Calibrate to spray accurately

The method of applying pesticides is determined by formulation of the chemicals involved (i.e., liquid or granular) and the application equipment available. A superintendent should feel free to select the method and equipment best suited to a program's needs so long as accuracy and uniformity are assured. A critically important facet of minimizing error concerns accurately calibrating application equipment. Small areas magnify minute application errors. As an example, a desired rate of three (3) kilograms (kg) of material per hectare (ha), based on a 10 square meter (m^2) plot becomes 3.3 kg/ha if inadvertently applied to only 9 m^2, or 2.7 kg/ha when applied to an 11 m^2 area.

There are two general approaches to, or methods of, applying herbicides: area basis and volume basis. Calculations for the amount of herbicide needed will be based on the application method chosen.

Area basis

The area of a plot, or plots, to be sprayed with a particular material at a predetermined rate forms the keystone of this system. However, should less than the full plot width be sprayed, the area actually sprayed supercedes the full plot area in calculating amounts.

Note: A small amount of liquid is sprayed at the beginning edge of (but outside) each plot to be sure that all lines and the boom are full and that all nozzles are operating properly. An additional amount is left in the boom and hoses at the end of the plot. Allowances are made by adding a predetermined amount of water and herbicide. With the area system, this step amounts to simply factoring additional area into the calculations. The added area should always be the same for a given boom, regardless of plot size, being based on the extra liquid needed to fill that boom and to check nozzle operation. This method is most satisfactorily used with a spray tank shaped to allow discharge of all the liquid.

(Editor's note: This section is included because many superintendents experiment with pesticides to determine which will give optimum performance and economy on a given course. Extreme care should be taken when spraying to fill the lines and boom, as mentioned in the note above, so as not to overspray in one area and kill the turf.)

Using a predetermined area size permits all calculations to be made in advance. Dry herbicides should be weighed into bottles, plastic bags, or paper envelopes in the herbicide storage area, because most balances do not function well under field conditions. Liquid formulations either can be measured in advance or

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measured from original containers in the field immediately prior to application.

Example 1

Material: atrazine
Rate: 2 kg active ingredient (ai)/ha
Plot size: 2 x 5 m
Replications: 3
Calculations:

(1) Plot size—2m x 5m = $10m^2$ x 3 replications = $30m^2$

(2) Add 1.5 m^2 to allow for filling boom and hose

(3) One hectare ($10,000m^2$) requires 2000g ai. $31.5m^2$ ($30m^2$ + $1.5m^2$) requires X g

$$x = \frac{31.5 \times 2000}{10,000} = 6.3 \text{ g ai}$$

Caution: The above example assumes the pesticide and water for all three replications are mixed together. *When spraying wettable powders, each replication should be MIXED and SPRAYED SEPARATELY unless great care is taken to prevent the herbicide from settling to the bottom of the tank.*

Greater accuracy is also required when all replications are mixed together; any error in application rate will not be noticed until the last plot of the series is sprayed. This is especially serious if all the spray is used before completing the last plot.

The amount of water required to cover the area to be sprayed can be determined by filling the sprayer's tank with clean water (only) and spraying the area at the desired pressure and speed and measuring the amount of water consumed. The operator should then pace himself by applying the measured amount of water to a non-plot area having the same size, surface, and walking conditions as the actual plot. Pacing requires several passes until the correct amount of water can be sprayed each time, making sure to actually begin spraying at the beginning of the pacing test and to stop spraying precisely at the test end as will be the case in applying herbicide to the plots.

Volume basis

With this method, the amount of herbicide is calculated for a given amount of water rather than for a certain area. The volume of water used usually exceeds that required to spray the plot or plots; consequently a method should be devised to assure a constant and accurate speed. A stop watch serves this purpose. The volume method is useful when plots are large enough to require refilling the spray tank and when the spray tank design prevents using all of the liquid. There does not appear to be any other advantage in spraying small plots by this method.

