Harrell's Horticulture Blog-Horticultural Math February 9, 2016

By Lynn Griffith
Tropical Plant and Soil Expert

A grower with 40 years experience called me the other day, asking when he drenches with chelated iron, how many parts per million iron is in the drench. This reminded me of a common problem. Growers and sometimes other horticulture professionals often don't know how to calculate PPM, or are afraid to admit that they don't. Many growers were never taught this, or if they were, it was long ago and they have forgotten. Not many people like to do math, and that's understandable.

However, I figured out a long time ago a rather simple solution for how to calculate things like this. It really isn't all that complicated once you see how to do it using my method. There are other ways to calculate these things, often more complicated than they need to be. There are times where it really helps growers and fertilizer/crop protection people to understand how to calculate parts per million. It's really easy doing it this way. Let me show you this simple method, and soon you'll be able to do this like a pro. I will walk you through it, and then let you try a couple yourself. You GOT This !

The basis for the way I calculate ppm and other things is to use a simple arithmetic equation called a proportion. Stay with me now, this will be easy.

The form of a proportion is basically this :

$$\frac{W}{Y} \qquad \frac{X}{Z}$$

$$\frac{W}{Y} = \frac{X}{Z}$$

Usually you know 3 of the 4 values, and you need to find the value of the unknown, which is X.

Let’s do a simple example, one that you all can do in your heads.

If two quarters equals 50 cents, how much is 5 quarters ? We know this instinctively, but here is how the arithmetic works in the form of a proportion :

$$\frac{2}{\$.50} = \frac{5}{X}$$

We know 3 of the 4 variables, we just need to calculate the unknown, in this case how many dollars is 5 quarters.

The way you solve a proportion is very simple, only 2 steps. You cross multiply, and then solve for X. Don’t run away screaming, this is easier than you think.

$$\frac{2}{\$\ .50} = \frac{5}{X}$$

You cross multiply, meaning 2 times X = .50 x 5.

Whatever the numbers are, you just multiply each number by the number diagonally across from it. That's step one. We're halfway there !

So, 2 times X = $.50 x 5

2X = $2.50

Now the second part, solving for X. To do this, you simply need to get the variable X by itself. All you do is divide both sides by the number next to the X.

In this example, divide both sides by 2 in order to get X by itself.

$$2X = \$2.50$$

$$\frac{2X}{2} = \frac{\$2.50}{2}$$

$$X = \$2.50/5$$

$$X = \$1.25$$

That's how much 5 quarters is !

Now, let's try a real world horticultural situation. C'mon, we can do this !!

But first, we need to memorize 1 thing. A gallon of water weighs 8.33 pounds. I just weighed a gallon of water on my bathroom scale, and sure enough ! That means the 100 gallons of water weighs 833 pounds. The simple proportion is :

$$\frac{1 \text{ gallon}}{8.33 \text{ lbs}} = \frac{100 \text{ gallons}}{X \text{ lbs}}$$

So, what do we do now ? Two simple things, cross multiply, then solve for X. Here we go :

$$1X = 8.33 \text{ times } 100$$
$$1X = 833$$

Divide both sides by 1 to get X by itself, and we get

$$X = 833 \text{ pounds !}$$

Knowing that 100 gallons of water weighs 833 pounds will be very important in calculating PPM, so please memorize it.

Now- for the horticultural problem my grower friend asked me about : If I drench with a pound per 100 gallons of Sequestrene 138, how many PPM iron is that ? Stay with me now, this is the regular season, these games count !

Sequestrene 138 is a 10 % iron formulation. So, that pound of product is only a tenth of a pound of iron.

So, we set up our proportion : A pound of a 10 % product is .1 pounds iron. So :

$$\frac{\text{.1 lbs iron}}{\text{833 lbs water}} = \frac{\text{X pounds iron}}{\text{1 million pounds water}}$$

We cross multiply, and solve for X, like always:

$$833\,X = 1 \text{ million times } .1$$
$$833\,X = 100{,}000$$

$$833\,X = 100{,}000$$

Dividing both sides by 833 to solve for X :

$$\frac{833\,X}{833} = \frac{100{,}000}{833}$$

$$X = 100{,}000 \,/\, 833$$

$$X = 120 \text{ parts per million !}$$

So, if we drench a pound per 100 gallons of a 10 % iron product, that's 120 PPM iron.

