Understanding Irrigation Water Analysis

by
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TURF LINE NEWS

Irrigation water quality has a profound effect on soil and turf health. Although irrigation water analysis is one of the most important analytical tools available to the turfgrass manager, it is sometimes one of the least understood.

When determining the quality or potential hazard of irrigation water, four categories are considered:

Salinity Status
Sodium Permeability Hazard
Specific Ion Toxicity
Nutrient Status

Salinity Status

The salinity status of irrigation water is determined by the water's ***Electrical Conductivity (EC)*** and is also expressed as Total Soluble Salts (TSS) or Total Dissolved Solids (TDS). Salts naturally present in irrigation water are dissociated into electrically charged ions. As the concentration of these ions increases, water is better able to conduct electricity. The positively charged cations consist primarily of calcium, magnesium and sodium. The negatively charged anions consist primarily of bicarbonates, sulfates and chlorides.

Soluble salts pose a hazard to turf health if they accumulate in the root zone. As soluble salt levels increase, turf must exert increasingly greater effort to extract water from the soil. Left unchecked, stress and drought conditions will develop regardless of soil moisture levels. Soluble salts are managed by leaching them through the root zone with adequate irrigation and good soil drainage.

An EC of 0.75, or a TSS of 500 ppm, is the critical level of soluble salts in irrigation water. Lower concentrations may be hazardous to salt sensitive plants or on poorly drained soils.

Sodium Permeability Hazard

In terms of affecting soil structure and water infiltration, sodium is the most important type of salt. As sodium base saturation increases, soil particles disperse or "run-together". Consequently, the soil loses its structure, water infiltration rates decline and turf health suffers. The sodium permeability hazard is therefore based on the potential for irrigation water to increase sodium base saturation to a dangerous level.

High sodium irrigation water is the principle cause of a sodium permeability hazard, but other factors contribute to the problem. Bicarbonates and carbonates in irrigation water increase the hazard by reacting with soil calcium and magnesium to form insoluble compounds. By removing free calcium and magnesium from the soil, this reaction creates room for sodium to accumulate. But if irrigation water has sufficient levels of calcium and magnesium, the negative effects from sodium, bicarbonates and carbonates are offset.

The ***Residual Sodium Carbonate*** **(RSC)** formula is a quick test to determine if irrigation

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water can reduce free calcium and magnesium in the soil. RSC is calculated by subtracting the water's calcium and magnesium from its carbonate and bicarbonate. A negative value indicates little risk of sodium accumulation due to off-setting levels of calcium and magnesium. A positive value indicates that bicarbonates and carbonates will reduce free calcium and magnesium in the soil, thereby creating room for sodium to accumulate.

The ***Adjusted Sodium Absorption Ratio*** **(SAR *adj*)** is perhaps the most important formula in determining the sodium permeability hazard of irrigation water. SAR *adj* measures the water's sodium level against calcium and magnesium, while adjusting for the effect from bicarbonates and carbonates. For most soils, a SAR *adj* of less than 6 is satisfactory. Values greater than 6 constitute a potential problem, particularly on poorly drained soils with high clay content.

Increasing free calcium in the soil will amend a sodium permeability problem. This happens because calcium, with a more powerful electrical attraction to soil particles, displaces sodium. Free calcium can be increased on non-calcareous soils with gypsum (calcium sulfate). On calcareous soils that contain insoluble calcium, irrigation water acid-injection or soil applied elemental sulfur are effective treatments.

When assessing the sodium permeability hazard posed by irrigation water, the cumulative impact on soil sodium and calcium is paramount. Contributing factors, such as bicarbonate or carbonate levels, should not be considered in isolation.

Specific Ion Toxicity

Irrigation water contains naturally occurring ions that can pose a toxicity hazard to turf at high concentrations. As a hazardous ion accumulates in the root or shoot zone, the plant will suffer stress and chemical injury. In some instances, direct foliage contact from irrigation water with high levels of these ions can also damage turf.

The ions that most commonly pose a toxicity hazard are **Chloride**, with a critical level of 70 ppm and **Boron**, with a critical level of 0.7 ppm. Sodium toxicity can occur in some circumstances, but soil permeability issues usually arise before toxic levels are attained.

Nutrient Status

Many of the ions naturally present in irrigation water are also plant food nutrients. In an irrigation water analysis, they are expressed as pounds of plant food applied per acre-foot of irrigation water. These nutrient additions can be included in your fertility program by making a simple conversion based on your annual irrigation volume. Understanding your water's nutrient status enables you to spend your fertilizer dollar more efficiently, while protecting the environment from unnecessary nutrient applications.

Conclusion

As outlined in this article, irrigation water analysis is both an important and complex subject. When determining the quality of irrigation water, always have your analysis conducted by a reputable laboratory. In addition, seek the advice of a Professional Agrologist familiar with irrigation water analysis when interpreting the results and deciding if amendments are required.

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