Science-Based, Sustainable Solutions To Salinity and Sodicity

A Serious Problem Becoming Worse

If you've dealt with serious salinity or sodicity problems on your golf course, you know how challenging they can be. And you probably also know the underlying causes, such as an increasingly limited supply of high quality irrigation water, will continue to deteriorate.

> ***Every water supply has some salt. Salt is added every time you irrigate. Certain fertilizers leave salt residues. Salt is always accumulating in soils. It becomes a problem when it reaches concentration levels that limit the growth of the turfgrasses you manage.***
>
> – Clark Throssell, Ph.D.
> GCSAA Director of Research
> Lecture on "Salts, Sodium and Bicarbonates" at the Wisconsin Turf Symposium, Kohler, WI, Nov. 2008.

Symptoms of excess salinity and sodicity in turfgrasses are essentially the same as drought stress…bluegreen color, poor root growth, leaf tip death, wilting, lower density on established turf, and much slower establishment if you're seeding, sprigging or sodding. Salinity and sodicity in soils cause physiological drought. Excess salts reduce water uptake and hinder water movement through the soil. Left uncorrected, the turf dies.

Increased Susceptibility to Multiple Stresses

When summer comes with its high temperatures and dry conditions, salt-stressed turf's survival threshold gets progressively lower. It also becomes increasingly susceptible to almost every other kind of stress. So just like the flu can kill people who are already ill or weakened, normally manageable stress can be catastrophic to turfgrass plants weakened by salinity or sodicity stress.

Current Best Management Practices Are Insufficient

If you are currently dealing with emerging or chronic salinity or sodicity problems, chances are you're already employing best management practices like leaching and flushing, blending waters, modifying irrigation systems, and carefully monitoring your levels of sodium and other salts. And if you're not already, you'll soon become an expert on every form of calcium known to man. But you probably also realize your turf needs more help. Although the symptoms ebb and flow, the trend is one way… and it's the wrong way.

Salinity and Sodicity – Serious Problems Requiring Proven Solutions

Salinity and sodicity are serious and complicated problems that are becoming more common for golf course superintendents. They will be made worse by the inevitable increase in the use of high salt content effluent water for golf courses and recreational turf. There is an increasingly urgent and obvious need for proven, effective and affordable solutions. That's what Ocean Organics provides…

Science-Based, Sustainable Solutions to Serious Problems.

Defining The Problems

Salinity and sodicity are related but very different problems.

Salinity refers to all of the salts present in the irrigation water or the growing medium. Typically, the most problematic salts include sodium, chloride, sulfate, carbonate and bicarbonate.

The three main problems with growing turf under salinity stress are (from Carrow and Duncan[1]):

- Reduced water uptake and subsequent "physiological drought."
- Toxicity to root or shoot tissues due to high salt concentrations.
- Ion imbalances leading to nutrient deficiencies of calcium, potassium, nitrate, magnesium, manganese, or phosphorus.

Sodicity refers specifically to the amount of sodium present in soils. Of all the salts, sodium (Na+) is the

[1] Carrow, R.N. and R.R. Duncan. *Salt-Affected Turfgrass Sites: Assessment and Management.* 1998. John Wiley and Sons, Inc.

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"800 pound gorilla." Even relatively low levels of sodium can destroy soil structure. The main problems with growing turf in sodic soils are:

- Poor soil structure caused by sodium-induced dispersion of colloids.
- Poor soil permeability (hydraulic conductivity and infiltration), which hinders water movement into and through the soil.
- Ion toxicity and imbalances in the plant.

An effective solution to high salinity and sodicity on golf courses and athletic fields requires a two-pronged strategy – one targeted at the soil, the other targeted at the plant.

Targeting The Soil

DeSal® is Ocean Organics' salinity and sodicity soil treatment product that addresses the key problems with growing turf under these conditions. Using our proprietary NuRelease® technology, DeSal®

- Decreases sodium and total salt concentrations in the rootzone
- Helps move sodium and total salts out of the rootzone
- Reduces the negative effects of sodium and total salts on turfgrasses
- Releases calcium, critical to effective water and nutrient transport, in the soil.

Calcium released by DeSal® in the rootzone has two functions. It displaces sodium on soil particles allowing the sodium to be more easily and economically flushed out. It also helps to supply the plant roots with calcium, which is known to improve salinity tolerance.

Managing Calcium

Managing calcium in particular is a key component in any well-thought-out strategy to solve sodicity and excess salinity problems. It is without question, the most important and most difficult nutrient to manage for turf professionals dealing with serious salinity and sodicity issues. It's important to note that just adding more and more Ca to the soil is impractical and does not fully solve the problem

While an effective solution to high salinity and sodicity on golf courses and athletic fields requires a two-pronged strategy (one targeted at the soil, the other targeted at the plant), both involve the tactical use of calcium. Among many other benefits that DeSal® delivers is dramatically improved calcium availability and efficiency.

