor or unit of one. It took me some thought process to figure out what James Wiley was talking about. Once I figured it out calibration became very easy whether I was calibrating a sprayer, planter or in-furrow insecticide boxes. He also taught me to take the time to be precise and accurate. We have even taken a half of day on one operation making sure equipment was calibrated properly because it is that important in today's economic environment.

Types of Applications: Before diving into the function of calibration let us discuss the types of applications that include broadcast, banded and post-directed. **Broadcast applications** are methods that allow us to apply chemicals over the top of the soil or crop (depending on the chemical) prior to planting (pre-emerge) or after crop establishment (post-emerge). With this method the spray covers every inch of the targeted area treated and hopefully there are no skips. This method is primarily used in forages for applying herbicides and insecticides either post-emerge or pre-emerge. This method is also used in row-crops especially with Roundup-Ready crops genetically altered for the application of Glyphosate over-the top. To me this is the easiest method to calibrate. In forages we can see the use of boom-type sprayers or boom-less sprayers and each require a different method of calibration. Most of our forage applications will use this methodology. **Banded applications** involve a method where a nozzle situated directly over the row or crop applies a designated amount of chemical to a smaller area. This method is used primarily in row crops for the application of pre-emerge herbicides or insecticides and requires the use of a treated or planted acre for calculation. The area being treated will be smaller than for the broadcast method. With this method it is less expensive than the broadcast method since we are treating only a small area. **Post-directed applications** are a form of banding primarily used in the application herbicides to row-crops that are too damaging to be applied via the over-the-top broadcast methods and to reach weeds in a crop that is too tall to insure adequate coverage of the weed species via the use of the broadcast over-the top methods. This method uses two nozzles strategically placed on both sides of the row to deliver the chemical toward the base of the crop minimizing damage to the crop but insuring adequate weed coverage. Here again we must know the treated acre and take in consideration both nozzles per row. Sometimes another nozzle can be placed over the row and calls for additional calculations. This nozzle is generally tied to another tank and spraying another chemical like an insecticide but sometimes it could be the same herbicide tied to the same tank but will depend on the chemistries and crop sensitivities. The inability to understand how to properly use this method caused us much grief in the early days of Roundup Ready cotton and because of this lack of understanding caused much boll shed resulting from improper setting of this method, understanding of the technology, germplasm and chemistry.

Calibration Processes: Calibration can be divided into two categories; the $1/128^{\text{th}}$ method for boom-nozzle sprayers and the $1/8^{\text{th}}$ method for the boom-less nozzle sprayers. Calibration of sprayers involves the selection of the correct nozzle, pressure and sprayer speed. Before beginning check to see if nozzles across the boom are the same type, make sure nozzles and strainers are not clogged (can be cleaned with ammonia) and make sure the pump and gauges/regulators are in good working order.

Boom-nozzle sprayers: For boom sprayers use the $1/128^{\text{th}}$ acre method (sometimes called the baby bottle or 100-foot methods of calibration) and is based on spraying $1/128^{\text{th}}$ acre. This makes sense because there are 128 ounces per gallon therefore, ounces sprayed per $1/128^{\text{th}}$ acre equal gallons sprayed per acre.

In using this method the following process should be adhered to:

- Determine the nozzle spacing or swath width.
- Use Table 1 to determine course length to travel based on nozzle or swath width in inches.
- Record time required to travel the course length. Also record gear, engine RPM and implement settings to be used while spraying. Make sure the tractor speed is set where it is comfortable and safe. A ground speed of 3-4 miles per hour is good for most applications. Slower speeds generally allows for more accurate applications. Fast speeds promote less accuracy in control and increases risk of off-target drift.

- Park sprayer (containing only water), maintain engine RPM used to drive course and turn sprayer on. Make sure all tips are spraying and the pattern is touching.
- Collect water from sprayer in a large container for the time it took to travel the course length.
- Transfer the water collected to a device that measures ounces (I use a baby bottle since I don't have a graduated cylinder). The ounces collected will equal the gallons per acre sprayed.
- Check the remaining nozzles.

Table 1: Distance for each nozzle to spray 1/128 th acre	
Effective Swath Width (inches)	Course distance (feet)
6	681
8	510
10	408
12	340
14	292
16	255
18	227
20	204
22	186
24	170
30	136
36	113
38	107
40	102
42	97
49	85

Boom-less Nozzle Sprayers: These sprayers include the cluster nozzle and the wide angle type nozzles. The cluster types are good for close quarters where booms can't go without tearing them up. However, the boom-less type nozzles are more difficult to calibrate and are often less accurate especially where the wind is blowing leading to off-target movement and lower pest control. The cluster nozzle consists of a single unit comprised of multiple nozzles that generates the swath width. Wide angle nozzles might be one or two single tips that displace a wide swath width. There are some wide angle nozzles that are plumbed to deliver a 15-30 foot swath from a single nozzle.

