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Mixing Small Batches of Pesticide from Concentrate (based on percent active ingredient)

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Small hand-pump spray bottles of pesticide in a “ready-to-use” dilution are commonly available as a convenience for consumers. Frequently they contain lower concentrations of pesticide than would be recommended for an agricultural use. This is a safety precaution because it is assumed that consumers may over-apply the product.

Ready-to-use products may add convenience, but generally they are much more expensive than concentrated products based on the amount of active ingredient. Mixing your own dilutions from concentrated pesticides allows you to choose the concentration of active ingredient, often at a much lower price than pre-mixes.

Be careful: Be sure the allowed labeled uses for the concentrated pesticide are the same as for your intended use of the product. For example, you cannot legally dilute permethrin concentrate for crops and use the dilution on horses, if not specifically listed on the label. Just because the active ingredients of two products are the same doesn't mean that they can be legally used interchangeably. **Always READ and FOLLOW all label restrictions.**

Determining the correct mixture of concentrated pesticide and water can be confusing. We use here an example of an insecticide labeled for use on horses to control biting flies and mosquitoes.

Ready-to-use products containing permethrin at less than 0.1% active ingredient are reported to not be very

effective when used at a normal rate, whereas products containing between 0.3 and 0.5% permethrin appear to be quite effective. An 8-ounce bottle of 10% permethrin concentrate may be found at a local farm supply retailer for less than \$8 and a 4-ounce product containing 40% permethrin concentrate for less than \$25.

Both concentrated products have the same label uses for horses as the ready-to-use product, but there is very little information on the label about mixing a small (32 ounces) batch for a hand sprayer. Given the information you now have, with the help of information presented below, you can easily determine the right mixing rates for preparing your own ready-to-use product.

Microsoft Excel® does the math for you, allowing you to accurately determine the correct ratio of concentrated pesticide and water to mix a small volume of ready-to-use product based on the percent of active ingredient. In the spread sheet (next page), row 5 across is where you enter information, and row 11 across is where you find the results.

Begin the process by entering the ounces of the final mixed spray (example, 32 ounces) into cell A5. The final concentration of the solution that you want (example, 0.3% solution) goes into cell B5 as 0.003 (note: 0.3% is equal to 0.3/100 which is equal to 0.003). Finally, in the next cell to the right, cell C5, enter the percent active ingredient of the concentrate that you are buying (example, 10% active ingredient, permethrin equals 0.10).

	A	B	C	D
1	amount	% active	% active	
2	of final	ingredient	ingredient	
3	product to	in final	in initial	
4	mix oz	mix	concentrate	
5	32	0.30%	10.00%	
6				
7				
8	ounces of			
9	concentrate	approx #	approx #	approx #
10	to add	teaspoons	table spoons	ml
11	0.96	5.45	1.82	27.24
12				
13				
14	Note that mass to volume conversions assume			
15	a concentrate density of 1 gm/ml			

To calculate our problem long hand we will do as follows:

$$\frac{32 \text{ oz total mix}}{\text{spray container}} \times \frac{0.003 \text{ oz ai}}{1 \text{ oz total mix}} \times \frac{1 \text{ oz total concentrate}}{0.1 \text{ oz ai}} = \frac{0.96 \text{ oz total concentrate}}{\text{spray container}}$$

This is that same answer as in the spreadsheet.

The spreadsheet tells you that you will need to put (cell C 11) approximately 1.82 tablespoons of concentration into your spray container. Fill the rest of the container to the 32 oz. mark with water, and then shake the container well to ensure adequate mixing.

Cell A 11 shows the same result in ounces (.96 oz.), B 11 the same result in teaspoons (5.45 tsp.), and D 11 the same result in milliliters (27.24 ml). The most accurate method of measuring concentrate may be to use an old syringe (cleaned thoroughly without the needle) and measure the product in milliliters.

(Some concentrated products come packaged with a self-contained measuring system.)

The conversion from (mass) ounces to volume is not exact since EPA lists the density of several permethrin products as 1.002 gm/cm³ and some as low as 0.96 gm/cm³. We assume that the densities of the pesticide products are the density of water which is 1.0 gm/cm³. This density difference will result in an error that will probably be less than the error resulting from trying to accurately measure with a tablespoon.

Equations used in Excel®

	A	B	C	D
8	ounces of			
9	concentrate	approx #	approx #	approx #
10	to add	teaspoons	table spoons	ml
11	=(A5*B5)/C5	=(A11*454/16)/5	=B11/3	=5*B11