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 aridsoils 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 aridsoils 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
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 con-
ducted 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 bent-
grasses have a higher salt tolerance than
perennial ryegrasses or Kentucky blue-
grasses. All have a higher salt tolerance
than Poa annua. Seaside creeping bent-
grass has a higher salt tolerance than
Penncross.

<table>
<thead>
<tr>
<th>Relative Salt Tolerance</th>
<th>Turfgrass</th>
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<tbody>
<tr>
<td>Good</td>
<td>Bermudagrass</td>
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<tr>
<td></td>
<td>Zoysiagrass</td>
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<tr>
<td></td>
<td>Creeping bentgrass</td>
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<tr>
<td>Medium</td>
<td>Tall fescue</td>
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<tr>
<td></td>
<td>Perennial ryegrass</td>
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<tr>
<td>Poor</td>
<td>Red fescue</td>
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<tr>
<td></td>
<td>Kentucky bluegrass</td>
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<tr>
<td></td>
<td>Colonial bentgrass</td>
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<tr>
<td></td>
<td>Centipedegrass</td>
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</tbody>
</table>

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 con-
centrations. A high salt concentration
impairs the absorption of water and
essential plant nutrients. Impaired seed
germination and poor vegetative estab-
lishment 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.