Irrigation Water Guidelines

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Parameter	Definition and Effects on Plant Growth
pH	The degree of acidity (or alkalinity) of the sample. A pH of less than 7.0 is acidic, 7.0 is neutral and above 7.0 is alkaline. This needs to be adjusted (buffered) first, before tank mixing. **5.5 – 6.0 (ideal) provides the best conditions for irrigation & tank mixing.** **> 7.0 can cause tank mix problems.**
Conductivity EC (electrical conductivity) 1 EC unit = 640 ppm	This test is used to determine the electrical conductivity (EC) of the water. The higher the salt content, the greater the flow of electrical current. The lower the level, the more you can tank mix. **< 1.5 desired range.** **> 1.5 potential problem.** **> 3.0 will burn under certain conditions.**
Sodium Adsorption Ratio (SAR)	This is an expression of the sodium hazard of irrigation water. It is the measure of the proportion of sodium to calcium and magnesium in the water. The SAR is also an index of the sodium permeability hazard as water moves through the soil. The main problem with a high sodium concentration is its effect on the physical properties of soil. This breakdown disperses the soil clay and causes the soil to become hard and compact when dry and reduces the rate of water penetration when wet. A breakdown in the physical structure of the soil can occur with continued use of water with a high SAR value. The effects of high SAR on the infiltration of irrigation water are dependent on the EC of the water. Generally, if the SAR is more than 10 times greater than the EC, then poor water infiltration will occur. **< 6.0 desired range (will add Ca to the soil).** **> 6.0 (will strip Ca from the soil); will burn under certain conditions; the lower the level, the more you can tank mix.**
Calcium	The calcium (Ca^{++}) cation is generally found in all natural waters. When adequately supplied with exchangeable calcium, soils are friable and usually allow water to drain easily. This is why calcium in the form of gypsum is commonly applied to improve the physical properties of tight soils. Sodium will be leached from the root zone when the Ca^{++} replaces the Na^{+} on the soil colloid. Irrigation water that contains ample calcium is most desirable. **40 – 120 ppm desired range.**
Magnesium	The magnesium (Mg^{++}) cation is also found in most natural waters. Together with calcium, Mg may be used to establish the relationship to total salinity and to estimate the sodium hazard. **6 – 24 ppm desired range.**
Potassium	The potassium (K^{+}) cation behaves similarly to sodium in the soil and is commonly found in natural waters in only small amounts**.** **5 – 10 ppm desired range.**
Sodium	The sodium (Na^{+}) cation is often found in natural waters due to its high solubility. When linked to chloride (Cl) and sulfide (SO_4), sodium is often associated with salinity problems. High concentrations in the soil can adversely affect turfgrasses. Poor soil physical properties for plant growth will result as a consequence of continued use of water with high sodium levels. **0 – 50 ppm desired range.**
Iron	The Iron (Fe^{+}) cation can be problematic in many irrigation waters. Excess iron can compete with other needed micro-nutrients and can cause staining of walkways or road surfaces. **2 – 5 ppm desired range.**

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Total Alkalinity	Water alkalinity, simply stated, is a measure of the water's capability to neutralize added acids. Related to pH, alkalinity establishes the buffering capacity of water. The major chemicals that contribute to the alkalinity of water include dissolved carbonates, bicarbonates and hydroxides. High alkalinity can cause an increase in the pH of the soil (reducing micro-nutrient availability), the precipitation of nutrients in concentrated fertilizer solutions, and reduce the efficacy of pesticides and growth regulators. **1 – 100 ppm desired range.**
Carbonate	Carbonates (CO_3) are salts of carbonic acid (the acid formed when carbon dioxide dissolves in water), and are found in some waters. An alkalizing effect results when combined with calcium and/or magnesium. This effect is much stronger when it occurs in the presence of the sodium cation. **< 50 ppm desired range.**
Bicarbonate	Bicarbonates (HCO_3) are also salts of carbonic acid and are common in natural waters. As soil moisture is reduced, calcium and magnesium bicarbonates can separate calcium from the clay colloid, leaving sodium to take its place. An increase of SAR in the soil solution will result. The overuse of a high bicarbonate irrigation water can contribute to a soil dominant in sodium, with a resulting reduction in water infiltration rates and soil gas exchange. **< 120 ppm desired range.**
Chloride	Chloride is an anion that is commonly found in irrigation water. Chlorides contribute to the total salt (salinity) content of soils. Necessary for plant growth in small amounts, while high concentrations will inhibit plant growth or be toxic to some plants. Irrigation water high in chloride reduces phosphorus availability to plants. **< 140 ppm desired range.**
Sulfate	Sulfate (SO_4) is relatively common in water and has no major impact on the soil other than contributing to the total salt content. Irrigation water high in sulfate ions reduces phosphorus availability to plants. **< 400 ppm desired range.** **> 400 ppm will acidify the soil.**
Salt Concentration	The total dissolved solids (TDS) or total salt content is measured by determining the actual salt content in parts per million (ppm). A physiological drought condition can result from excess salts accumulating in the soil by increasing the osmotic pressure of the soil solution. Plants can wilt due to insufficient water absorption by the roots compared to the amount lost from transpiration, even though the soil may have plenty of moisture. (TDS = EC x 640) **< 960 ppm desired range.** **> 1900 ppm or (3EC) = increased burn potential & poor tank mix options.**
Boron	Necessary for plant growth in small amounts, adequate boron is found in most waters. Significant concentrations of boron can frequently occur in various water sources; therefore water should be tested to check for toxic amounts. Where concentrations exceed 1 ppm, it may be toxic to turfgrasses. Plant tolerance to boron may improve on soils high in lime, compared to non-calcareous soils. **.2 – .8 ppm desired range.**
Cation/Anion Ratio	Calcium and magnesium levels should always be higher than the sodium and chloride levels. **1:1 ideal ratio.**

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