Understanding Sprays in Parts Per Million (PPM)

Introduction

Application rates of crop protection and plant growth regulator products can be given in several different forms on the product label. The most common form is expressed in amount of product per hectare. Another form is a specific amount of product per volume of water. The final form of rate, as discussed below, is in parts per million – or PPM. For the tree fruit grower, amount of product per hectare and PPM cannot be used interchangeably, or unexpected – and potentially costly – results may occur.

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Where PPM Is Common Language

Some crop protection and plant growth regulator products have labels that give recommendations to apply the product at a specific target PPM or within a PPM range. The thinner Fruitone® or NAA is the most commonly used tree fruit product with a PPM label. The antibiotics Streptomycin 17 and Kasumin are other products with labels expressed in PPM. You may also find various other labels that indicate recommendations in PPM.

What is PPM?

Parts per million (PPM) is a measurement of the concentration of a chemical in a solution. In the case of crop spraying, PPM refers to the concentration of these products relative to a water carrier. One (1) PPM is equivalent to one part chemical in 1 million parts – the remainder being water. One hundred (100) PPM is equivalent to 100 parts chemical in 1 million parts – the remainder being water. The higher the PPM, the more concentrated a spray is.

What How Do I Calculate PPM?

The following formulas and examples are useful in determining PPM for spray applications.

How Much Product Do I Need To Add To A Tank To Apply A Given PPM?

The amount of product to add to the spray tank to achieve a target PPM is easily calculated from the following formula (Formula 1) using 3 numbers:

FORMULA 1: AMOUNT OF PRODUCT TO ADD PER SPRAY TANK TO ACHIEVE A DESIRED PPM

$$\text{Amount of Product to Add (mL or g)} = \frac{\textit{Desired PPM} \times \textit{Tank Water Volume (Litres)}}{\textit{Product Concentration (mL/L or g/L or g/kg)}}$$

1. The ***Desired PPM*** - this can be obtained from the product label (Figure 1) or other local recommendations.

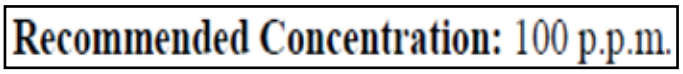

Figure 1: The label for this product recommends using a concentration of 100 PPM.

2. ***Tank Water Volume*** refers to the capacity of the spray tank if a full tank is used OR the amount of water added to the spray tank if a partial tank is used. **MUST BE IN LITRES**!

1 US Gallon = 3.785 Litres; 1 Imperial Gallon = 4.546 Litres

e.g. 400 US Gallons X 3.785 Litres/US Gallon = 1514 Litres

3. The ***Product Concentration*** in mL/L, g/L, or g/kg – also can be obtained from the product label. See the following examples (Figure 2,3,4):

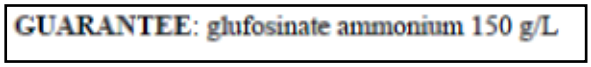

Figure 2: The label for this herbicide product indicates a concentration of 150 g/L.

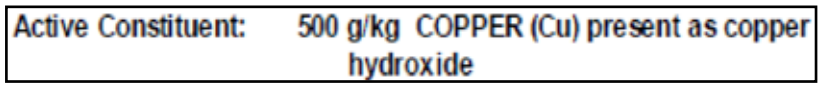

Figure 3: The label for this fungicide product indicates a product concentration of 500 g/kg.

Many products also have a product concentration expressed in percentages. For products that are expressed in percentages (e.g. Fruitone® L), multiply the label percentage by 10 to obtain the product concentration in mL/L for liquid products or g/kg for solid products. In the example below, Fruitone® L has a product concentration of 31 ml/L (Figure 4).

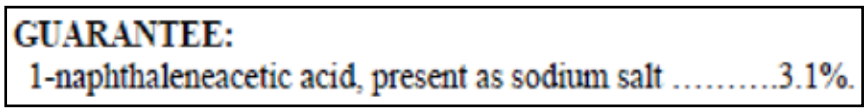

Figure 4: The label for Fruitone® L contains a product concentration of 3.1%. Multiply the percentage by 10 to obtain the product concentration in mL/L for liquid products or g/kg for solid products. As Fruitone® L is a liquid product, the product concentration is 3.1% X 10 = 31 mL/L.

EXAMPLE 1: APPLICATION OF 5 PPM NAA WITH FRUITONE® L USING A FULL SPRAY TANK OF 2000 L

To calculate how much Fruitone® L to add to a tank for a 5 ppm application we can use Formula 1 from above.

What is known:

1. The desired PPM is 5.
2. The spray tank capacity is 2000 L and a full tank is used.
3. The product concentration of Fruitone® L is 31 mL/L (see Figure 4 for explanation).

The following calculations can now be made:

$$\text{Amount of Product to Add (mL or g)} = \frac{\textit{Desired PPM (5 PPM)} \times \textit{Tank Water Volume (2000 L)}}{\textit{Product Concentration (31 mL/L)}}$$

Amount of Product to Add (mL or g) = $\frac{5 \times 2000}{31} = 10\,000$

Amount of Product to Add (mL or g) = $\frac{10\,000}{31} = 322.6$ mL

Answer: If 322.6 mL of Fruitone® L is added to 2000 L of water, the resulting tank solution will be 5 PPM NAA. Regardless of how much spray volume is applied per hectare or acre of orchard, the solution applied will always be 5 PPM.

