Pesticide and Fertilizer Math: Converting Product Rates into Smaller, Practical Amounts

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Pesticide and fertilizer calculations are not a lot of fun for most people. They can be difficult, confusing, and even scary. But getting the math right when calibrating a sprayer, applying fertilizer, or converting large scale rates into rates for smaller applications is absolutely critical in producing a quality product and protecting the environment.

Applying the proper amount of fertilizer requires that you know the size of the area to treat, the desired application rate, and the analysis of the fertilizer product. Applying the proper amount of pesticide or other product with a sprayer requires that you have properly calibrated your sprayer and mixed up the right concentration of product in the tank. When application rates of fertilizers, pesticides or other products are given in larger scale units, such as lbs/acre, it may also be necessary to convert those rates to smaller units when making applications on smaller scale.

Calculations for all of these involve **rates**. A **rate** is one unit of measure per another unit of measure, such as 3.2 gallons/acre, or 7 fl. oz./1000 ft^2. A rate is like a fraction in how the math is performed, but different from a fraction in that rates can be inverted without changing their meaning. So, 3.2 gallons/acre is the same as 1 acre/3.2 gallons. You can't do that to a fraction!

Let's look at an example of how to do rate-based math:

You want to apply a liquid pesticide to your leafy greens at the labeled rate of 12 oz./acre. Your patch measures 160 ft^2 and your sprayer is calibrated to apply 40 gallons/acre. How many **ounces** of pesticide do you need to add to your sprayer?

The strategy is to set up the calculations by following the units of measure. You know that the answer you need is in the units of **ounces**. You can use a conversion factor (1 acre/43,560 ft^2) to cancel units to get to ounces. Mathematically speaking, multiplying by a conversion factor is the same as multiplying by 1.

Set up to cancel units to get oz:

$$\frac{12\ oz}{acre} \times \frac{1\ acre}{43{,}560\ ft^2} \times 160\ ft^2 = 0.044\ \textbf{oz}$$

Notice that the units 'acre' and 'ft^2' cancel out of the numerator and the denominator in this equation, and you are left with the **ounces** needed to treat your patch.

But how do you physically measure 0.044 ounces of product? Use one more conversion factor in your equation to translate it into units you can measure, for example, milliliters (ml).

How do I measure 0.044 oz?

$$0.044 \text{ oz} \times \frac{29.6 \text{ ml}}{1 \text{ oz}} = 1.3 \text{ ml needed}$$

It's not too hard to find something to measure out 1.3 ml of a liquid, such as a syringe without a needle, available at most drug stores or online. Similarly, a relatively inexpensive digital postage scale can be used to weigh out small amounts of dry product.

Here are a few conversion factors to help you make the calculations:
1 acre=43,560 ft^2
1 fl. oz.=29.6 ml
1 gallon=128 fl. oz.
1 oz.=28.35 grams
1 pt.=473.2 ml
1 tablespoon=3 teaspoons
1 cup=16 tablespoons
1 lb=454 grams
1 teaspoon=4.93 ml
1 quart=2 pt.=4 cups

If you are using a backpack sprayer for smaller applications, calibrate it properly and often! As crop canopy increases, spray volume may need to increase, and walking speed decrease, for adequate coverage. We also suggest that you follow the Rutgers recommendations on retrofitting your backpack sprayer wand with a pressure regulator and better nozzles. Information on these steps can be found here:

http://snyderfarm.rutgers.edu/snyder-backpack-sprayers.html

In summary, when confronted with rate-based calculations on the farm, use this strategy:

- Write down what you know (rates, area, tank size) including the units of measure in fraction form;
- Define, in units, what you are trying to calculate;
- Go from what you know to what you need by using conversion factors and canceling units.

Follow the units; they will not lead you astray!