The first step requires calibrating the sprayer to determine the output of water. A very convenient method of calibrating a small plot sprayer is described by L. Kasasian in his book, *Weed Control in the Tropics:*

"Pour a measured amount of water in the sprayer and spray 100 m^2 exactly as if one were applying herbicide. When this is done, measure the amount of water left, and by subtraction, calculate the amount used. Then multiply by 100 to obtain the volume rate per hectare."

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Example 2

Assume: sprayer applies 200 liters (l) of water/ha

Total plot area: 2m x 5m = $30m^2$

Solution: use proportions

$$\frac{\text{liters/ha}}{m^2/ha} = \frac{X \text{ liters}}{30m^2} \quad \frac{200 \text{ liters}}{10{,}000\ m^2} = \frac{X \text{ liters}}{30m^2}$$

$$X = \frac{200 \times 20}{10{,}000} = 0.6 \text{ liters for 3 plots}$$

Since 0.6 l is the exact amount of water needed to spray 30 m^2, the researcher might decide to use one liter as the total volume for each three plot series. The remaining 0.4 l is used to check the nozzles and allow for error. The amount of herbicide can then be calculated for one liter.

Example 3

Compound: atrazine

Desired Rate: 2 kg ai/ha

Total plot area: 3 plots, 2m x 5m each = $30m^2$

Assume: sprayer applies 200 l of water/ha

$$\frac{\text{grams/ha}}{\text{liters/ha}} = \frac{x \text{ grams}}{\text{liters}/30m^2} \quad \frac{2000 \text{ grams}}{200 \text{ liters}} = \frac{x}{1 \text{ liter}}$$

$$X = \frac{2000 \times 1}{200} = 10 \text{ grams active ingredient}$$

The commercial product (c.p.) required if the formulation is an 80 percent active wettable powder can be calculated as follows assuming 100 g of c.p.:

100 g c.p. = 80 g ai

$$\frac{\text{Grams of commercial product}}{\text{grams of active ingredient}} = \frac{\text{x grams commercial product}}{\text{10 grams active ingredient}}$$

$$\frac{100 \text{ grams}}{80 \text{ grams}} = \frac{X}{10 \text{ grams}}$$

$$\frac{10 \times 100}{80} = 12.5 \text{ grams commercial product for 1 liter of water}$$

Field sprayers

Three methods of calibrating field sprayers are:

Method 1

(1) measure one hectare, acre, or other land unit;
(2) fill the sprayer with clean water only;
(3) spray the area at a predetermined speed and pressure;
(4) refill the sprayer measuring the amount of water needed to do so.

The volume of water consumed provides the calibrated rate of liquid application to be used for calculating the amount of herbicide required.

The same method can be used for a smaller area:

Method 2

(1) place a marker at each end of some convenient length test strip, i.e., 100 meters;
(2) fill the sprayer with clean water;
(3) spray the measured test strip at a predetermined speed and pressure;
(4) refill the sprayer measuring the amount of water needed to do so and solve the following equation:

$$\text{liters/ha} = \frac{10{,}000\ m^2/ha \times \text{liters used}}{\text{strip length x width of spray swath}}$$

Example 4

Water consumed: 8 l

Length of test strip: 100 m

Width of spray swath: 6 m

$$\text{liters/ha} = \frac{10{,}000 \times 8}{100 \times 6} = 133.3$$

Another technique for calibrating:

(1) fill the sprayer with clean water;
(2) operate the sprayer at a predetermined pressure;
(3) use vessels to collect the water spray discharged from one-third of the nozzles simultaneously during one minute;
(4) have the sprayer move at field speed, then measure the distance travelled in one minute.

The amounts collected for each are measured, then averaged. The average delivery for one nozzle multiplied by the total number of nozzles equals the total discharge.

Example 5

Plots (replications) to be sprayed: 3

Plot size: .25 ha

Area = 3 x .25 = .75 ha
= .75 x 30% = .975 ha
or rounding off, 1 ha.

$$\text{liters per ha} = \frac{8 \times 10{,}000\ m^2/ha}{6x100} = 133.3$$

The above article was excerpted from the *Field Manual for Weed Control Research*, published by the International Plant Protection Center, Oregon State University, Corvallis, Oregon.