We use our innovative NuRelease® technology to great advantage in our DeSal® soil-targeted salinity-sodicity stress formulation. This proprietary blend of natural compounds mimics the natural sequestering power of exudates produced by healthy roots and soil microbes. These help reduce sodium toxicity in the plant by making calcium more plant available through the roots.

Targeting The Plant

Stress Rx® (introduced originally as Salt Rx™) is an innovative foliar applied material that significantly increases salinity stress tolerance in turfgrasses. It contains unique osmoprotectants in a proprietary formulation that help plants subjected to salinity stress maintain osmotic balance and cell membrane integrity without disrupting enzyme activity.

Salinity Solutions from Sea Plants

One of our key osmoprotectants is glycinebetaine. While our origins are in turf and ornamental horticulture, we also make and market materials for specialty agriculture. Agricultural research shows that glycinebetaine alleviates salt and other environmental stresses. Betaines, including glycinebetaine, are among the many unique constituents we utilize in the seaweeds we process for specialty agricultural and horticultural applications. (Betaines are one of the reasons seaweeds not only survive but flourish in salt water.) We increase our glycinbetaine concentrations in Stress Rx® using other natural sources to enhance the protection to turf under salt stress. Ocean Organics is a pioneer in the transfer of this knowledge from agriculture to turf.

- Osmoprotectants are organic solutes that help plants maintain osmotic balance in their cells during salt stress and protect cells from water loss due to ion imbalances. Relatively few organic solutes can accumulate in sufficient concentrations without inhibiting enzyme activity; glycinebetaine is one of them.
- Enzymes are some of the most important compounds in life. They are absolutely vital for survival of all plants. Glycinebetaine has been shown to maintain the activity of enzymes

in a wide variety of plants under a wide variety of unfavorable conditions including high temperature, extremes of pH, and high salt concentrations (Mickelbart) [2].

- Our research at Rutgers University shows that salt-stressed turf accumulates glycinebetaine when our proprietary foliar materials are applied and that they help maintain osmotic balance.
- Other researchers have proven that glycinebetaine increases the rate of net photosynthesis in salt-stressed plants (Mäkelä et al.)[3].

Sodium Toxicity = Calcium Deficiency

Just as sodium displaces calcium on soil particles and destroys soil structure outside the plant, sodium also displaces calcium in the plant cell membrane with equally destructive results. When sodium displaces calcium in the cell membrane, plant membranes become leaky and compromised. When this happens plants can't effectively transport water and nutrients and photosynthesis degrades. Getting calcium into the plant is critical for turfgrass survival under these conditions. To ensure plant cell membranes are protected, Stress Rx® also contains a foliar source of calcium.

Talk's Cheap. Research Isn't

There are other products claiming to solve salinity and sodicity problems. Few have credible independent research to support their product claims. Even fewer have proof that their products work on turf under play. DeSal® and Stress Rx® have been tested by land grant universities (Rutgers and Virginia Tech) and independent field researchers.

The following statements are printed with the permission of The Corral de Tierra Country Club, The Shadow Hills Golf Club and The Hi-Lo Golf Course Superintendents Association Research Committee. They are summary statements of the results of their research in 2005 and 2008 conducted by Mahady & Associates. Though neither the Association nor the Golf Courses can endorse commercial products, all are committed to sharing research results that may be relevant to their colleagues.

In these trials, DeSal® is NB36820.

"DeSal® (NB36820) was the top performing salt management product out of 7 programs in a replicated field trial conducted by Mark M. Mahady & Associates, Inc. on the Poa annua chipping green at Corral de Tierra Country Club near Monterey, California."

"In a replicated field trial funded by the Hi-Lo GCSA Research Committee and conducted by Mark M. Mahady & Associates, Inc. on fairways at the Shadow Hills Golf Club (Indio, CA), DeSal® (NB36820) exhibited the greatest change in the concentration of critical salt management components* out of nine programs tested…"

*Including EC, soluble salts, exchangeable sodium, extractable sodium, and extractable chloride.

Monitoring And Measuring Product Efficacy

From poa annua greens grown on native soils to Bermuda grass fairways in the desert, **DeSal® outperformed all other materials tested**. Independent field research has shown that DeSal® is highly effective in reducing levels of:

- Exchangeable sodium
- Extractable sodium
- Soluble salts
- Extractable chloride, and
- Electrical conductivity (EC) in both sandy and clay soils.

These are among the most important standards that scientists and turf professionals use to monitor and measure product efficacy in solving salinity and sodicity problems. Used in a well-thought-out salinity and sodicity management program, our products can help you prevent a problem from becoming a crisis.

Ocean Organics…Science-Based, Sustainable Solutions

Contact your Ocean Organics Distributor today, or call us at 800-628-4769, or email bill@oceanorganics.com.

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[2] Mickelbart, Michael. Assessing the contribution of glycinebetaine to environmental stress tolerance in sorghum. From workshop held at International Maize and Wheat Improvement Center (CIMMYT), El Batan, Mexico, June 21-25, 1999.

3 Mäkelä P. et al. Uptake and translocation of foliar-applied glycinebetaine in crop plants. Plant Sci. 121: 221-230.