WHAT'S IN YOUR IRRIGATION WATER?

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Water is an essential component of turfgrass management. Understanding what is in your irrigation water may head off problems before they occur. It also might allow you to use the current water source more effectively.

There are five major components of irrigation water quality that should be considered when evaluating a water source. The five major components are:

- Salt content – expressed as electrical conductivity (EC) or total dissolved solids (TDS).
- Sodium hazard – expressed as sodium absorption ratio (SAR).
- Carbonate, bicarbonate, calcium and magnesium content – expressed as residual sodium carbonate (RSC).
- Ions present in toxic concentrations – usually boron and chloride expressed as milligrams per liter (mg/L) or parts per million (ppm).
- Water pH.

Of these five major components of irrigation water quality, salt content is the most common problem.

WHAT ARE SALTS?

Salts are the combination of any negative ion, except hydroxide (OH-), with any positive ion other than hydrogen (H+). Salts may be soluble like sodium chloride (NaCl), calcium chloride (CaCl2) or Epsom salts (MgSO4) or insoluble like limestone (CaCO3) or gypsum (CaSO4). Many of the fertilizers used in turfgrass management are soluble salts. Examples include potassium chloride (KCl), potassium sulfate (K2SO4), urea [CO(NH2)2], and ammonium sulfate ((NH4)2SO4). Soluble salts impede plant growth; insoluble salts do not impede plant growth.

SALT CONTENT

All irrigation water sources contain soluble salts and traces of other materials. Salt content varies by water source. All soils contain salts, primarily calcium and magnesium and in certain situations sodium. These salts originate from minerals weathering to form soil, from irrigation water, and from fertilizers. Soils that contain high levels of accumulated salts are

referred to as saline soils. In areas with abundant precipitation (precipitation > evapotranspiration), saline soils are rare because precipitation leaches (washes) salts through the soil profile. In areas of limited rainfall, or during day periods, it is possible for salts to accumulate at the soil surface due to capillary rise of water and evaporation. Saline problems can develop in any soil if drainage is impaired, water contains high levels of salts, or insufficient leaching occurs.

WATER MOVEMENT IN PLANTS AND SOIL

Water moves in plants and soil due to a water potential gradient. Water moves from an area of higher energy status (less negative water potential) to an area of lower energy status (more negative water potential).

High levels of salts in the soil solution make it impossible for the plant to take up water. In soil, water moves from a wet area (less negative water potential) to a dry area (more negative water potential). Water moves from an area of low salt concentration (less negative water potential) to an area of high salt concentration (more negative water potential). When the salt concentration in soil solution is greater than in the root system of the plant, the plant is unable to take up water. Under these conditions the plant will wilt and eventually die. Wilt and death of the turfgrass plant may occur even though there is ample soil moisture due to the high salt content.

SALINITY HAZARD

Several classification systems have been proposed to interpret the salinity hazard of water. Table 1 contains guidelines that can be used to help determine the salinity hazard of water. If the recommendations you receive from a laboratory regarding a water test are different from that presented here, it may be because they are using a different classification system.

OCCURRENCE OF SALINITY DAMAGE

Salinity problems are most often encountered during periods of heat and drought stress. Heat stress makes the turfgrass plants more susceptible to damage from other stresses. Drought stress means the demand for water by turfgrass plants is high causing superintendents to water nightly.

Each time the turf is watered, more salts are being added to the system. Turfgrass plants take up nearly pure water leaving salts in the soil. When water evaporates it is in a pure form. The net result is the salt content in the soil is increasing. Compounding the heat, drought and salinity stresses is the fact it is very challenging to leach excess salts from the root zone during hot, dry periods.

Table 1. Salinity hazard of irrigation water.

