PENN STATE

Wildland Weed Management
College of Agricultural Sciences
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Simplified Sprayer Calibration

Calibration is measuring the output of a sprayer so that you know how much spray material you are applying to a given area. You must know this to apply an herbicide at a specific dosage, which is usually described as amount of product per unit area (e.g. ounces per acre).

We will describe calibration of a backpack sprayer, using water rather than the spray mixture, to simulate a fixed speed, fixed pattern application; and a spot-treatment configuration.

When calibrating a backpack sprayer, we can reduce arithmetic by using the 'Ounces to Gallon' method.

This method is based on making the calibration application to an area of 1/128 of an acre, or 340 square feet (43,560 sq. ft/128=340 sq. ft). We do this because 1 gallon equals 128 ounces. This allows us to convert a measurement of *ounces* of water sprayed directly to the 340 sq. ft test area to *gallons* sprayed per acre. Applying 30 *ounces* to 340 sq. ft. is the same coverage as applying 30 *gallons* to an acre.

Once we have determined our coverage in gallons per acre (GPA), we can determine how much area our mix will cover and how much herbicide we need to add to properly treat that area.

We will use this method to calibrate two types of application:

- a fixed-width, or band application
- a spot treatment, where targets are scattered in a site

Example: Band Application

A band application is a fixed-width, fixed speed application. The steps to calibrating this application include laying out your 340 sq. ft test area, practicing your application so that it actually simulates the operational application, completing the test application and determining the volume sprayed.

Lay Out the Sample Area

The sample area will still cover 340 sq. ft, but it should be the width of your spray pattern. You need to determine the length of the test area. To determine the length, divide the width (in feet) into 340. If you are going to treat a 4-ft wide pattern, then the length of the sample row is 85 feet (340 sq. ft ÷ 4 ft = 85 ft).

Time Your Application to the Sample Area

When you measure the time required to treat the sample area, operate the backpack as you will when spraying. Therefore, determine how high you need to hold the boom to treat a 4-foot width, and treat the 85-foot course with only water in your backpack as you are measuring your time to cover the distance.

Measure the time it takes to cover the sample distance several times to get a reliable average time.

Measure the Ounces Needed to Treat the Sample Area

Once you know how long it takes to treat the sample area, you will collect the amount of spray solution your sprayer delivers in that time to determine the GPA of your application.

If it took you 15 seconds to cover the sample area, then you collect the spray from your sprayer for 15 seconds and measure it in ounces.

When collecting, it is important to pump the sprayer the same way you did when making the test application, or the flow rate will differ and you calibration will be less accurate. To get a reliable average volume, repeat the measurement.

Determine Your Mixture

Now that you have measured the ounces collected and determined your GPA, you can calculate how much of an acre your sprayer will cover. For our example, let's assume you have a 4-gallon backpack sprayer that you will fill to 2.5 gallons. Set up a proportion, as shown below, to determine how much of an acre your backpack sprayer will cover.

If we collected 20 oz (20 GPA), we would do the following calculation:

$$\frac{\textbf{20 gal}}{\textbf{1 acre}} = \frac{\textbf{2.5 gal}}{\textbf{\textit{Y} acre}}$$

'Cross multiply' to determine '*Y*', as follows:

2.5 gal X 1 acre ÷ 20 gal = 0.12 acre.

Therefore, our 2.5 gallons of mix will cover 0.12 acres.

We will use '0.12' as our 'acre fraction' to determine how much herbicide to add to our backpack sprayer.

For our example, we'll use the following mix to prevent Japanese stiltgrass from growing along a trail:

'Plateau'	1 oz/acre
'Pendulum AquaCap'	96 oz/acre

When we apply our 'acre fraction', we determine the following amounts to add to our 2.5 gallons of solution:

'Plateau':

0.12 acre X 1 oz/acre = 0.12 oz

'Pendulum AquaCap':

0.12 acre X 96 oz/acre = 11.5 oz

For small volumes, it is best to convert to metric measurement and determine your amount in milliliters (mL). Small graduated cylinders from 10 to 100 mL are available from lab supply and natural resource management vendors. Using metric measurement for small volumes is much more precise than English units of teaspoons (5 mL) and tablespoons (15 mL).

