



Salinity Management in Home Lawns

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Highly saline soil or water can be a major issue in home lawns because of its detrimental effects on the growth, appearance and quality of turfgrass. High salinity can also affect plant health and the ability of plants to take up water. Because of this, turfgrass can experience drought-like effects even if there is an abundance of moisture in the soil, making it difficult for homeowners to diagnose turfgrass decline. This publication builds a basic foundation for understanding common sources of high salinity and its impact on turfgrass in the home landscape. It also offers several management tips for homeowners to help protect and enhance their lawns in spite of high salinity. Since the purpose of this publication is not to explain salinity measurement and analysis, please refer to Oklahoma Cooperative Extension Service publications HLA-6612, "Turf Irrigation Water Quality: A Concise Guide" and L-297, "Interpreting Soil Salinity Analyses" for this information. Similarly, the scope of this publication only includes salinity and is not intended to describe management under sodic or saline-sodic conditions. More information on those conditions may also be found in the previously mentioned publications.

Common Sources of Salinity

Salinity is the amount of salts in soil or water. Many people expect that high salinity only affects water and soil near the ocean. However, areas that are far from the ocean are often plagued by poor water quality in the form of high levels of salts. Salinity in soil naturally occurs in the following ways:

- **Weathering of parent material:** Over time, rocks and minerals break down into smaller particles. This is caused by weathering forces such as wind and water erosion, human activity and degradation by chemicals. As this occurs, salt minerals are released from the parent material into the surrounding soil or water.
- **Saltwater intrusion:** Groundwater aquifers are often at risk of being infiltrated by saltwater. As this groundwater is depleted by natural or human causes, such as over-irrigation, saltwater is drawn into the aquifer. When this happens, the water table is maintained, but the groundwater becomes higher in salinity.

Oklahoma Cooperative Extension Fact Sheets are also available on our website at: <http://osufacts.okstate.edu>

Some groundwater resources in Oklahoma, extracted by home wells, are naturally saline. Saline water has high salt content thus, is low in quality. When Oklahoma homeowners irrigate with this saline water, salt accumulates in the soil. This is due to the fact that after irrigation, a portion of the applied water evaporates, leaving behind the salts. This occurs even if the water is high quality and low in salinity; high salinity magnifies the problem. Since turfgrass is often managed under irrigated conditions, saline water is the most common cause of high salinity problems in Oklahoma lawns.

Impact of Salinity on Turfgrass

Turfgrass salinity problems are mainly related to a decline in turf quality and appearance (Figure 1). Examples of these problems include stunted growth, reduced germination and leaf firing (yellowing/browning and eventual death of the leaves). These symptoms are due to three main physiological problems experienced by plants in saline soils, described below.

Osmotic Stress

As salinity levels increase in the soil, water flows out of the root tissue to balance the high salinity of the soil (Figure 2). A plant's inability to regain water from the saline soil is osmotic stress. This causes the plant to wilt and, in some cases, die as if it were in drought conditions. Physiological



Figure 1. Perennial ryegrass exhibiting decreased turf quality due to saline irrigation water.

provides detailed information about controllers and sensors for smart irrigation management.

- **An irrigation audit:** Maintaining uniformity of water application can be done by conducting an irrigation audit. This can identify areas of the lawn that are receiving too much or too little water. Oklahoma Cooperative Extension Service publication HLA-6610, "Simple Irrigation Audit for Home Lawns in Oklahoma" provides more information on conducting an irrigation audit.

Tip #8: Mow

Mowing reduces salts that accumulate in the leaves if mowing is regular. As the leaves of the grass are trimmed lower, many of the accumulated salts are removed from the plant. Trimming no more than 1/3 (Figure 5) of the turf height per mowing will leave enough leaf area for the turfgrass to remain healthy. Bagging the grass clippings, rather than allowing them to decompose, helps remove the salts from the lawn altogether.

Further reading

For more information on related topics, check out the following Oklahoma Cooperative Extension Service publications at factsheets.okstate.edu:

AGEC-1056: Benefits and Concerns Associated with Aerobic Treatment Systems (ATS)