What PPM Did I Spray?

Formula 1 above can also be rearranged to calculate the concentration of a spray applied in PPM (Formula 2). To use the formula the following needs to be known: the amount of product added to the spray tank (in mL or g), the product concentration (same as number 3 in Formula 1), and the water volume in the spray tank (same as number 2 in Formula 1; **MUST BE IN LITRES**!).

FORMULA 2: PPM OF APPLIED SPRAY BASED ON PRODUCT ADDED, PRODUCT CONCENTRATION, AND WATER VOLUME IN THE SPRAY TANK.

Applied PPM = $\frac{\textit{Product Added} \text{ (mL or g)} \times \textit{Product Concentration (mL/L or g/L or g/kg)}}{\textit{Tank Water Volume (Litres)}}$

EXAMPLE 2A: GROWER 1 APPLIES 1087 ML OF FRUITONE® L IN A FULL TANK WITH A CAPACITY OF 3370 L OF WATER

To calculate what PPM this solution would make, Formula 2 may be used:

What is known:

1. A total of 1087 mL of Fruitone® L was added to the spray tank.
2. The product concentration of Fruitone® L is 31 mL/L (see Figure 4 for explanation).
3. A full spray tank was used with a capacity of 3370 L.

The following calculations can now be made:

Applied PPM = $\frac{\textit{Product Added (1087 mL)} \times \textit{Product Concentration (31 mL/L)}}{\textit{Tank Water Volume (3370 L)}}$

Applied PPM = $\frac{1087 \times 31}{3370} = 33\,697$

Applied PPM = $\frac{33\,697}{3370} = 10.0$

Answer: If 1087 mL of Fruitone® L is added to 3370 L of water, the resulting tank solution will be 10 PPM NAA. Regardless of how much spray volume is applied per hectare or acre of orchard, the solution applied will always be 10 PPM.

EXAMPLE 2B: GROWER 2 APPLIES 1087 ML OF FRUITONE® L IN A PARTIAL TANK OF 1123 L OF WATER.

To calculate what PPM this solution would make, Formula 2 may be used:

What is known:

1. A total of 1087 mL of Fruitone® L was added to the spray tank.
2. The product concentration of Fruitone® L is 31 mL/L (see Figure 4 for explanation).
3. A partial tank containing a water volume of 1123 L is used.

The following calculations can now be made:

$$\textit{Applied PPM} = \frac{\textit{Product Added (1087 mL)} \times \textit{Product Concentration (31 mL/L)}}{\textit{Tank Water Volume (1123 L)}}$$

$$\textit{Applied PPM} = \frac{1087 \text{ X } 31 = 33\,697}{1123}$$

$$\textit{Applied PPM} = \frac{33\,697}{1123} = 30.0$$

Answer: If 1087 mL of Fruitone® L is added to 1123 L of water, the resulting tank solution will be 30 PPM NAA. Regardless of how much spray volume is applied per hectare or acre of orchard, the solution applied will always be 30 PPM.

Why Shouldn't I Use A Rate Per Hectare (or Acre) With PPM Recommendations?

As PPM is a concentration, it is directly proportional to the amount of water in the solution (i.e. the spray tank). The PPM of a spray tank is fixed the moment you stop adding additional product or water to the tank. After the solution is mixed, the PPM of the solution applied will ALWAYS be the same! Switching nozzles on or off or swapping nozzles for more or less output will not change the PPM of the application after the solution is mixed.

What impact could this have? The potential impact can be illustrated using Example 2a and 2b. If a grower has a recommendation to apply a rate of 1087 mL of Fruitone® L in a thinning spray per hectare and does not adjust the amount of product for water volume, two very different results can occur:

> Grower 1 is spraying 30-year-old seedling trees and would like to use 10 PPM NAA. They read a rate of 1087 mL of Fruitone® L per hectare for 10 PPM. Grower 1 uses a full tree-row canopy volume of water given the large size of the trees amounting to 3370 L per hectare (equal to 300 imperial gallons per acre). Grower 1 applies NAA at 10 ppm (see Example 2a).
>
> Grower 2 is spraying 10-year-old Honeycrisp/M.26 trees and would like to use 10 PPM NAA. They read a rate of 1087 mL of Fruitone® L per hectare for 10 PPM. Grower 2 uses less volume, given the smaller size of the trees, amounting to 1123 L per hectare (equal to 100 imperial gallons per acre). Grower 2 applies NAA at 30 ppm (see Example 2b).

As in the example of Grower 1 and Grower 2, the actual applied PPM can vary by several fold if rates per hectare are not adjusted for water volume. The reaction to a thinning spray of 10 PPM compared to 30 PPM NAA will no doubt be quite different depending on the time of application.

What Should I Do To Spray Products in PPM?

1. Avoid using straight rates per hectare for products expressed in PPM.
2. Calculate how much product to add to the spray tank based on desired PPM and tank water volume.
3. Spray as you normally would, adjusting nozzles for smaller/larger trees, and ensuring proper coverage, and you will always be applying at the desired PPM.

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May 2015