Single Nozzle Wide Angle Sprayer



Two Nozzle Wide Angle Sprayer



The following process is used to calibrate these pieces of equipment;

- Turn the sprayer on and measure the swath width in feet. Swath width should be visually assessed when the vehicle is moving at 5.0 MPH with very low wind speed and wind direction is parallel to the travel direction.
- Use the following table to determine the length of the calibration course.
- Record the time required to travel the designated distance.
- Also record gear, engine RPM and implement settings to be used while spraying.
- Park sprayer, maintain same RPM and collect water for time it took to drive course. I use a doubled, heavy-duty garbage bag held around the tip or cluster apparatus to collect the water. I also use a five gallon bucket to hold the bag with water up since it will become quite heavy.
- Pour water into a large bucket and then into a measuring device that measures pints. In this method the pints collected equals the gallons per acre. If there are two separate nozzles tbe sure to add the two collections together to get total out-put.

Tabel 2. Calibration lengths for boom-less sprayers	
Effective swath width	Course Distance
(feet)	(feet)
15	363
18	302
20	272
22	248
24	227
26	209
28	194
30	182
32	170
34	160
40	136
47	116
50	109
52	105
56	97
60	91

How much chemical to add to the sprayer: Once all of this has been done we should know how many gallons per acre the sprayer is applying. Now how much chemical do we put in the tank?

Example: Assume our sprayer holds 150 gallons of water and our out-put is 20 gallons per acre. Divide 150 by 20 and that equals 7.5 acres covered per load. Now we know the sprayer will cover 7.5 acres per load. Now let us assume we are applying Grazon Next at 1.0 quarts per acre. We would put 7.5 quarts of Grazon Next in the tank (1.0 quarts per acre x 7.5 acres). Remember to take this into consideration when filling the tank up. To avoid diluting the spray mix I will fill the tank to 75 gallons in this case (50%), add the chemical and fill to the 150 gallon mark. Now let us assume we are using Dimilin insecticide applied at 2.0 ounces per acre. Here we would add 15 ounces to the tank (2.0 ounces per acre x 7.5 acres). Now let us assume we are using Surmount herbicide at 3.0 pints per acre. Here we would

add 22.5 pints per load or 2.8 gallons per load. There are 8.0 pints per gallon so divide 22.5 pints by 8.0 to give you the gallons of product to add.

As you can see if we know how much water our sprayer is applying per acre we can now know how much chemical to add per load.

Nozzle Types: Nozzle type and orifice size of the nozzle are very important to the application. Remember, a small orifice size and high pressure is a formula for high drift possibilities. This can be compounded by windy conditions. Nozzles are the most neglected device on a sprayer. They are often clogged or worn and this oversight can cost an operation upwards of \$10,000.00 for this little oversight. If a nozzle is applying 5.0% too much or too little from the average of the rest of the nozzles they should be replaced. To determine nozzle size use this formula; Gallons/Minute=Gallons/Acre x Miles/Hour x Width/5,940. Remember, not all nozzles are the same and the output is different for an 8002 and 8003 nozzles. The following shows the nozzle type, its sprayer pattern, pressure range and suggested use.

Nozzle Types, Spray Patterns and Suggested Uses.

Type	Spray Pattern	Pressure (psi)	Suggested Use
Flat Fan	Fan-like pattern of medium droplets. Not uniform across width	20-40 (15-40 psi for low pressure nozzles)	Pre & Postemergence, broadcast booms. Requires 30% overlap for uniform application
Even Fan	Fan-like pattern. Uniform volume across entire width.	20-40	Pre and postemergence. Good for banding.
Flood Fan	Wide, flat pattern of coarse droplet	10-30	Broadcast booms, chemical-fertilizer mixtures, layby. Requires 100% overlap.
Off-Center Flat Fan	Flat fan pattern. Directed to one side of tip. Swath width 20-144".	20-40	Post directed, low-profile spraying. Larger drops and increased volume deposited. Uniform deposits not expected.
Large-off-Center Flat Fan	Swath directed to one side from 12-33 feet width	30-40	Herbicide application to ditches and roadsides. Uniform deposits not expected.
Cone	Circular, with heavy concentration on outside. Small droplets.	40-60	Complete foliar coverage. Insecticide, fungicide and growth regulators. Use where slight drifting is not hazardous.
Boomless Nozzle Cluster	Swath width up to 60 feet. Pattern easily distorted by wind. High spray trajectory.	20-40	Pastures and broadcast spraying where obstructions to boom exist. High drift potential. Deposit uniformity not expected.

Once the spraying endeavor is completed, clean the tank thoroughly by flushing the lines and pump with a mixture of water and ammonia (1.0 gallon of ammonia per tank) or a recommended tank cleaner in water. I always remove my tips and strainers and clean them with ammonia and water and flush the sprayer without the tips and then with the tips. I will rinse out three times before putting the equipment up. This is definitely where cleanliness is next to Godliness to avoid errors and increase accuracy. Also if the pump is not working correctly it can give a misleading calibration. If the pump is and or tips are changed be sure to recalibrate. If tips are worn or corroded the rates will not be the same as when they were new. Therefore, make sure the tips are kept in good shape.

For more information on sprayer calibration contact your local Extension Office and ask for additional calibration information and more about forage weed and insect control or contact me at 601-813-7166.