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Title

IMPROVING THE pH OF IRRIGATION WATERS WITH ACIDIC FERTILIZERS

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Introduction

Many irrigation water sources have high contents of calcium, magnesium and bicarbonates (hard waters), the reaction of the water is alkaline with pH values between 7.2 and 8.5 (Mengel, 1994).

The interaction of these waters with fertilizers can cause diverse problems, such as formation of precipitates in the fertilization tank and clogging of the drippers and filters. The bicarbonates in the water react with nutrients in the water, such as calcium or magnesium, causing precipitates to block irrigation emitters, micro-sprinklers, and fittings in lines (Pitts et al, 1990).

Clogging is especially critical for drip systems that must be kept free from suspended solids and microorganisms that plug the small orifices in the emitters. Clogged emitters and sprinklers result in variable water distribution during irrigation and uneven fertilizer application during fertigation. Variable water or fertilizer application hinders uniform crop development, reduces yields, and jeopardizes quality. For growers to effectively use micro-irrigation technology, they must prevent clogging of drip lines and emitters (Nakayama and Bucks, 1991).

In addition, the bicarbonate ion can be toxic to plants, but more importantly, it interferes with other nutrients and makes them less available to plants. The main problem concerns phosphorus application: the presence of high concentrations of calcium and magnesium and high pH values lead to the precipitation of calcium and magnesium phosphates and carbonates. The resultant precipitates are deposited on pipe walls and in orifices of drippers and can completely plug the irrigation system.

At the same time, P supply to the roots is impaired. pH values for optimal availability of all the nutrients is in the range of 6-6.5. pH determines the phosphorus availability since it affects the processes of precipitation/ solubilization and adsorption/desorption of phosphates. pH also influences the availability of micronutrients (Fe, Zn) and the toxicity of some of them (Al, Mn) (Marschner et al, 1987).

Similar problems are found in calcareous soils (alkaline soils with pH values greater than 7 due to the presence of calcium carbonate, CaCO_3). Phosphorus availability in calcareous soils is almost always limited because the phosphorus is fixed in less soluble compounds in combination with Ca (Sharpley, 1989). In these soils, nutrient availability can be improved by decreasing soil pH.

Water acidification

Acidifying irrigation water is a valuable technique for lowering the pH of irrigation water to aid in creating the optimum soil pH. Optimal pH value of the irrigation solution must be around 6. Beyond adjusting the water pH and maintaining the micro-irrigation lines, acidifying the soil and water has other potential benefits: lowering the pH of the soil often improves availability of phosphorus, calcium, zinc, iron, and other micronutrients on calcareous soils. Acidifying water also helps to improve water penetration and alleviates some of the stress of sodic soils.

Acidifying the irrigation water improves the uniformity of pH in the field and enhances the early establishment and growth of the plants. Repeated application of higher

pH, high bicarbonate water, however, contributes to the general tendency for acidified soils to return to the original, higher pH. Acidification of the water slows the rise in pH of acidified soil and creates a more uniform growing environment for the crop.

Solid acid

Until now, farmers normally add liquid acids (phosphoric acid, sulfuric acid, or hydrochloric acids) to irrigation water in order to reduce water pH. This involves additional treatment with hazardous liquid acids which are difficult to handle and store. Other problematic aspects of liquid acids are the risks of spills and worker exposure (Pitts et al, 1990).

PeKacid™ is a highly acidic (pH=2.2), fully-soluble phosphorus (60% P₂O₅) and potassium (20% K₂O). The use of PeKacid™ replaces the conventional application of phosphoric acid, resulting in an easier, safer and more effective fertilization process. It is an "acid in the bag" product - is a solid acid in dry form, combining the advantages and efficacy of phosphoric acid with the ease and safety of handling a solid crystalline fertilizer. Due to its acidic nature, PeKacid™ has an anticlogging action and enhances nutrients' uptake. No additional treatment with hazardous liquid acids is required any more.

PeKacid™ is specially formulated for fertigation applications in calcareous soils and/or alkaline and hard irrigation water. PeKacid™ provides acidity to neutralize and dissolve bicarbonates, thus avoiding the problem of scaling and clogging of pipes and drippers. The benefits: longer lifespan of the irrigation systems, uniform and efficient distribution of irrigation water and fertilizers, less work needed and reduction in acid requirements. The acidifying effect also increases nutrients availability in the soil solution, thus improving nutrient uptake by the plants.

PeKacid™ is a very efficient acidifier: its bicarbonate (HCO₃⁻) neutralization force is 240, which means that a dose of 240 g PeKacid™ fully neutralizes 1 eq of HCO₃⁻ in 1 m³ water. When used in a concentrated form, PeKacid™ can also dissolve/disintegrate existing carbonate settlements originated from calcium carbonates or calcium and iron phosphates.

Conclusions

PeKacid™ is a new acidic fertilizer for fertigated field crops irrigated with hard waters and/or grown on calcareous soils. PeKacid™ has anticlogging action and acidifying power, providing blockage-free irrigation. It reduces the pH of the irrigation water, which helps to prevent precipitates, keeping irrigation systems clean. Therefore PeKacid™ replaces the conventional application of phosphoric acid, resulting in an easier, safer and more effective fertigation.

PeKacid™ is a solid acid in dry form, combining the advantages and efficacy of phosphoric acid with the ease and safety of handling a solid crystalline fertilizer. PeKacid™ is intended for soil-less as well as open-field horticulture fertigation

applications, and is well-suited for use in blended of fully-soluble fertilizers as a tool for incorporating calcium, magnesium and micronutrients into the mixed fertilizers.

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