

Phosphorous Acid Derivatives for Control of Pythium, Phytophthora, Fusarium and other Disease Causing Fungi in Hydroponics and other Cropping Situations.

Nomenclature: Names and spellings of the acids and salts of phosphorus are often confused. The following defines the correct names of these products.

Phosphorus is the name of the element from which several acids are derived.

Phosphorous acid derivatives, as used in these notes, refers to mixed mono and di potassium salts of phosphorous acid (aka. **phosphonic acid**). The most common formulations contain 40% (400g/L) active ingredient expressed as the content of the parent phosphorous acid. Some higher concentrated formulations are also available. The potassium salts of these acids are named **phosphites**. They have fungicidal activity and are slowly converted, by oxidation, to phosphates that are plant nutrients.

Phosphoric acid salts are named **phosphates**. They have no fungicidal activity. **Phosphoric acid** is used in hydroponics in winter to maintain an acid pH and supply phosphorus required by all plants. This acid is different to **phosphorous** acid.

Derivatives of both acids may be used as plant nutrients. Phosphoric acid salts (phosphates) are commonly used fertilisers and are readily and quickly taken up by plants. Phosphorous acid salts are not used as such by plants but become slowly available, following oxidation, to the phosphate based nutrients used by plants.

Phosphorus is not found as the element in nature but it is an essential component of all living organisms appearing in nature in 'rock-phosphate' and many forms derived from plants and animals.

Some years ago a French product, Alliete™ was marketed as a wettable powder for disease control on a number of ornamental and more recently fruit crops including Avocados. The active ingredient of this product is an aluminum salt with a common name of **fosetyl**. It was one of the first derivative of **phosphorous** acid. A number of other phosphorous acid derivatives are now available in New Zealand and are widely used as systemic fungicides and nutrient 'tonics' for a wide range of crops. The products may be labeled as either pesticides or fertilisers.

There are two groups of biologically important acids that are formed by phosphorous. One group, of three acids, are known as the **phosphorous acids**, sometimes called **phosphonic** acids. In water the orthophosphorous acid (H_3PO_3) is mainly present. The **mono and di potassium salts** of this **phosphorous acid** are used in horticulture as fungicides and are available from Pure Hydroponics Ltd as the liquid **Phos 400™**. These materials are slowly changed to phosphates in the plant.

The second group of three acids are known as **phosphoric acids**, and again it is the orthophosphoric acid (H_3PO_4), that occurs commonly. Salts of this acid are known as **phosphates** that are used as fertilisers in horticulture (superphosphate etc.) and as phosphoric acid used in hydroponics systems in winter.

It is important not to confuse the derivatives of these two acids since they have two very different activities and uses in horticulture.

Phos 400™ contains 40% active ingredient (expressed as acid) and is said by some to enhance a plant's ability to resist disease. It is an effective fungicide against *Pythium*, *Phytophthora* and *Fusarium* fungi and suppresses many other fungi. It has no adverse effect on the biologically active *Trichoderma* fungi and therefore can be used in conjunction with formulations of this biological control agent. It has an established MRL that enables it to be used on many crops according to good agricultural practices.

Symptoms of Infections.

Pythium and Phytophthora root and basal rots result in the death of the major roots of the plants. Pythium infections are often yellowish while Phytophthora is coffee brown. Regeneration of roots may occur but often root area is inadequate in the heat of the day and plants wilt but may temporarily recover overnight. Fusarium infections are pinkish. Hormone like leaf, stem and flower deformities may occur from minor root infection.



Pythium root infection. Advanced symptoms. Sever wilting of crop seen in hottest period of the day.



Typical symptoms of infected roots. Tap root often rotted off. Early root infections are yellowish brown.

Methods for use:

General crop spray: Apply at 250ml/100L with the spreader Latron B1956™ at 12-25ml/100L. (See ™ note, bottom of p3.) May be mixed with many pesticides. Not compatible with coppers or Oxine™. The combinations will burn plants. Readily translocated up and down in the plant and may be applied every 14 days if fungal problems, including the above mentioned fungi, are present. Slowly oxidised to phosphate which is active in the plant. The formulation is also a useful source of potassium. Effective for late blight control on potatoes and tomatoes. May be used on vegetables (in NZ) without limits. See labels for tree fruits. Consult if crops exported.

Hydroponics use: To control the above fungi causing root infections use 100ml per 1000L of the nutrient solution. In serious infections the rate for the first addition can be increased up to four fold. Calculate the total volume of solution in the nutrient system (volume in the tank and in circulation) and add the required amount of diluted Phos 400 into the catchment tank. This should be done slowly so that the diluted material is uniformly distributed through the circulating solution. This may be best achieved by suspending a bucket of the diluted material, fitted with a micro-tube, above the catchment tank. Allow the material to run slowly into the tank over the period that it takes the pump to circulate the total volume of dilute nutrient through the system. Repeat additions every 3-4 weeks or every 14 days if there is a root infection present. Use similar methods for run-to-waste setups ensuring that the total application is applied in one irrigation cycle.

Compatible with diluted nutrients (e.g. cF 8-30). Not compatible with Oxine™ or ozone. Do not add to the concentrated A and B nutrient tanks. Unpredictable results may occur and its efficacy is likely to be lost. If used in an injection system, add down stream from the point where the concentrate solutions are added and mixed. Add in a single dose based on the volume of circulating solution required to achieve the recommended dose rate.

In addition it is an advantage to apply foliage sprays (details above) in between the additions to the nutrient solutions. In serious root infections one or other of these treatments can be applied at weekly intervals.

Soil and Media Uses: As in hydroponics, these materials may be applied to media and soils to limit diseases caused by the listed fungi. Control using 100-400ml/1000L as a drench and apply

at least 4mm/sq m. Avoid excessive rates since soil structure can be adversely affected and high rates are not required for control of the fungi. Also apply the sprays recommended above.



Examples of Fusarium Infections :

Left. Gloriosa showing typical distorted growth resulting from infection, shown on the tuber below.

Top Centre and Right. Freesia with foliage symptoms and pink mycelium of the Fusarium infection on the tuber.

Lower Left: On Tulips - Pink infected roots, 'scorch' on the flower bud resulting from the infection on a few roots.

Lower Right: Fusarium root infection on Lisianthus

Important Notes:

The diseases mentioned above are readily introduced into new plantings by gnats, shore flies and similar insects. Effective control, including the use of the above materials, must also be accompanied by the control of these insects that carry the fungi inside greenhouses from nearby flooded areas, ditches and ponds where they breed. In some places these flooded areas, that may result from green house activities, can also be drenched at monthly intervals, with Phos 400.

TM Aliette is the Registered Trade mark of Bayer.

TM Latron B1956 is the Registered Trade mark of Dow AgriSciences (NZ) Ltd for a non-ionic spreader that is stable with Oxine. Avoid the use of 'super' spreaders and untested surfactants.

TM Oxine is the Registered Trade Mark of Bio-Cide International Inc, Oklahoma, USA.