Calibration of a Boomless Sprayer Mounted on an ATV

The use of boomless sprayers mounted on an all-terrain vehicle (ATV) is becoming a popular way to spray pesticides and herbicides in difficult-to-reach areas such as under trees and along fences. As with any other sprayer, a boomless one has also to be calibrated. Calibration is the process of adjusting sprayer components to deliver the desired volume (rate) per area.

BEFORE YOU START

Sprayers are used daily in the delivery of chemicals to crops and ensure productive yields and pest-free areas. Misuse of chemicals, however, is a potentially dangerous situation. Some chemicals used in agriculture are highly toxic, and proper safety equipment has to be used during application. Even though no chemical is being used during calibration, safety should still be our primary concern. Never use your mouth to clean clogged nozzles or strainers. Use chemically resistant gloves, protective clothing and goggles when manipulating nozzles, strainers, fittings, etc. Use only water during calibration.

To ensure a correct spray operation, follow these steps carefully:

STEP 1: Measure spray width (W)

Find out what the swath width produced by the spray is, in inches. If no manufacturer information is available, the easiest way of doing this is to spray over some surface (asphalt or cement) and to look at the wetted footprint. Measure the footprint in inches. Remember that this footprint will most likely change if the spray pressure changes.

STEP 2: Measure ATV speed (MPH)

Vehicle speed is the most important issue in calibration. A constant speed is needed to maintain a correct application per area (such as gallons per acre, GPA) since there is no way of adjusting pump flow according to speed for these systems. The best way to determine ATV speed is to measure it in a field that resembles the one that is going to be sprayed. Measure about 150 feet, and determine the necessary time to travel this distance. Repeat this process at least three times and compute an average spraying speed using the formula,

$$\text{Speed (mph)} = \frac{\text{length (ft)}}{\text{time(s)}} \times 0.6818$$

For example, the length used was 150 feet and the average time recorded was 11.3 seconds. Speed is calculated as,

$$\frac{150}{11.3} \times 0.6818 = 9 \text{ mph}$$

STEP 3: Measure nozzle flow (GPM)

Find out flow per unit of time (gallons per minute, GPM) for the nozzle, at the desired pressure. Usually the nozzle manufacturer publishes such information on the user's manual. If the available information is not for the desired pressure, the following formula can be used,

$$\frac{GPM_1}{GPM_2} = \frac{\sqrt{PSI_1}}{\sqrt{PSI_2}}$$

For example, manufacturer lists nozzle flow rate of 1.2 GPM @ 45 PSI. The desired pressure is 25 PSI. What is the rate nozzle flow?

$$\frac{1.2}{GPM_2} = \frac{\sqrt{45}}{\sqrt{25}} \rightarrow GPM_2 = \frac{1.2 \times \sqrt{25}}{\sqrt{45}} = 0.89 \text{ gpm}$$

An alternative way to find flow information is to measure the flow from the nozzle. Use a bucket to collect spray for about 30 seconds and measure it using a graduate receptacle. If using a bucket is not a viable option, try marking the sprayer's tank, spray for a desired length of time and refill it to the previously marked spot. Record the volume needed to refill the spray. Convert the number to gallons per minute.

For example, let's say you collected 0.45 gallons in 30 seconds. The gallons per minute amount is:

$$GPM = \frac{0.45 \text{ gallons}}{30 \text{ seconds}} \times \frac{60 \text{ seconds}}{1 \text{ minute}} = 0.9 \text{ gpm}$$

NOTE: *If the boomless sprayer is equipped with more than one nozzle, the spray width and nozzle flow information have to be collected from all of them.*

STEP 4: Define the application rate (GPA)

The application rate, usually in gallons per acre (GPA) can be found on the label of the product being used. Usually a range of volume is suggested, such as 5 to 10 gallons per acre. Select a GPA that will match the performance of the sprayer, taking into consideration the speed of application and nozzle flow capacity. To convert and application rate from gallons per acre (GPA) to gallons per 1,000 ft^2 (GPTF) use the following formula:

$$GPTF = \frac{GPA}{43.56}$$

STEP 5: Calculate the expected flow of the nozzle (GPM)

Using the selected application rate (GPA), the spray width (W) and ATV speed (MPH), calculate the expected flow from the nozzle using the following formula:

$$GPM = \frac{GPA \times W \times MPH}{5{,}940}$$

For example: application rate is 5 GPA, spray width is 25 inches, ATV speed is 9 mph. What is the necessary flow in gpm?

$$GPM = \frac{5 \times 25 \times 9}{5{,}940} = 0.189$$

A nozzle flow of 0.189 gallons per minute is needed for the application.

Compare calculated flow with measured flow from STEP 3. If the measured flow (STEP 3) is higher than the calculated flow (STEP 5), you need to reduce pressure on the system until they are about the same. If you measured less volume than the calculated, you need to increase pressure.

If the application rate is expressed in gallons per 1,000 ft^2 (GPTF) use the formula below to calculate expected nozzle flow:

$$GPM = \frac{GPTF \times W \times MPH}{136.36}$$

Note: Make sure the units match! Speed should be in miles per hour (MPH), application rate in gallons per acre (GPA) or gallons per 1,000 ft2 (GPTF) depending on the application, and spray width should be in inches (in). The use of other units will introduce errors in the calculated values.

Final Note: Remember to observe weather conditions before you spray to reduce the chances of an off-target drift. Refer to publication #3057, **Agricultural Sprayer Calibration,** for examples on how to correctly calculate mixing quantities for the tank and how to compensate for changes in the solution's specific gravity.

CALIBRATION WORK SHEET

A. Speed Check:

Distance measured: _____feet.

Time recorded: 1. _____ seconds.
2. _____ seconds.
3. _____ seconds.

Average time spent: _____ seconds.

$$Speed = \frac{distance\ (ft.)}{average\ time(s)} \times 0.6818 = \quad mph$$

B. Swath Width:

Record swath width, in inches: _____.

C. Measured Nozzle Flow:

Record nozzle flow, in gallons per minute: _____.

D. Application Rate:

Record application rate here, in gallons per acre (GPA) or gallons per 1,000 ft^2 (GPTF).

D.1 _____ GPA D.2 _____GPTF.

E. Calculate Expected Nozzle Flow Rate:

Using GPA:

$$GPM = \frac{item\ A \times item\ B \times item\ D.1}{5{,}940}$$

Using GPTF:

$$GPM = \frac{item\ A \times item\ B \times item\ D.2}{136.36}$$

F. Compare Nozzle Flow:

Is nozzle flow calculated on **item E** greater than value expressed in **item C**?

Yes → Increase system pressure and repeat **item C** until values are similar.

They are about the same → **The sprayer is calibrated and prepared to deliver the chosen rate at the specified speed.**

No, it is smaller → Decrease system pressure and repeat **item C** until values are similar.

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