SPRAYER CALIBRATION LAB 10

A. Why is calibration important

1. To obtain the performance of a pesticide as specified on the product label.

2. To be able to repeat successful procedures and minimize expenses.

3. To diagnose problems with failure in product performance or crop injury.

4. To be able to document legal doses applied when using "RESTRICTED USE PESTICIDES". (Most important under current and increasing scrutiny by state regulatory agencies)

B. Useful conversion values

1. 1 GALLON = 128 OUNCES = 4 QUARTS = 8 PINTS = 3.785 LITERS

2. 1 ACRE = 43, 560 FT² = 0.40468 HECTARE

3. 1 POUND = 16 OUNCES = 454 GRAMS

C. Simple math for use in all calibration problems

1. There are many ways to determine the values needed in various calibration problems and there are many approaches to calibration of hydraulic spray equipment.

2. The methods described here make use of one simple algebraic principle called “a proportionality constant” or simply solving for X.

3. The math used involved is simple multiplication and division. The hardest part of calibration for most students is where to start and what units need to be determined.
4. A simple math procedure to determine the amount of legs on 4 horses:

   a) We need to develop an equation **that asks a question**. The equation starts by stating what we know and describing what we want to determine.

   b) We use an equation to answer a simple question. How many legs are on 4 horses, when we know that 2 horses have 8 legs? Follow the example below:

\[
\frac{2 \text{ horses}}{8 \text{ legs}} = \frac{4 \text{ horses}}{X \text{ legs}}
\]

   (1) To determine X legs, cross multiply and set the result equal to each other.

\[
\begin{array}{l}
(2) \times (X) = (4) \times (8) \\
2X = 32 \\
X = \frac{32}{2} \\
X = 16, \text{ by cross-multiplying we have derived the answer posed in the original equation. Now we know that 4 horse have 16 legs}
\end{array}
\]

c) All future calibration problems will involve setting up these horses and legs equations where you will have 3 known values and one unknown (X) to determine.

d) All calibration problems should be solved in stages; you solve a series of equations that relate to each other. At all stages you can check your answers to prove to yourself that your calculations are correct.

D. Determination of sprayer gallons per acre (GPA) based on application to test area:

1. The proper and most accurate test area to calibrate a sprayer is one that has similar characteristics to the actual area to be sprayed

   a) If plowed fields are to be sprayed, then calibration should take place in an area with soft plowed soil.

   b) If spraying turf on rolling hills, calibration should take place across terrain that is representative of the slopes and grass texture.

   c) Calibration on flat roads or other hard surfaces will not give you the same results as those taken under actual field conditions.
2. A test area is setup so that a spray (just water, no pesticides) application can be made to a small area of known size. The amount of liquid that is delivered to the test area is recorded. The speed of movement across the test area and spray delivery conditions are supposed to be same as those used in an actual spray application.

   a) The volume applied to the test area will be used in calculations to determine how much liquid would be required if the same sprayer covered a larger area. We determine the per acre carrier volume because herbicide recommendations in the U.S. are provided on a per acre basis.

3. When calibrating tractors, note the gear range and engine RPM. These two settings will provide the forward speed that must be the same every time a spray application is made so that successful results can be repeated.

4. When calibrating a backpack sprayer, walking speed and pumping rate must be set at levels that the operator can maintain. The backpack should be half filled during calibration runs in the test area.

5. In the following example, a test area is setup that is 4 x 100 feet for a total area of 400 square feet. While walking across and spraying this area, 35.3 oz. of water is needed for complete coverage of the test area with a small backpack sprayer. Use the horses and legs equation to relate the 35.3 oz. applied to the 4 x 100 foot test area to gallons applied on a per acre basis (1 acre = 43,560 ft²). To do this we setup an equation and solve for X again as follows:

   \[
   \frac{35.3 \text{ oz.}}{400 \text{ ft}^2} = \frac{X \text{ oz}}{43,560 \text{ ft}^2}
   \]

   \[
   (400) \cdot (X) = (35.3) \cdot (43,560)
   \]

   \[
   400X = 1,537,688
   \]

   \[
   X = \frac{1,537,688}{400} = 3844
   \]

   a) You can prove to yourself that you have the correct answer by substituting the value (3844) for X in the equation and performing the division implied by the fractions.

   (1) \( \frac{35.3}{400} = 0.008825 \)

   (2) \( \frac{3844}{43,560} = 0.0088246 \)
b) You can convert the oz. value to gallons using the same equation and using the proper conversion values for ounces and gallons.

\[
\frac{1 \text{ gallon}}{128 \text{ oz.}} = \frac{X \text{ gallon}}{3844 \text{ oz.}}
\]

\[
\begin{array}{c|c|c}
(128) \times (X) & = & (3844) \times (1) \\
128X & = & 3844 \\
X & = & \frac{3844}{128}
\end{array}
\]

\[
X = 30, \text{ thus we can see that 35.3 oz. applied to the 400}^2 \text{ ft test area is the same as applying 30 gallons to an entire acre (30 GPA).}
\]

6. Now that we know the delivery volume of the sprayer on a per acre basis, we can look on the product label and determine how much is recommended on a per acre basis. Once we know the per acre amount we can determine how much to put into the tank of the sprayer we just used on the test area.

