What's in the Water?
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After an above normal June, much of the state received below average precipitation during July. This increased reliance on irrigation water. Without frequent and heavy rainfall to leach salts from the soil, there is an increased risk of problems resulting from poor water quality. Many turfgrass managers have their water tested, but understanding the values on water test report can be confusing. We'll quickly highlight some of the most important water quality problems, and how to interpret water test reports in order to diagnose and remedy them. We will also discuss the importance of understanding how nutrients in the irrigation water can impact your fertilization program.

Salinity

Salinity is a measure of the salt content of the irrigation water, and is expressed as the **electrical conductivity (ECw)**. Salinity problems arise when salt concentrations build up in the soil to levels that limit water uptake by the plant. Soluble salts may also accumulate on foliage and cause tissue damage. Typical salinity hazard ranges for irrigation water EC are highlighted in Table 1. Different turfgrass species also have different tolerances to salinity; annual bluegrass, colonial bentgrass, Kentucky bluegrass, and rough bluegrass are most sensitive to salinity, while creeping bentgrass and fine fescue species are only moderately sensitive, and perennial ryegrass and tall fescue are moderately tolerant. Salinity problems are most likely to arise during drought periods, when natural rainfall does not leach salts out of the soil. During such drought periods, irrigation can be used to leach salts and effectively treat salinity problems.

Table 1. Salinity hazard ranges for irrigation water

Salinity Hazard	ECw
	dS m^{-1}
Low	<0.75
Medium	0.75-1.50
High	1.50-3.00
Very High	>3.00

Sodicity

Sodicity is a measure of the sodium (Na) content of the irrigation water, and is expressed as the **Sodium Adsorption Ratio (SAR)**, which is a ratio of sodium relative to calcium and magnesium. Sodicity can affect soil permeability. As sodium replaces calcium and magnesium on soil cation exchange sites, clay in the soil becomes dispersed, structure is degraded, pore space decreases, and water infiltration rate declines. Typical sodicity hazard ranges for irrigation water SAR are highlighted in Table 2. Some water testing labs report an adjusted SAR, which attempts to predict future permeability hazards caused by chemical reactions that take place between calcium and carbonate in the water. Adjusted SAR can overestimate the true SAR, sometimes by a factor of two, so it is important to know which value you are interpreting. <u>Sodicity is not a concern for sand-based putting greens because of large sand particles and lack of clay minerals</u>. For finer-textured soils, sodicity problems can be treated by the application of gypsum ($CaSO_4$) followed by leaching. Gypsum supplies calcium to replace sodium on cation exchange sites, and leaching removes this sodium from the soil.

Table 2. Sodicity hazard ranges for irrigation water

Sodicity Hazard	SAR
Low	<10
Medium	10-18
High	18-26
Very High	>26

Concentrations of Toxic Elements

Irrigation water may contain certain nutrients at levels that are toxic to some plants. One of the primary elements that may be toxic in irrigation water is boron (B). Typically, irrigation water should contain less than 1 ppm of boron to be considered safe. Kentucky bluegrass is sensitive to soil boron levels of 2-4 ppm, while other grasses show sensitivity at 6-10 ppm. Sodium and chloride may also pose a toxicity threat in irrigation water, but turfgrass is much less sensitive than ornamentals. These elements may pose a risk when they accumulate on foliage, leading to tissue damage. The best treatment for water containing toxic elements is dilution, which can be accomplished by combing two water sources together, or by using filtering techniques such as reverse osmosis.

What about bicarbonate?

Most water testing labs report the bicarbonate (HCO_3^-) content of the irrigation water, but this term should not be interpreted directly. Despite claims that bicarbonate from irrigation water can reduce permeability, there is a lack of scientific evidence to support this idea. Salts (including bicarbonate) may visibly accumulate at the soil surface during drought periods, but this is most pronounced in high-traffic areas with poor turf density. Visible crusts can form but usually are associated with biotic films on top of the surface such as algae (Figure 1). Maintaining adequate turf density will eliminate this issue, and is a cheaper alternative to treating irrigation water to remove bicarbonate.

Figure 1. A putting green with healthy, dense cover (left) beside a green with poor density (right). Irrigation was identical, but bicarbonate only accumulated where algae and moss was prevalent due to low turf density.

Nitrogen and other nutrients in water

Nutrients such as nitrate-nitrogen (NO_3-N) and potassium are also commonly found on water test reports. These nutrients are considered beneficial because they're a source of free fertilizer. Frequent irrigation with water containing high concentrations of NO_3-N can contribute significant amounts of nitrogen. Water NO_3-N concentrations of 10 or 20 ppm, which is possible in agricultural areas, contribute 0.05 and 0.10 lbs of N/1000 ft^2 with every inch of irrigation applied to the turf. During a dry month such as last July, irrigating with water containing 20 ppm NO_3-N can easily provide 0.4 to 0.6 lbs of N/1000 ft^2. Adjust nitrogen fertilization programs to compensate for NO_3-N in the irrigation water.

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