Salt Injury– An Increasing Problem

by **DONALD D. HOOS**
Western Director, USGA Green Section

Salt inhibits bermudagrass establishment on poor land site.

A PROBLEM OF increasing occurrence in Southern California and other areas of the Southwest is establishing and maintaining turfgrasses in areas of poor soil quality. This is particularly true of establishing grasses in areas of high salt accumulation. More and more golf courses are being built on sites unsuitable for any other purpose. Soil conditions on these sites are usually less than ideal. On the aridsols typically found in the Southwest, many sites used for golf courses are high in clay content with a great deal of calcium carbonate or gypsum present in the form of caliche. The soil pH is usually between 7.0 and 8.0 on these soils. If water used for irrigation is high in sodium, its combination with the aridsols can be a problem.

Problems occur when sodium cannot be leached below the root zone of the grass plant. Poor drainage in these clay soils is often a problem on poor land sites used for golf course construction. Because of the high salt content of both irrigation water and the soil, sodium has a tendency to accumulate at the soil surface. Evaporation rates in the Southwest tend to be high, and this further accentuates salt accumulation at the soil surface.

The use of effluent water for irrigation also adds to the problem of salt accumulation. Because of evaporation during the holding process as water moves from domestic use to the effluent processing plants, sodium levels become more concentrated. Effluent water generally has slightly higher sodium levels than subsurface water used for irrigation. The combined use of poor land sites and effluent water for irrigation of new golf course developments should be carefully screened for identification of salt-related problems.

High salt levels affect turfgrass visually by causing wilting and a blue-green appearance, followed by irregular stunting of growth. Tip burn is often present. An anaerobic layer is often formed in the upper root zone and thatch layer. This layer is typically black in color and exudes a readily identifiable odor. Under these conditions, less oxygen enters the root zone to promote aerobic microbial activity. Growth of roots in this layer is quite difficult, even for bermudagrass.

Drainage

Under high salt conditions, poor quality turfgrass develops in low spots and in poorly drained areas where sodium concentration is greatest. This brings us to the major method in solving establishment and management problems under sodium conditions — drainage and leaching. If drainage can be improved to allow sufficient movement of water through the root zone and to leach accumulated salts, there is a better chance to avoid salt problems. If water can penetrate and move through the soil profile, there is less evaporation near the soil surface and thus less accumulation of sodium in the root zone.

Therefore, one of the first steps toward correcting a sodium problem should be to seek ways of improving drainage in any affected areas. Installation of French drains may be sufficient; other areas may need recontouring to allow surface drainage away from low spots. In some cases, redesign of the irrigation system may be needed. Relocation of sprinkler heads may also be needed to solve a sodium problem in low areas in front of greens. The overlap of green and fairway sprinkler heads in low areas in front of greens often results in accumulation of excess sodium. Often, by moving heads or reprogramming of the irrigation sequence, this problem can be overcome without additional measures.

