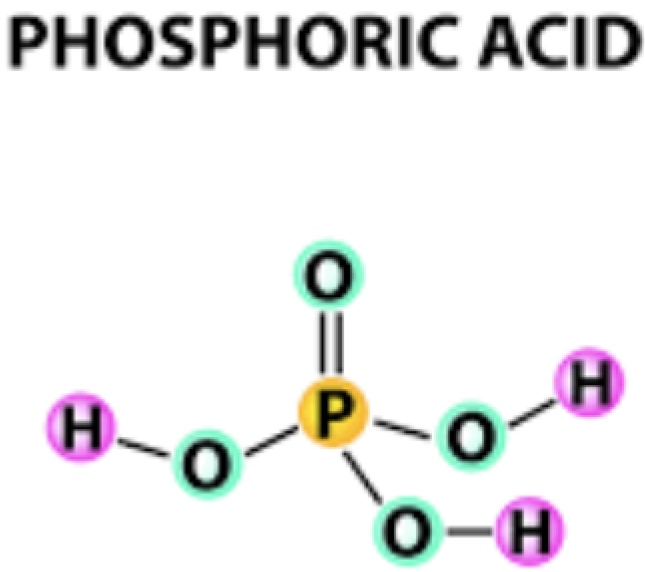
How much Phosphorous are you adding to your solution to adjust pH?

Phosphoric acid is one of the most commonly used pH down agents in hydroponics. This is because phosphoric acid is available in high purity, is easier to handle and has lower cost. However, phosphorous is a significant plant macro-nutrient as well, and substantially changing the level of available P in a nutrient solution can have negative effects on plant growth. Since many hydroponic users – especially those that use hard water sources – might be adding significant amounts of acid to correct their pH level, it is important to estimate how much phosphorous you're contributing to your solution by adjusting pH and whether this means you also need to adjust your formulation to use less P within it.



Schematic representation of a phosphoric acid molecule.

Phosphoric acid is generally available in concentrations from 30 to 80%, most hydroponic users will use pH-down solutions that are in the 35-45% range, which are prepared to be concentrated enough to last a significant amount of time while diluted enough to allow for easier handling and to be less corrosive. You can use the equation given above to calculate the P contribution in ppm from a given addition of phosphoric acid (you can look up the density for a given concentration using [this table](#)). Adding 1mL/gal of 45% phosphoric acid will contribute around ~48 ppm of P to your nutrient solution. This is a very large amount of P considering that the normal range for flowering plants is between 30-60 ppm.

Having an excess of P can be very problematic as phosphorous can strongly antagonize certain nutrients, especially if the pH of the solution drifts up as the plants are fed. At P concentrations exceeding 120 ppm, this element can start to antagonize elements like Fe, Ca and Zn very strongly, preventing their absorption and leading to plant issues. Furthermore, excess of P can often cause problems with P absorption itself – as it can become locked up inside the plant as Fe or Ca salts – which can lead to P deficiency-like symptoms. The most tricky thing about P toxicity issues is that they do not show as certain characteristic symptoms, but mostly as deficiencies for other nutrients or even P itself. The exact symptoms will depend on the VPD and particular environmental conditions as these play an important role in Ca absorption as well.

> *P contribution in ppm = (Acid concentration in % / 100) * 0.3161 * (volume of addition in mL) * (density of acid in g/mL) * 1000 / (total volume of solution in liters)*

Many growers will indiscriminately add P without considering how much was required to adjust pH, which is a bad idea due to the above reasons. A water source that is very hard might require almost 1mL/gal to fully adjust the solution to the pH range required in hydroponics, if a normal hydroponic solution is fed – which will contain all the necessary available P (assuming the user adds very little outside of it) – then this means that the final solution might end up with P levels that will strongly antagonize several nutrients. It’s therefore no wonder that many hydroponic growers in harder water areas suffer from consistent issues with Ca and Mg, many of these cases could be caused by the presence of excess P within nutrient solutions. *While many hydroponic hard-water formulations will adjust for Ca and Mg in hard water, they will generally not adjust for P as they cannot know for certain how the user will lower the pH.*

If you’re a hydroponic grower using phosphoric acid, keeping track of how much P you’re adding to your nutrient solution to adjust pH is going to be very important. If you’re adding more than 0.25 mL/gal of 45% phosphoric acid – of course adjust accordingly for higher/lower concentrations – then you should consider adjusting your hydroponic formulation to account for this expected P addition and prevent your formulation from reaching abnormally high levels of P.