THE QUALITY OF IRRIGATION WATER: A FACTOR NOT TO BE OVERLOOKED

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Few superintendents take into consideration the quality of the water they use for irrigation purposes. Yet, poor quality water weakens the quality of turfgrass. It only takes a few basic tests to identify such a problem. You only have to collect a water sample directly from the sprinklers and send it to a laboratory.

The selection of a water source for irrigation purposes should be related to the type and concentration of inherent substances therein dissolved or in suspension. It also depends upon the physical and chemical soil characteristics. Some water sources are pure, but others contain high ratios of salts, microorganisms and other residues. They could directly harm the turfgrass or affect the soil properties and thus cause indirect problems.

The major elements that influence the quality of water are :

- the total concentration of soluble salts;
- the relative proportion of sodium, bicarbonate, calcium and magnesium;
- the amount of boron in water.

Essentially, all irrigation water sources contain dissolved salts. Many of these salts promote the growth of turfgrass, but some can be phytotoxic. Water quality is based upon the amount of soluble salts it contains.

Acceptable quality : the soluble salt concentration is between 100 and 1000 ppm.

Unacceptable quality : : the soluble salt concentration is over 2000 ppm.

A soluble salt concentration over 2000 ppm can be detrimental to the growth rate of new turf shoots. It is recommended to irrigate turfgrass with a water source containing no more than 800 to 1000 ppm of soluble salts, unless the soil is exceptionally leachy and the subsoil is well drained.

The Table below shows an irrigation water classification proposed by the United States Department of Agriculture (USDA). The degree of salinity is expressed in terms of electrical conductivity, which is easy to calculate with non-expensive measuring instruments (the more salts in the water, the higher is the conductivity).

Class Electrical conductivity (EC) Salinity value

Class 1 (C1) 250 m S/cm Low

Class 2 (C2) 250 m S/cm to 750 m S/cm Moderate

Class 3 (C3) 750 m S/cm to 2250 m S/cm High

Class 4 (C4) Over 2250 m S/cm Very high

A 750 m S/cm EC value is the approximate limit in terms of turf growth without having to apply special salinity treatments, including particular cultural practices. On the other hand, an EC value of less than 400 m S/cm is considered effective for the growth of most turfgrass species.

Water with a Class 2 electrical conductivity can be used to irrigate well-drained soils and turfgrass not too sensitive to salts. C3 water should not be used for poorly drained soils. In addition, it should not be used with salt-sensitive plants, even in well-drained soils. Class 4 includes water sources unsuitable for irrigation.

All turfgrass species are not sensitive to the same extent to saline soils. Kentucky bluegrass, colonial bentgrass and red fescue are highly sensitive, while tall fescue and perennial ryegrass are less sensitive.

Sodium

Among salts being dissolved in water, sodium (Na) must be taken into careful consideration. High sodium concentrations can be harmful to turfgrass as it changes the physical properties of the soil.

Sodium concentration in irrigation waters cannot be analyzed on a solo basis. Indeed, the influence of sodium depends on the concentration rate of calcium and magnesium. Also, instead of sodium concentration, we should refer to a value that takes into account the combined effects of sodium, calcium and magnesium. Such a value is referred to as the sodium absorption ratio (SAR) by the soil.

The SAR is used to classify the risks associated with sodium in irrigation water sources. Water with a SAR over 10 will accumulate sodium in the soil. Sodium affects the deflocculation of a clay soil, thus decreasing its noncapillary porosity (air porosity) and its water infiltration rate. Such effects on the soil structure are particularly harmful on intense traffic turfgrass.

Using the SAR, irrigation waters can be divided into four classes. Such classification is primarily based upon the sodium effects on the soil physical conditions.

Class Sodium absorption ratio (SAR) Sodium rate

Class S1 10 and less Low

Class S2 10,1 to 18 Moderate

Class S3 18,1 to 26 High

Class S4 Over 26,1 Very high

Class S1 - this type of water can be used on virtually any soil and the risk of accumulating sodium at a harmful level is minimal

Class S2 - the risk of accumulating sodium at a harmful level is rather high on fine textured soils with a high cation exchange capacity (CEC). However, this type of water can be used on sandy soils with good permeability.

Class S3 - this type of water can accumulate harmful sodium rates in virtually all types of soils. Soil amendments such as gypsum can be required to exchange sodium ions. Also, drainage practices must be performed more often.

Class S4 - this type of water is generally inappropriate for irrigation purposes.

Chlorides and sulfates

When present in irrigation waters, these elements increase soluble salts concentration. Excessive chloride and sulfate concentrations can cause leaf scorches on the grass and even kill it. Concentrations between 250 and 400 ppm are not recommended for the irrigation of salt sensitive plants. Fortunately, chloride and sulfate salts can be rapidly dissolved. Thus, they can be leached into well-drained soils.

Boron

Boron (B) is a trace element essential for the plant growth, but only required in small quantities. Boron is water soluble and it can be found in several irrigation water sources. When its concentration in water exceeds 1 to 2 ppm, boron can be toxic for turfgrass. Also, boron tends to accumulate into the soil through chemical complexes which do not leach out very easily.

Bicarbonate

Density of bicarbonate ions (HCO_3^-) in irrigation waters should also be assessed. Higher rates of bicarbonates cause calcium and magnesium precipitation, which increases the SAR. Water is inappropriate for irrigation purposes when the residual concentration of $NaHCO_3$ is over 2,5 mEq/L. However, with a concentration of less than 1,25 mEq/L, the water is likely safe to use.

Other elements to be taken into account

Other trace elements, such as chromium, nickel, mercury and selenium, can be potentially toxic. Most of them are mainly found in town sewage and industrial effluents.

Several particles, organic or not, can be suspended in water, especially in running water sources. For instance, algae in irrigation waters can cause various problems on putting greens (crusting, black layers). Meanwhile, clay and loam particles can harden the soil surface thus reducing the water infiltration rate. Suspended particles can sometimes wear out, or even break, the irrigation system. In some cases, irrigation water should undergo a filtration process at its very source.

Conclusion

Most problems associated with irrigation waters occur in the long run. Yet, poor-quality water will weaken turfgrass and make it more sensitive to environmental stress and diseases. A qualitative analysis of water based upon the criteria described in this article can prevent many problems making it possible to plan long-range solutions. Water is one of the most important elements in golf course management and it does require a special treatment. Extreme attention must thus be put on any environmental change, such as excavation and drainage activities, the establishment of a new company in the region, smokestack pollution, farm fertilizer spreading, etc. If any doubts subsist, additional analyses must be performed.

References

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Farnham et al, Wastewater Reuse for Golf Course Irrigation, adapted from Westcot and Ayers, 1984.