SDSU Extension

iGrow Corn

BEST MANAGEMENT PRACTICES

Chapter: 41
Chemical Sprayer Application and Calibration

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The purpose of this chapter is to discuss chemical application and calibration. Applying pesticides at labeled rates is the legal obligation of the user. If too little is applied, you may not control the targeted pest. If too much is applied, your chemical costs increase, you may be in violation of the law, and there may be negative effects on the crop, humans, livestock, and the environment. Calibration doesn't need to be complicated but should be done frequently to ensure correct rates and provide optimum efficacy for target pests. Rate controllers have automated calibration, however, they contain mechanical sensors that can wear or become sticky, so they also need to be checked to ensure that they function properly.

Figure 41.1 Flow from a spray nozzle. (Courtesy SDSU)

Sprayer Calibration and Maintenance

Well-maintained equipment that applies treatments at the prescribed rate optimizes control and reduces application errors. A small investment of time and money for the replacement of worn-out or faulty parts can be minimal compared to loss of product or crop yield. Details on equipment calibration is outlined in FS 933 "Calibration of Pesticide Spraying Equipment" available online at Wilson (2006).

In South Dakota, anyone who applies pesticides (including herbicides) to an agricultural commodity that has a value greater than $1,000 is required to be a certified applicator. There are two categories of certification: private applicators and commercial applicators. Contact your local Extension educator or the South Dakota Department of Agriculture for more information on certification.

Certified applicators who handle and apply any pesticide are required by rule to have a written "pesticide handling and discharge response plan." A template for developing this plan is available from your local Extension educator or the SD Department of Agriculture and is available online at http://www.state.sd.us/doa/das/hp-pest.htm. The plan can serve as a reference for action in the event of an emergency.

Pesticides are a regulated material and must be stored, handled and applied in compliance with federal and state law. Some general safety tips for transport, storage and pesticide mixing are presented in Table 41.1. Questions regarding regulatory compliance should be directed to the SD Department of Agriculture, Office of Agronomy Services (605) 773-4432.

Safety and Worker Protection

Table 41.1 Safety tips for transport, storage, and mixing of pesticides:

Transport

- ✓ Place small containers (2.5 gallons or less) in water-tight totes.
- ✓ Do not exceed weight limits of trailers.
- ✓ Tie down tanks with load straps strong enough to secure the load.
- ✓ Avoid transportation on vehicles or trailers where the load can cause a rollover.

Storage

- ✓ Store herbicides away from sensitive areas such as wells, populated buildings, animal feed, etc.
- ✓ Avoid storing herbicides in unheated storage over the winter, freezing may break containers or compromise the integrity of the product.
- ✓ Avoid storing or transporting near direct heat (e.g., furnaces or exhaust).
- ✓ Triple rinse, store in appropriate locations, and dispose of containers as labels direct.
- ✓ Lock doors to avoid accidental opening or vandalism.

Use and Mixing

- ✓ Secure hoses, containers and pumps.
- ✓ Lock valves to avoid accidental opening or vandalism.
- ✓ Load and mix herbicides 150 ft from wells, lakes, or wetlands.
- ✓ Have an anti-back siphon device when filling equipment.

Record Keeping

The 1990 Farm Bill initiated the Pesticide Recordkeeping Program (PRP) and requires certified private applicators to keep records of all applications of federally restricted-use pesticides (RUP). Essentially, producers are required to record what, when, where, and to what crop a RUP was applied. Instructions and record-keeping forms are available by contacting county Extension educators, the SD Department of Agriculture, or the USDA Agricultural Marketing Service (http://www.ams.usda.gov/science/prb/Prbforms.htm). More information is provided in Chapter 4.

Personal Protective Equipment

When working with agricultural chemicals, it is important to wear the appropriate protective clothing. Manufacturers must provide information about the type of personal protective equipment (PPE) that must be worn when mixing, loading, handling, and applying pesticides. This information has to be on the pesticide label. There are different types of equipment needed (gloves, eye protection, and coveralls made of different materials to protect your skin) based on the solvents used in the pesticide formulation and the length of time you will be exposed to the chemical. Read and follow label directions to handle pesticides safely.

Sprayer Calibration

Before spraying a field, it is important to check the machine to see whether it is in good order. Walk around the sprayer to make sure booms are straight, level, and not bent or kinked; braces and springs are intact; shields are in place; and hoses, pumps, and gauges are operational and do not leak. If something failed at the last job, fix it. If you need to do welding, rinse off the sprayer prior to the operation. After repairing or replacing worn and broken parts, clean the strainer, nozzle screens, and nozzles with water mixed with ammonia or tank cleaner, based on label recommendations. Use a nozzle brush or a toothbrush to clean the nozzles. Do not use a wire or knife blade because they can damage the screens and nozzles. Once you determine that the sprayer is in good working order, you are ready to calibrate the sprayer. Directions for calibrating sprayers are available at Wilson (2006).

How Much Pesticide and Adjuvant per Tank?