Hazard	Dissolved salt content of water: TDS ppm or mg/L	Dissolved salt content of water: ECw dS/m or mmhos/cm	Leaching requirement
Low – Water with little likelihood that soil salinity will develop.	160	0.25	Some leaching required. This occurs with normal irrigation.
Medium – Water which may have detrimental effects on sensitive plants.	160-480	0.25-0.75	Moderate amount of leaching needed.
High – Water which may have adverse effects on many plants and require careful management.	480-1,440	0.75-2.25	Good drainage required and moderate leaching. Plant salt tolerant species.
Very High – Water generally not recommended for irrigation.	>1,440	>2.25	Excellent drainage required and excessive leaching needed. Salt tolerant species required.

SYMPTOMS OF SALINITY DAMAGE

Turfgrasses growing in situations where high levels of soil salinity and irrigation with a water containing salts are common, several problems may occur. These problems are usually not uniform across the golf course. Specific symptoms may include:

- Reduce the number of seeds germinating.
- Delay rate of seed germination.
- Blue-green or gray-green color of established turf. The appearance is the same as drought stress. In this case the drought is physiological, the plant cannot take up enough water, rather than a lack of moisture in the soil.
- Leaf tips will turn brown and die.
- Density of turf decreases.

WATER MANAGEMENT WITH SALT AFFECTED WATER

1. Improve Drainage

In any situation, if the soil does not drain well a potential salinity problem may exist. An excellent first step in dealing with saline soil is to establish good drainage. This may include aerification to reduce soil compaction and improve infiltration of water, cultivation to break up layers in soil that impede water movement, and the installation of drainage systems. Soil modification to create high sand content root zones with excellent drainage is a long-term solution to dealing with an undesirable salt content in water.

2. Leach Excess Salts

Applying extra water above the turf requirements can be used to leach excess salts out of the root zone. The goal is to maintain a salinity level in soil that is not increased through salts added by irrigation and yet can support turfgrass growth. Keep in mind that turfgrasses take up nearly pure water from the soil solution. Each irrigation adds more salt, particularly when using a water with a high salinity level. In most cases, it is not practical to greatly lower the salinity level of the soil unless abundant supplies of good quality water are available.

3. **Plant Salt Tolerant Grasses**

Species and cultivar selection should be made carefully when establishing turf in areas where saline water or soil may be a problem. In terms of species, creeping bentgrass has good salt tolerance, perennial ryegrass and tall fescue have moderate salt tolerance, Kentucky bluegrass has poor salt tolerance, and annual bluegrass has very poor salt tolerance. Cultivars within a species have a wide range of salt tolerances. Therefore, cultivar selection is very important when dealing with water that contains higher levels of salt than desired.

4. **Blending Water**

A poor quality water with a high EC can be improved by blending it with a better quality water. The blending can be accomplished by pumping the two sources of water into a lake or pond and allow mixing to occur. The resulting mixture of water may then be used to irrigate the turf site. When blending water it is important to remember that the quality of the poor water will improve in proportion to the volume of high quality water added. If equal volumes of two water sources are added together, the EC mixture will be the average of the EC values for each water source. A water test should be conducted on blended water to be certain of salinity level.

5. **Irrigate More Frequently**

To offset the increased salinity level of soil and thus the reduced water availability to the turf, it may be necessary to irrigate more frequently to maintain a higher soil moisture level. This approach is a short-term solution. It may be useful in situations where leaching of salts occurs naturally during rainy periods and frequent irrigations would be needed in dry periods when salts tend to accumulate. This strategy may work where it rains every week or two.

6. **Irrigation System Modifications**

Separate irrigation systems can be installed. One system using low salinity water can be used for high priority areas such as putting greens where a turf species with a low salinity tolerance is planted. A second system using high salinity water can be used for the rest of the course where a high salinity tolerant species is planted. Obviously, this is an expensive undertaking but provides a long-term solution.

It is possible to produce high quality stands of turf using a water source higher in salts than desired. The first step is to collect a water sample for testing. Once you know the extent of the salinity problem, a comprehensive strategy can be implemented for using the water source while still meeting the demands for the turf site. The strategy developed should emphasize good drainage and regular leaching of salts. There is no substitute for these two practices when dealing with a water with a salt content higher than desired.