Injection of Urea-Sulfuric Acid Fertilizer to Improve Water Quality

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Abstract - *This paper proposes an additional component to traditional fertilizer and irrigation water management. The continuous management of irrigation water pH has been developed over the past two decades in production agriculture. The same principles for its applications are equally important for horticulture and turf management.*

All water used for irrigation contains some dissolved salts. The suitability of water for irrigation generally depends on the kinds and amounts of salts present. All salts in irrigation waters have an effect on plant-soil-water relations, on the properties of soils and indirectly on the production of plants. (Stromberg)[i]

One of the hazards of irrigated horticulture is the possible accumulation of soluble salts in the root zone. Some plants tolerate more salts than others, but all plants have a maximum tolerance. Most plants are more sensitive during early seedling growth and then become increasingly tolerant during later states of growth and development. Ordinary irrigation methods result in some leaching so that the accumulation of salts in the soil is reduced but not eliminated. Before a critical assessment of the salinity hazard of any irrigation water is made, it is necessary to know how much salt a plant can tolerate and how much leaching is needed to reduce the salt in the soil or growing medium to an acceptable level. (Western Fertilizer Handbook)[ii]

Of the salts that may be present in irrigation waters, this paper will focus on bicarbonates and carbonates. These two anions are similar in its adverse effects. Appreciable amounts of carbonate ions can be present only at pH values of 9.5 or higher. The relative amounts of bicarbonates and carbonates present are a function of the pH value of the solution. (Agricultural Handbook No. 60)[iii] All references to bicarbonates in this paper are assumed to include both carbonates and bicarbonates. Bicarbonate is routinely analyzed in water analysis tests. Acids act upon bicarbonates and carbonates, resulting in the formation of carbon dioxide and water, as shown in the following equation, using sulfuric acid: [ivv]

$$2HCO3 + H2SO4 \rightarrow SO4 + 2H20 + CO2$$

Traditional management of horticultural landscapes and lawns are to broadcast soil amendments and/or fertilizers once or twice a year.

Many of the soils in the Western United States are highly calcareous and high in pH. Often irrigation water is high in pH and high in bicarbonates. These irrigation waters are adding salts to the landscape. High pH will restrict the nutrient uptake, depending on the nutrient.

It has been demonstrated that adding urea-sulfuric acid fertilizers, at a controlled rate, on a continuous basis, to achieve an adjusted water pH of 6.5 to 7.0, under the right conditions, has significant response. The landscape maintenance person is required to have a hand held pH meter to monitor the pH. The pH of the irrigation water, downstream of the injection point of the urea-sulfuric acid fertilizer, determines the rate of injection of the fertilizer. The higher the salt content and pH of the irrigation water, a higher rate of injection of urea–sulfuric acid fertilizer is needed, and the results are expected to be more dramatic.

The benefits of continuous injection of urea-sulfuric acid fertilizer include:

- Deeper soil penetration of the irrigation water
- Less surface water runoff
- Decrease of total amount of irrigation water required
- Increased leaching fraction, with more salts leached below the root zone, than what would be leached by water alone
- As the water pH is reduced, the bicarbonates in the water are reduced
- Continuous application of nitrogen as a nutrient, in small controlled amounts
- Continuous application of sulfur as a nutrient, in small controlled amounts
- Continuous application of sulfuric acid to lower the water pH to a neutral pH level
- Urea-sulfuric acid is a relatively safe fertilizer to handle in the event of skin contact

Different ratios of urea-sulfuric acid fertilizers are available, to balance the nitrogen and sulfuric acid ratios, to meet the optimum response of the water and plant nutrient requirements. This liquid fertilizer is available from different fertilizer manufactures and retailers under different trade names.

The systems require back-check protection if the water comes from a public water supply, to assure all interested parties that fertilizer is not backing up and potentially contaminating the upstream water supply.

The fertilizer injection systems have an up-front cost to the user. However, under the right soil and water conditions, and with proper management, the response by the landscape can be dramatic.

[i] Stromberg, Les K., "Water Quality for Irrigation," University of California Cooperative Extension, Fresno County, CA, 1975

[ii] Soil Improvement Committee, California Fertilizer Association, Western Fertilizer Handbook, Second Horticulture Edition, Interstate Publishers, 1998

[iii] Richards, L.A. (editor), USDA Handbook No. 60, Diagnosis and Improvement of Saline and Alkali Soils, 1954

[iv] Gregory, James R., "Uses of Sulfuric Acid as a Water Amendment in Agriculture," Technical Proceedings, International Irrigation Show, San Antonio, Texas, November 4, 2001

[v] Unknown author, "Bicarbonates Bad guy in Western Soil, Water," California-Arizona Farm Press, June 20, 1998