If the carrier application rate is 5 gallons/acre and you want to apply 16 fluid ounces of product/acre, then you need to put 16 fluid ounces of product for each 5 gallons of water. If you have a 100-acre field, then you need 500 gallons of water (100 × 5), and you will need 12.5 gallons of product (16 fluid ounces ×100

acres = 1,600 ounces/128 ounces per gallon = 12.5 gallons). These values can be scaled up or down as needed.

Carefully read the label to determine whether and what type of adjuvants or surfactants should be included in the spray mix. Adjuvants may be recommended as an amount in volume/volume of the gallons in a sprayer OR as an amount per acre. If the amount is given as a volume/volume, then know how much of the herbicide mix is in a tank and then determine the amount to add. For example, if you have a full 500-gallon tankload and the adjuvant is suggested at 2% v/v, then:

> (500 gal * 2/100) = 10 gallons of surfactant should be included. If the 500-gallon tank has only 300 gallons then (300 gal * 2/100) = 6 gallons.

If instead, the adjuvant is suggested on an acre basis, then the number of acres that will be treated with the sprayer load needs to be estimated and the amount of adjuvant calculated. For example, if the adjuvant should be applied at 1 quart/acre, the tank has 500 gallons of pesticide mix, and the output is 10 gal/a, the amount of adjuvant that should be added would be:

> 500 gal/(10 gal/a) = 50 a/tank;
> 1 quart/a * 50 a/tank = 50 quarts/tank; 1 gallon = 4 quarts so
> 50 quarts/tank * 1 gallon/4 quarts = 12.5 gallons

Always double-check calculations, as this is easier and cheaper than making a mixing error. Read and follow label instructions for minimum carrier application rates. In some cases, 15 or 20 gallons of carrier per acre is needed to optimize spray coverage, especially for contact-type chemicals. Also add any recommended surfactants or spray additives at the correct rate. Label instructions will also provide the correct order for mixing chemicals in the tank. When applying a tank-mix of chemicals, make sure that the highest minimum rate of carrier is used for the application.

Simple Technique to Calibrate a Sprayer

1. Measure the width covered by one nozzle. This is the center of one nozzle to the center of the next nozzle along the boom.
2. Measure the amount of time to travel 1/128th of an acre (Table 41.2).
3. Using an ounce-delineated measuring container, with your sprayer loaded, collect spray from one nozzle for the time required to drive 1/128th of an acre.
4. If your nozzles are 18 inches apart and the sprayer is traveling at 5 mph collect spray for 30.8 seconds. Each ounce equals 1 gal/acre.

Also, make sure the spray pattern across the boom and from individual nozzles is correct. If more or less flow is needed across the boom, adjust the pressure (lower pressure to decrease the output, higher pressure to increase the output) or adjust the rate controller as needed.

Nozzle wear will affect the output and pattern of the nozzle. The material of the nozzle and type of formulation used will influence the wear. For example, abrasive materials will cause the nozzle orifice to open, causing greater output and less

Table 41.2 The relationship between swath width of a spray nozzle, distance, and length of time required to collect the spray. The number of ounces collected is equal to gal/acre. (Modified from Clay et al., 2011)

Nozzle width	Distance for 1/128th a	mph			
		5	10	15	20
inch	feet	sec	sec	sec	sec
6	681	92.9	46.4	31	23.2
8	507	69.1	34.6	23	17.3
10	408	55.6	27.8	18.5	13.9
12	340	46.4	23.2	15.5	11.6
14	292	39.8	19.9	13.3	10
16	255	34.8	17.4	11.6	8.7
18	226	30.8	15.4	10.3	7.7
24	170	23.2	11.6	7.7	5.8

Example 41.1 A sprayer has a nozzle width of 14 inches and the sprayer is traveling at 15 mph. How long should spray be collected from one nozzle?

13.3 seconds

You collect 21 ounces in 13.3 seconds, how many gallons per acre is the sprayer calibrated for?

21 gal/acre

precise pattern over time. Stainless-steel and ceramic nozzles are less affected by formulation type. Plastic nozzles are affected by the solvents in an herbicide formulation and may swell shut, lowering the nozzle output. If the output pattern of a nozzle is nonuniform, check to make sure that the screen for the nozzle (or screens at other places in the sprayer) is not plugged. If individual nozzle output is 10% higher or lower than the average, then the nozzle should be replaced.

Spot Check Rates

As you are spraying the field, conduct routine checks to make sure the correct amount of solution is being applied. For example, if you know that each trip around the field is 20 acres and the application rate is 5 gal/acre, then each trip should use 100 gal. If < 100 gallons are used, you are underapplying and if > 100 gallons are used, you are overapplying. Recalibrate the sprayer as needed to match the desired and true output. If the amount is slightly less, the pressure gauges may not be correct or main screen or nozzles may be plugged. If the amount is more, check the pressure output and the system for leaks.

References and Additional Information

Ayers, P.D., and B. Bosley. 2005. Sprayer calibration fundamentals. Colorado State University Extension.

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Acknowledgements

Support for this document was provided by South Dakota State University, SDSU Extension, and the South Dakota Corn Utilization Council.

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