'Plateau':

0.12 oz X 30 mL/oz = 7.5 mL

'Pendulum AquaCap'

11.5 oz X 30 mL/oz = 345 mL

Example: Spot Application

The most common use of a backpack sprayer will likely be to spot-treat weeds that are scattered throughout a site. For example, if you have some mile-a-minute scattered in a habitat area, you can estimate your spray coverage so that your mix will be effective without over- or under-applying. For this procedure, use the following steps:

- Measure a test area of 340 sq. ft (ex. 17 by 20 ft.) that has vegetation similar to your target weeds
- Choose test area vegetation of similar height and leaf texture – don't use a lawn area as a test site to calibrate for a multiflora rose treatment
- Outside of the test area, take a few minutes to practice your application to get a consistent level of spray coverage to the foliage
- Treat *all* the vegetation in the test area with the same level of spray coverage as you will treat your target weeds.

In this procedure, you cannot simply time how long it takes to apply. Use the 'subtraction method' to determine your GPA. Mark the starting water level in your sprayer prior to the test application, and *determine by subtraction* what volume you sprayed as you refill the sprayer to the original water level from a graduated container with a known amount of solution. If you start with 64 oz in the container, and have 29 oz left when you refill the sprayer to the original level, your application volume is

64 oz – 29 oz = 35 oz sprayed = 35 GPA

For this example, we want to apply 'Garlon 3A' at 32 oz/ac, and we are going to mix 2.5 gallon of solution for each backpack load.

To determine how much 'Garlon 3A' to add to our backpack, we calculate how much area our backpack sprayer will treat, by setting up a proportion.

$$\frac{\textbf{35 gal}}{\textbf{1 acre}} = \frac{\textbf{2.5 gal}}{\textbf{\textit{Y} acres}}$$

You 'cross multiply' to determine '*Y*' as follows:

2.5 gal X 1 acre ÷ 35 gal = 0.071 acre.

Our 2.5-gallon mix will cover 0.071 acres. We will use '0.071' as our 'acre fraction' to determine how much of our intended herbicide mix to add to our backpack sprayer. For our example, we'll use the following mix:

'Garlon 3A *32 oz/acre*

'Alligare 90' (surfactant) *0.25 % by volume*

To calculate the amount of herbicide, we apply our 'acre fraction' to determine the amount to add to make 2.5 gallons of mixture:

'Garlon 3A'

0.071 acre X 32 oz/ac = 2.3 oz

Surfactant calculations are a little different, as they are based on the amount of solution sprayed, rather than the area covered by the spray. We don't use the acre fraction. We calculate how much material we need to achieve the desired concentration, on a volume basis.

'Alligare 90':

0.25 percent = 0.25/100 = 0.0025

0.0025 X 2.5 gallon = 0.00625 gallon

0.00625 gallon X 128 oz/gallon = 0.8 oz

When measuring small volumes, it is easier to use the metric system, and use small graduated cylinders rather than teaspoons and tablespoons. Below is the arithmetic to convert fluid ounces to the metric unit for small volumes of liquid, the milliliter (mL). One fluid ounce equals 29.6 mL. We will round to 30 mL.

2.3 oz 'Garlon 3A' X 30 mL/oz = 69 mL

0.8 oz surfactant X 30 mL/oz = 2.4 mL

Therefore, for 2.5 gallons of mix, add 69 mL of 'Garlon 3A' and 2.4 mL of 'Alligare 90'.

There will always be variation in spot treatment, but taking the time to calibrate the application will ensure that you are using the dose of herbicide that you need.

You should also do this for each applicator if you have more than one person doing the treatment. If different applicators are going to work autonomously, they can calibrate and mix individually. When applicators are going to work together, it makes more sense to have the group choose one target volume and alter their practice so that everyone is applying the same level of coverage and using the same mixture.

Summary

Although calibration represents an 'extra' step, and time you feel you don't have, it is not. You cannot apply correctly without calibrating. Applying the dose of herbicide needed to achieve control ensures that 1) the work actually gets done right and personnel time is not wasted on retreatment, and 2) that material is not wasted, or even worse, unintended injury to non-target plants occurs.

Additionally, applicators that master calibration gain a valuable skill and take control of the process, rather than simply mimicking instruction - which may be incorrect.

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