**E. Determination of amount of herbicide to apply to one acre:**

1. Herbicides are prepared in a variety of forms, based primarily on the chemistry of the active ingredient and intended usage. Below are some pesticide formulation symbols and related concentrations

   a) 4EC or 4L = 4 pounds of active ingredient as an emulsifiable or liquid concentrate in one gallon.

   b) 65DF = 65 pounds of active ingredient in 100 pounds of dry flowable granulars.

   c) 80WP = 80 pounds of active ingredient in 100 pounds of wettable powder. The DF formulation is similar to the WP but with less dust forming potential.

   d) 15G = 15 pounds of active ingredient in 100 pounds of granular formulation.

2. The Pesticide label describes the amount of product needed to obtain the pest management performance of the active ingredient(s). In this example, the manufacture’s recommendation for Roundup for complete kill of susceptible plants is 32 oz. over 1 acre.
F. Determine how much liquid or dry weight amount of herbicide must be added to the final liquid volume to be sprayed (i.e. the “finished spray volume”).

1. Compose an equation that incorporates known facts about the spray system (GPA), recommended amount of pesticide and finished spray volume.

   a) Sprayer delivers 30 gallons per acre

   b) Roundup applied at 32 oz per acre.

   c) Finished spray volume is 4 gallons.

2. The question that needs to be expressed as an equation is:

   a) With a sprayer that applies 30 gallons per acre and a Roundup use rate of 32 oz/a, how much Roundup is added to a 4 gallon spray tank to achieve the performance specified on the product label?

3. To determine the amount of chemical placed into the 4-gallon tank we use the equation below.

\[
\frac{32 \text{ oz Roundup}}{30 \text{ gallon}} \times (X) = \frac{X \text{ oz.}}{4 \text{ gallon}}
\]

\[
\frac{32 \times 4}{30} = \frac{X}{30}
\]

\[
X = \frac{128}{30} = 4.3
\]

Thus 4.3 oz of Roundup diluted to 4 gallons and applied with the backpack will provide an application rate of 32 oz Roundup/acre over any treated area.

a) Try to determine the total area covered with the 4-gallon backpack.
(Hint 5,808 ft\(^2\))
G. Requirements for accurate application of pesticides

1. Know the liquid volume required to cover a known surface area with a specific type of spray equipment
   
   a) In herbicide work this volume is usually expressed in gallons per acre \( = \text{GPA} (A = 43,560 \text{ ft.}^2) \). This value is obtained through calibration.

2. Know the amount of pesticide recommended on an area basis.
   
   a) Information provided on pesticide label.

   b) Expressed in terms of dry weight or liquid amount (oz, pint & quarts) per acre.

3. Know the size of the tank from which the pesticide is being delivered or total amount of “finished spray solution” that needs to be prepared.
   
   a) Tank should be marked in 5-gallon increments for smaller jobs.

   b) Tank sizes range from a 1-gallon sprayer to more than 200-gallon commercial tanks.

4. The ability to maintain consistent spray pressure, ground speed and proper nozzle height for recommended overlap over the entire area to be sprayed.
H. Standard herbicide calibration problem

1. You have a sprayer with a 12-foot boom and an 80-gallon tank that delivers 5 gallons of liquid along a 450-ft. length of turf. You want to treat a large turf area consisting of Bermuda grass infested with goose grass and decide to use Sencor 75 (metribuzin). Sencor 75 is formulated as a wettable powder with 75% active ingredient. The recommended rate of Sencor 75 is 0.5 lb/a. Determine how much Sencor is placed into the spray tank to obtain the recommended rate across all treated areas.

2. Problem solving breakdown.

   a) You must first determine the gallons per acre that the sprayer is delivering. This information is contained in the first sentence. The equation below can be used to solve this part of the problem.

\[
\frac{5 \text{ gallon.}}{(12 \times 450) \text{ ft.}} = \frac{X \text{ gallon}}{43,560 \text{ ft}^2}.
\]

<table>
<thead>
<tr>
<th>(5400) x (X)</th>
<th>(43,560) x (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5400X</td>
<td>217800</td>
</tr>
<tr>
<td>X</td>
<td>217800/5400</td>
</tr>
<tr>
<td>X</td>
<td>40.3, the sprayer is applying 40 GPA.</td>
</tr>
</tbody>
</table>

   b) You know how much of Sencor is recommended on a per acre basis and you know volume of liquid need to cover 1 acre. Now determine how much you will place in the 80-gallon tank.

\[
\frac{0.5 \text{ lb}}{40 \text{ gallon}} = \frac{X \text{ oz}}{80 \text{ gallon}}
\]

<table>
<thead>
<tr>
<th>(40) x (X)</th>
<th>(0.5) x (80)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40X</td>
<td>40</td>
</tr>
<tr>
<td>X</td>
<td>40/40</td>
</tr>
<tr>
<td>X</td>
<td>1 lb, you will put 1.0 lb. of Sencor 75 in the 80 gallon tank.</td>
</tr>
</tbody>
</table>

3. You should be prepared to solve similar problems in the classroom quiz. Always solve your calibration problems in stages and use equations that ask a specific question. Take the answer you get and place it into the equation and prove your answer is correct by performing the divisions implied by the fractions in the “solve for X” equation.