BRITISH COLUMBIA | Ministry of Agriculture, Food and Fisheries

Calibrating Boom Sprayers

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Introduction

Calibration is one of the most important aspects of spray application as it will ensure that the proper rate is applied, reduce off target drift and improve efficacy of the product. Yet it is often overlooked and not given consideration by many operators.

Common reasons for not calibrating are:

- difficulty
- length of time required to calibrate
- confusing terminology
- multiple methods for calibration
- the incorrect belief that calibration has very little impact

This Factsheet describes a simple and effective method for calibrating a boom sprayer, with clear terminology and equally clear reasons for calibrating regularly.
It is very important that any calibration technique be followed exactly. Do not mix and match parts of different calibration techniques. It is important that protective safety clothing is used while calibrating and adjusting spray equipment.

Defining Terminology

"Application rate" (also known as Product Rate) is a term used to describe the amount of formulated product that is applied to a treatment area.

"Delivery rate" (also known as Sprayer Output) describes the total amount of material that is delivered by the sprayer to the treatment area (e.g., 100 L/ha or 10 gal/ac).

Why Calibrate?

Calibration is essential because it:

- confirms that the delivery rate is accurate
- ensures that the correct application rate is applied
- reduces product waste, drift, and environmental impact
- confirms that each nozzle is delivering the desired output

That final point is very important. A boom that has both worn and/or plugged nozzles can still deliver the calculated delivery rate, as some nozzles may be over applying and some under applying, so every nozzle must be tested.

When to Calibrate

Application rates and delivery rate requirements change, depending on the crop type, the crop and pest staging. Therefore, calibrate for each significantly different situation.

Calibrate the sprayers:

- at the beginning of each season
- after changes to application equipment or settings (e.g., nozzles, operating pressure, pump or tractor)

Where to Calibrate

Calibrate sprayers in the actual field conditions you will be spraying in. Calibrating a sprayer on a hard surface (such as pavement) can induce errors as high as 15% compared to calibrating in a tilled field. Calibrate away from buildings and wells.

How to Calibrate

There is more than one way to calibrate a sprayer. Essentially, every method requires you to find:

- True ground speed of the sprayer
- Delivery rate per nozzle
- Total delivery rate of the sprayer

Calibration Step-by-Step

1) **Perform a pre-calibration inspection (refer to Appendix A)**

Fill the cleaned sprayer with clean water.
Start the pump and set the tractor engine speed to the desired rpm. Open the manifold valve to fill the lines and begin spraying. Adjust the pressure regulator, or set the main by-pass, to obtain the desired operating pressure. Perform the following steps:

- Check that the agitation system is functioning properly
- Search for and correct any leaks

2) **Set travel speed**

This is done to correct speedometer errors due to wheel slippage. Fill the cleaned sprayer half-full with clean water to represent the average weight. It is important to perform this step in the field so it accounts for soil type and slope of terrain. Be sure to drive both up and down hill during testing if applicable.

1) You can use a GPS speed tracking app on your smart phone or,
2) Measure the time for the sprayer to drive a known distance and calculate the speed with the steps bellow:
    - Measure out a distance of at least 50 m and mark the start and finish positions with stakes or flags
    - Select the gear and engine speed in which you intend to spray
    - Bring the sprayer up to speed and begin timing as the front wheel passes the first flag
    - Stop the timer as the front wheel passes the second flag
    - Stay out of any ruts and run the course two more times
    - Determine the average time for the three runs

- Calculate forward speed using one of the following formulae, depending on the units used:

Forward speed (**km/h**) = Distance travelled (m) / Average drive time in seconds x 3.6 (a constant)

or

Forward speed (**mph**) = Distance travelled (ft) / Average drive time in seconds x 0.682 (a constant)

3) Calculate the target output per nozzle

Nozzles are sold based on their output per minute. A set of nozzles on a boom, should produce the required output regardless of the width of the boom. Use either of the following formulae, depending on preferred units:

a) For litres per hectare

Output per nozzle (**L/min/nozzle**) = Target Delivery rate (**L/ha**) x Forward speed (**km/h**) x nozzle spacing (**cm**) / 60,000 (constant)

b) For gallons per acres

Output per nozzle (**US gal/min/nozzle**) = Target Delivery rate (**US gal/acre**) x Forward speed (**mph**) x nozzle spacing (**in**) / 5,940 (constant)

Select a set of nozzles that will produce the required spray output when operated in the middle of their pressure range. This range should reflect the typical operating pressure of the sprayer.

