

Managing Saline & Alkaline Soil: Soil Diagnosis

Managing saline and alkaline soil requires monitoring the salinity content in both the irrigation water and soil. In our last issue, we discussed analysis of irrigation water quality. In this issue, we will discuss the analysis of soils as it relates to determining salt concentration and salt type.

SALT CONCENTRATION: TOTAL SOLUABLE SALTS

As the salt concentration in the soil increases, plants must exert increasingly more effort to extract water from the soil. At some point, the soil will hold onto the water more tightly than the plant roots can extract it. As a result, the soil's ability to supply usable moisture is reduced. If the salt concentration continues to increase, drought symptoms will occur.

Total soluble salt is usually reported as electrical conductivity. As the salt load in the soil increases, the value for electrical conductivity will also increase. Typically, MDS Harris performs two different tests. The first test is a fast and simple procedure. A slurry of soil is made using a 1:1 ratio of soil to water. This procedure is best for determining if the soil has a high salt concentration and monitoring its level from one year to the next. It answers the question, "Is the salt concentration increasing or decreasing over time?"

The second test is the saturated-paste method. This involves adding only enough water to saturate the soil. A coarsely textured soil will need less water than a heavy clay. As a result, this method is more "truly" calibrated to the salt concentration encountered by turf roots. Therefore, the saturated-paste method is best for determining potential salt injury.

The table below shows the interpretations for the two salt determination methods. When looking at salt interpretation tables, it is important know which method is being used because most interpretation tables will just state salt concentration without stipulating the method. As you can see in the table below, the 1:1 ratio is about half of the saturated paste.

Table 1: Two Methods of Salt Determination and Tolerance Rating

Slurry 1:1 Extract mmhos/cm	Saturation Paste; E _{Ce} mmhos/cm	Tolerance Rating
0.01 - 0.45	0.01 - 2.00	Low
0.45 - 1.50	2.01 - 4.00	Low
1.51 - 2.90	4.01 - 8.00	Medium
2.91 - 8.50	8.01 -16.0	High
> 8.50	> 16.0	Very High

Turf grass varieties vary in their ability to tolerate saline solutions. Below is a table representing the relative tolerance of various turf grasses, based on the saturated-paste method.

Table 2: Turf Tolerances to Saline Conditions

Turf Variety	Tolerance Rating	Maximum E _{Ce} Value (Maximum E _{Ce} concentration)
Bermudagrass	Medium	4.00 - 8.00 mmhos/cm
Bentgrass	Medium	4.00 - 8.00 mmhos/cm
Centipedegrass	Medium	4.00 - 8.00 mmhos/cm
Colonial bentgrass	Medium	4.00 - 8.00 mmhos/cm
Behiagrass	Low	2.00 - 4.00 mmhos/cm
Kentucky bluegrass	Low	2.00 - 4.00 mmhos/cm
Perennial Rye grass	Low	2.00 - 4.00 mmhos/cm
Fescue grasses	Low	2.00 - 4.00 mmhos/cm

Note: Salt tolerance is lower during germination. The above table is for established turf, germination would require E_{Ce} values of less than 3.0 mmhos/cm.



This table of maximum salt concentrations assumes average soil moisture conditions are maintained throughout the season. If soil moisture conditions are higher than average, damage will be less. On the other hand, as soil dries out, salt concentration increases along with salt injury. On average, salt concentration doubles as the soil dries from saturation to field capacity. It doubles again as it dries to wilting point. For example, a saturated-paste salt concentration of 3.0mmhos/cm would be about 6.0 mmhos/cm at field capacity and 12.0 mmhos/cm at permanent wilting point.

TYPE OF SALT

The big three soil salts are calcium, magnesium, and sodium in combination with chloride, sulfate, and bicarbonate. The most important salt is sodium because of its potential to destroy soil structure and reduce water infiltration. As the proportion of sodium absorbed in the clay increases, the soil tends to disperse or “run together,” bringing about reduced rates of water penetration. However, soil sodium alone provides little information about the potential effect on soil structure and water infiltration. The dangers of soil sodium are best expressed as a ratio to calcium plus magnesium. Based on this concept, the sodium absorption ratio (SAR) was developed to express the soil sodium danger. SAR above 15 is expected to be more of a problem for a heavy textured fairway soil versus sand built greens because heavy textured soils have low infiltration rates under good conditions.

Soil boron concentrations are rather low in comparison to the other salts, but is important to mention from a toxicity standpoint. Soil boron concentrations below 0.7 ppm are safe for sensitive plants, 0.7 to 1.5 ppm is marginal, and more than 1.5 ppm is toxic to many crops.

CONCLUSION

Soil salinity and alkalinity are best managed by knowing soil salt concentrations and salt type. Interpretation tables for salt concentration and salt type are based on the saturated-paste extract. Soil salinity E_ce values less than 2.0 mmhos/cm are safe for most turf varieties. With E_ce values above 2.0 mmhos/cm, salt damage can be high depending on sensitivity. Salts that contain sodium are dangerous to soil structure and water infiltration. The ratio of sodium to calcium plus magnesium (SAR) reflects the true soil-sodium danger. Soil with SAR above 15 is prone to drainage problems.



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