Now, let's take another familiar one : A pound of 20-20-20 in 100 gallons is how many PPM Nitrogen ???

Well, we know that pound is only 20 % Nitrogen, so the pound of formulation is .2 pounds of N

So, we set up our proportion :

$$\frac{.2 \text{ lbs N}}{833 \text{ lbs H2O}} = \frac{X \text{ pounds}}{1 \text{ million lbs H20}}$$

Now, we cross multiply and solve for X :

833 X = .2 times 1 million

833 X = 200,000

Divide both sides by 833 to solve for X

X = 200,000/833

X = 240 PPM Nitrogen !

So, a pound of 20-20-20 per 100 gallons is 240 PPM Nitrogen.

To save you time, 13 ounces of 20-20-20 per 100 gallons is 200 PPM Nitrogen

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So, if you've come with me this far, you must feel like a pretty smart cookie !

Ok, only a little more. What about liquids ?

Well, remember one more constant :

- Most liquid fertilizer products weigh pretty close to 10 pounds per gallon.
- You can tell this by having lugged 2.5s or 5s around to nurseries
- The exact weights per gallon are usually on the label, but 10 lbs per gallon is a good rule of thumb
- It's the weight of the water (8.33 lbs) plus the weight of the fertilizer in the water
- So, let's take another real world situation :

Harrell's Max Liquid Magnesium

The rate is 2 quarts per 100 gallons

The product weighs 10.34 lbs/gallon (pretty close to 10 pounds per gallon, so we'll use 10

If we spray or drench with 2 quarts of Harrell's Max 4 % liquid Magnesium per 100 gallons, how many PPM magnesium is that ?

Remember the 3 steps : set up a proportion, cross multiply, then solve for X. Easy as 1-2-3

Ok, 2 quarts of product weighs about 5 pounds, 4 % of which is magnesium. So 5 pounds times 4 % = .2 pounds of magnesium in the 2 quarts

$$\frac{.2 \text{ lbs Mg}}{833 \text{ lbs H20}} = \frac{X \text{ pounds}}{1 \text{ million lbs H2O}}$$

$$833X = .2 \text{ times } 1{,}000{,}000$$

$$833X = 200{,}000$$

$$X = 200{,}000/833$$

$$X = 240 \text{ PPM Magnesium !}$$

Now, you can watch me play the banjo, but you won't learn how to do it until you try it yourself.

So, here's a sample problem to see if you've got it. I will put the calculation and the answer down, but try this yourself, I know you can do it !

Here's the exercise : Harrell's Sprayable Urea is 46 % Nitrogen. If we spray it at 5 pounds per 100 gallons, how many PPM Nitrogen is that ?

Try this yourself, no peeking. The answer will follow.

Remember the 3 steps :

1) Set up a proportion
2) Cross Multiply
3) Solve for X

The correct answer is 2761 ppm Nitrogen !

Here's how : 5 pounds of urea x 46% = 2.3 lbs N

$$\frac{\text{2.3 pounds N}}{\text{833 lbs H2O}} = \frac{\text{X pounds N}}{\text{1 million lbs H2O}}$$

833 X = 2.3 million

X = 2.3 million/833

X = 2761 PPM Nitrogen

Bonus Round !

- Now, for you real sharpies out there, 2761 PPM nitrogen-
- Is what percentage of nitrogen in the solution ?
- Hint : Remember 1 % = 10,000 PPM

$$\frac{1\ \%}{10{,}000\ \text{ppm}} = \frac{X\ \%}{2761}$$

$$10{,}000\ X = 2761$$

$$X = 2761 / 10{,}000$$

$$X = .2761\ \%\ \text{Nitrogen}$$

This form of calculation will also work with pesticides and other products. However, the weights per gallon may be way different. Pesticide ppm calculations are best done using the pounds of active ingredient per gallon information from liquid pesticide labels.