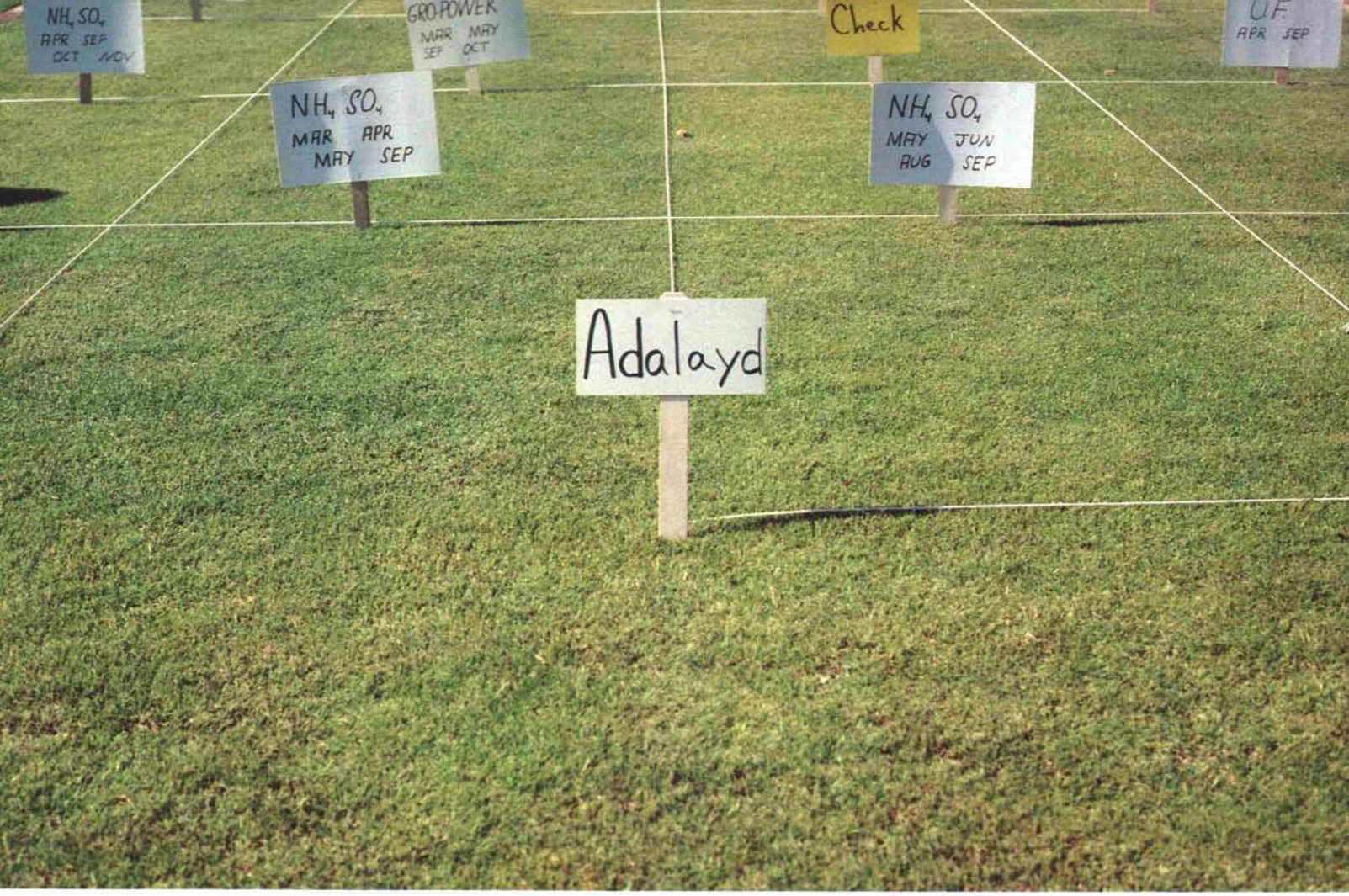
Aeration

Another important process in establishing and maintaining grasses in high sodium areas is to aerate and cultivate affected areas regularly. The coring process relieves compaction and improves water penetration. It also encourages oxygen exchange in the root zone and helps prevent anaerobic conditions from developing.

Amendments

Most of the soils in the Southwest are typically high in calcium. For this reason, many of the soils exhibiting sodium problems do not respond to gypsum applications. In some cases, gypsum will modify the effects of irrigation water high in sodium and the turfgrass will benefit. This is especially true on sand and in putting greens. Acidifying the soil with sulfur or sulfur-containing materials will produce the most dramatic results in solving sodium problems. The sulfur tends to improve the soil's infiltration rate by dissolving calcium carbonates which accumulate on the soil particles and act as plugging agents. Lowering the soil pH as a result of regular sulfur applications also tends

Salt injury on bermudagrass has appearance of being diseased.



New salt-tolerant grasses are being developed.

to make needed soil nutrients, such as iron and phosphorus, more available to the turfgrass plant.

Grass Variety

Choosing the right grass variety for use under high salt conditions is another important consideration. There is no doubt that certain grasses tolerate much higher levels of salt than others. A great deal of research is being directed toward developing grasses that tolerate higher levels of salt than grasses presently available. In the past few years, several new grasses have been released that have a high tolerance for sodium. Fults alkaligrass was released by Colorado State University several years ago. Under cool season grass conditions, it does remarkably well at higher salt levels. Adelaide and Futurf, varieties of *Paspalum vaginatum*, are warm season grasses that also tolerate relatively high levels of sodium. Their appearance and growth habits are similar to common bermudagrass. Research is being conducted at the University of California (Riverside) on these grass varieties to determine the effects of common management practices on their growth and establishment.

Of presently available grasses for use on golf courses, the bermudagrasses have the best tolerance for sodium. Of the cool season grasses, creeping bentgrasses have a higher salt tolerance than perennial ryegrasses or Kentucky bluegrasses. All have a higher salt tolerance than *Poa annua*. Seaside creeping bentgrass has a higher salt tolerance than Penncross.

Relative Salt Tolerance	Turfgrass
Good	Bermudagrass
	Zoysiagrass
	Creeping bentgrass
Medium	Tall fescue
	Perennial ryegrass
Poor	Red fescue
	Kentucky bluegrass
	Colonial bentgrass
	Centipedegrass

Summary

The turfgrass species, soil texture and depth of the salt concentration in the soil profile are all factors than can affect turfgrass growth under high salt concentrations. A high salt concentration impairs the absorption of water and essential plant nutrients. Impaired seed germination and poor vegetative establishment are often encountered when high sodium conditions exist. Physical properties of the soil are also altered when sodium levels are high. Sodium causes deflocculation of the soil colloids. This can lead to a reduction in soil aeration which increases susceptibility to compaction and decreases water infiltration rates.

The best solution to sodium problems is to leach away the excess sodium through improved drainage and increased aeration of problem areas. Soil amendments to acidify the area may be beneficial if leaching of excess sodium can also be achieved.