CHEMICAL LOG

Correcting Saline & Sodic Soil Problems

By Carl Spiva

In order to understand and correct salinity/sodicity problems on any soil, it is necessary to understand a few fundamentals of soils, water and the plants that are grown.

The first order of business is to obtain a good representative soil sample and a sample of the water that is used or expected to be used. On greens, the depth of sampling should be slightly deeper than fertility testing, since non-fertilizer salts generally are somewhat more mobile than other fertilizer elements.

A test consisting of a soil core of zero to eight inches, *minus the grass and accompanying thatch*, from 10 to 15 locations in the suspect area, is recommended. Though the area may be relatively small, such as a golf green, greater sample numbers improve the overall statistical significance so that a truly "representative" sample is obtained. These 10 to 15 cores are combined to form a composite sample.

A water analysis is much easier to obtain; simply fill a clean glass pint jar (preferably) from the source outlet.

An understanding of the mobility of the elements in question is most important. Of the elements we will discuss, sodium is immobile and the most difficult to displace. Boron has moderate absorption and chloride is quite mobile and relatively easy to move.

As a general statement, grasses are more tolerant of salinity than most ornamental plants but bentgrasses, the predominant on greens, have the lowest tolerance of the grasses in the golf course category. They require a salinity of less than four mmhos/cm or dS/m (deciSiemen per meter, a term having exactly the same value numerically; i.e., one mmhos/cm = one deciSiemen/meter). As a goal, the E.C. (Electrical Conductivity, as measured by the above values) should be about 1.5 mmhos/cm (or 1.5 dSm/m). To reduce the salts in the root zone, *drainage is essential!*

Examine the soil profile for clay layers, cemented layers, sand lenses and compaction, or a combination of two or more of these conditions. Physical alteration of the soil profile may be necessary. Once drainage has been eliminated as a possible limiting factor for reclaiming a saline soil, it is simply a matter of applying good quality water to the soil in quantities greater than the plants can use, thereby leaching the soil. In general, for each foot of soil to be leached:

- Six inches of irrigation water will leach out about one-half of the salt.
- 12 inches of irrigation water will leach out about four-fifths of the salt.
- 24 inches of irrigation water will leach out about nine-tenths of the salt.

Good quality irrigation water is also an essential requirement and a good test will reveal answers to our questions concerning:

1. Salinity
2. Permeability
3. Specific ion toxicity
4. Foliar absorption

Sodium is the major culprit in our western soils. It affects soils in two ways. First, it can be toxic to plants if present in sufficient quantity. Second, it can cause permeability problems by deflocculating the soil particles. These potential problems can be predicted fairly well by looking at the S.A.R. values on soil and water tests. S.A.R. is an acronym for Sodium Absorption Ratio: the comparison of the amount of sodium in a soil or water to the sum amount of calcium and magnesium. The higher the S.A.R., the more that problems are likely to occur.

If sodium is high, it must be replaced with calcium and leached from the profile. This can be accomplished in two ways. If there is free lime (calcium carbonate) in the soil, an acid-forming material can be added, which will react with the calcium carbonate to form calcium sulfate. The calcium in calcium sulfate is far more soluble than calcium carbonate and the calcium ion, having a greater absorption affinity for the soil particle, replaces the sodium ion and allows it to be leached out as sodium sulfate.

If there is no free lime in the soil to be reclaimed, there is no alternative except to add soluble calcium. Gypsum is generally the amendment of choice. It might be noted that free lime, along with a great deal of irrigation water, will provide a modest amount of soluble calcium. However, it takes a great deal of time since the free lime is only very slightly soluble in water. This author chooses to rely upon acidifiers and gypsum, depending on whether sufficient free lime is present or not, to achieve good reclamation. For every milliequivalent (230 ppm) of sodium that needs to be replaced, 80 pounds of 100 percent gypsum would be needed per thousand square feet to a depth of one foot. Again, extra water (leaching) is required to provide good reclamation.

If free lime is present in adequate amounts, sulfur materials can be used and for each milliequivalent of sodium needing replacement, 15 pounds would have to be applied per every thousand square feet to reclaim a depth of one foot. Sulfur takes a little longer and depends upon warm temperatures, plenty of water and *finely ground* product, or a product that has plenty of reactive surface (i.e. "popcorn" sulfur and similar materials). Gypsum should be finely ground to be the most efficient and fast acting.

Boron is toxic to plants in high concentrations but can be leached from the soil profile over time. It is intermediate in its mobility and often a modest amount of gypsum will aid in the leaching of boron by assuring good soil flocculation. Many grasses are fairly tolerant of boron but the amount in the soil should be kept to less than one ppm and the water should have less than .5 ppm for optimum growth.

Carbonate and bicarbonate ions in water tend to precipitate calcium and magnesium as calcium and magnesium carbonates and sodium tends to take their places on the exchange complex. This obviously can lead to a problem. For that reason, monitoring of carbonate and bicarbonate in irrigation water is important.

Some success with acidifying irrigation water to about pH 6.0, to keep the calcium and magnesium in solution rather than having the precipitate out, has been accomplished. A simple titration can determine the amount of acid formers that are needed. Some of the new acid fertilizers, applied in the irrigation water, show great promise and their use should increase where alkaline waters and high sodium are problems.

Some caution is in order: Don't apply more than 50 pounds of gypsum per thousand square feet of green or tee at one time, even though the amount needed to do the job requires more than that. Wait a few months, and apply up to 50 pounds if needed, and wait again until the total amount needed is applied. On greens and tees, gypsum (and lime, if an acid soil is treated with it) dissolves quite slowly, and a "sludge" can form at the soil surface if more gypsum is applied than can be dissolved in a few weeks time. Also, the amount of elemental sulfur applied should be restricted to about five pounds per 1,000 square feet per application, with the same waiting period if more is needed to accomplish reclamation. Burning can be a problem under some circumstances if more is applied at one time. ❑

Editor's Note: Carl Spiva is an agronomist and consultant in Modesto, CA.