4) Measuring actual delivery rate

In theory, the sprayer has been set up to deliver a specific delivery rate based on the output per nozzle. In practice, the output may be different than expected. This is true both of new nozzles, which can vary in output by as much as 15%, and of old ones, which may be worn through use. To calculate the actual delivery rate, measure the actual output per minute of each nozzle.

- This can be done with a stopwatch and graduated cylinder (Figure 3)
- or a device such as a SpotOn calibrator that does all the calculations for you (Figure 4)

(Figure 3)

(Figure 4)

- Position the sprayer on a level location and fill it approximately half full of water
- Start the sprayer pump. Set the pressure to that used when selecting nozzles (step 3)
- Collect from each nozzle into a graduated cylinder for 1 minute or collection vessel
- Replace any nozzles that are 10% more or less than the manufactured rated output
- Calculate the total output of the boom and compare to the targeted total output from step 3

a) For litres per hectare

Actual Delivery rate (**L/ha**) = Output per nozzle (**L/min/**) x 60,000
Forward speed (**km/h**) x nozzle spacing (**cm**)

b) For gallons per acres

Actual Delivery rate (**US gal/acre**) = Output per nozzle (**US gal/min/**) x 5,940
Forward speed (**mph**) x nozzle spacing (**in)**

- Once you have calculated the Actual Delivery Rate you can determine how much product to put in the tank as you can calculate how large of an area one tank will cover.

For More Information

AgriService BC

Telephone: 1 888 221-7141
E-mail: AgriServiceBC@gov.bc.ca

Video: Sprayer Cleanout
https://sprayers101.com/esm-6/

Video: Boom Height
https://sprayers101.com/esm7/

Video: Early Morning Spraying
https://sprayers101.com/esm-5/

Video: Rate Controllers
https://sprayers101.com/esm-1/

Pesticide Applicator Certification and Training
https://www2.gov.bc.ca/gov/content/environment/pesticides-pest-management/certification-training

Appendix A

SPRAYER INSPECTION CHECKLIST

PUMP AND HOSES

- ☐ Leaky pump valves, diaphrams and/or plungers checked/replaced
- ☐ All hoses and fittings sound (while under pressure)
- ☐ Pump flushed and spray discharge clear
- ☐ Pump lubricated

FILTERS, STRAINERS AND NOZZLES

- ☐ All filters (tank basket, suction filter, in-line filters and nozzle strainers) clear and not damaged
- ☐ Check valve diaphragms clean and function
- ☐ All nozzles clean and unbroken
- ☐ Each nozzle shut-off and/or flip body is working

REGULATORS, GAUGES AND CONTROLS

- ☐ All gauges accurate
- ☐ Pressure and shut-off valves (ball or solenoid) work smoothly
- ☐ Regulator(s) and/or bypass valve(s) move easily
- ☐ Pressure gauge defaults to zero and does not bounce or leak

BELTS AND POWER TAKE OFF

- ☐ All belts have proper tension and no wear or cracks
- ☐ PTO greased, connection zones checked and guard in place

SPRAY PRESSURE ADJUSTMENT

- ☐ Regulator/bypass adjusted to achieve desired pressure at usual tractor RPM
- ☐ Each boom operating at desired pressure for each nozzle combination

TIRES AND TANK

- ☐ Tires have correct pressure, tight bearings and no cuts
- ☐ Drain plug can be removed
- ☐ Tank has clear vents, is secure to chassis and has no punctures or damage