E-1038: A Guide to Saving Water in the Home Landscape

HLA-6420: Lawn Management in Oklahoma

HLA-6445: Smart Irrigation Technology: Controllers and Sensors

HLA-6604: Thatch Management in Lawns

HLA-6610: Simple Irrigation Audit for Home Lawns in Oklahoma

HLA-6612: Turf Irrigation Water Quality: A Concise Guide

L-249: Soil Testing...the Right First Step

L-296: Understanding Your Household Water Test Report

L-297: Interpreting Soil Salinity Analysis

L-323: Understanding Your Irrigation Water Test Report

PSS-2207: How to Get a Good Soil Sample

PSS-2226: Reclaiming Slick-Spots and Salty Soils

PT 2002-12: Understanding Your Soil Test Report

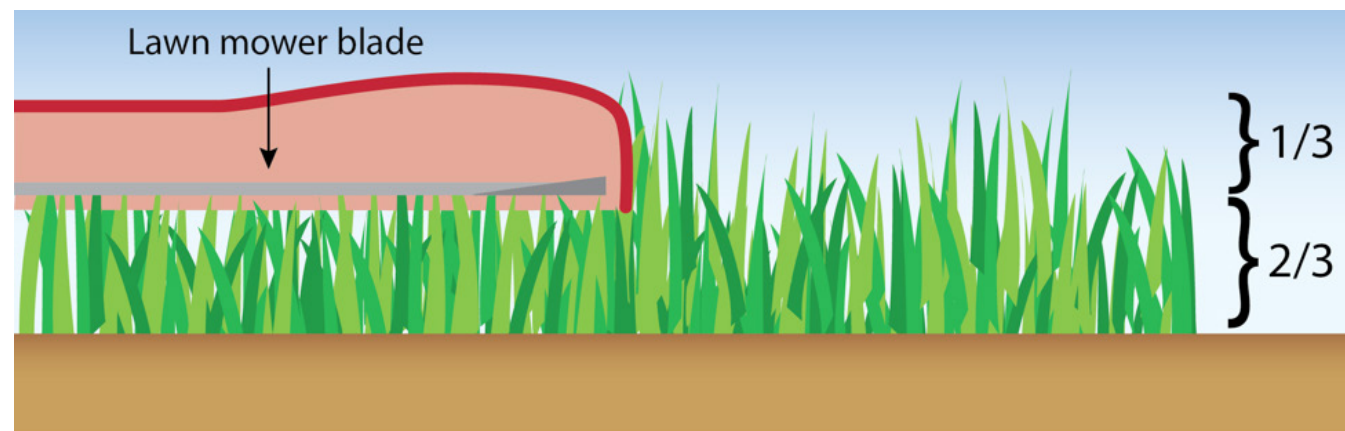


Figure 5. Illustration of the "One-Third Rule" of mowing turfgrass.

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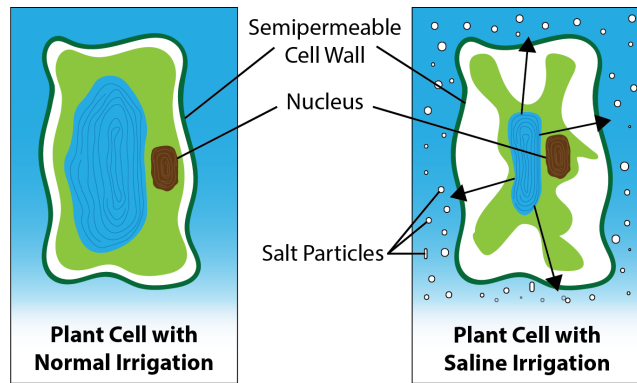


Figure 2. Osmotic stress.

drought is another term for osmotic stress. To compensate for osmotic stress, plants take up salts through their roots, which reduces the difference in solute concentration between plant tissues and the soil.

Salt Accumulation in Plant Tissues

High salinity in soil and water can cause salts to build up to toxic levels within plant tissues unless mechanisms within the plant limit salt intake. Some species of turfgrass, such as bermudagrass, have salt glands that allow small amounts of salt crystals to be excreted from the leaves. However, if saline irrigation water is being applied via overhead sprinklers, salts are likely being absorbed by the leaves as well as the roots.

Reallocation of Essential Nutrients

High salinity affects a plant's ability to adequately utilize essential nutrients. Nitrates, one of the most notable nutrient compounds, are a form of nitrogen that is easily used by plants for growth. However, salinity causes nitrate-use to be reallocated from shoots and leaves to the roots of the plant. At moderate salinity levels, this results in increased root growth, but stunted growth of the plant above ground. This increase in root surface area may be an effort to compensate for the plant's decreased ability to take in nutrients under saline conditions.

Salinity Management Tips

Here are several helpful tips for managing and preventing salinity issues and enhancing lawn health:

Tip #1: Test soil and irrigation water periodically

Many homeowners are familiar with collecting an annual soil sample from their lawn for analyzing the nutrient content of the soil. This is a very useful practice to determine the nutrient composition and soil texture of the lawn and to receive nutrient application recommendations. If salinity is a concern, soil salinity testing can also be conducted through any county extension office in Oklahoma. Also, conducting analysis of the home irrigation water every two to three years can make a huge difference in determining which management strategies to implement based on the quality of the irrigation water being used. Oklahoma Cooperative Extension Service publications HLA-6612, "Turf Irrigation Water Quality: A Concise Guide," L-249, "Soil Testing...the Right First Step Towards Proper Care of Your Lawn and Garden," L-297, "Interpreting Soil Salinity

Analyses;" and L-323, "Understanding Your Irrigation Water Test Report" provide more information on soil and water testing and salinity measurement and analysis.

Tip #2: Leach salts from the soil

Leaching is a management strategy that drains salts from the root zone into lower layers of the soil profile. A saline soil is properly leached when enough water is added to drain the salts out of the root zone and to account for the increased water requirement of the turfgrass under high salinity conditions. The amount of water needed for leaching can be calculated; however, this calculation is highly dependent on the salt concentration in the root zone and the texture, structure and depth of the soil:

- **Soil texture:** Medium to coarse (e.g. sandy-loam) textures allow for a more rapid movement of water through the soil profile. On the other hand, heavy textures (e.g. clay) have slower water movement.
- **Soil structure:** Well-developed soil structures allow for improved water infiltration and movement, while soils with weak or no structure have low water infiltration rates and slow movement.
- **Soil depth:** Deep soil profiles have more pore space and thus can hold larger amounts of leached water. Shallow soils do not have enough space for additional water and waterlogging may occur in these soils. Below the surface of some soils, hardpan—a layer of compacted, impermeable clay—prevents water from passing through lower levels of the soil. This can lead to waterlogging and transporting previously-leached salts back to the turfgrass root zone.

Overall, one important factor to consider is the fate of leached water. In ideal soils, leached water will be filtered through the root zone to layers that will not interfere with the growth of vegetation. For shallow soils or those with a hardpan, artificial drainage needs to be installed at appropriate depths and distances to allow for the collection and removal of leached water.

Tip #3: Use rainfall effectively

Rainwater contains very low salinity. Thus, it can be used effectively to leach salts from the root zone. Humid regions usually receive sufficient rainfall for leaching, whereas dry regions do not, especially during drought. One way to maximize rainfall is to reduce runoff by modifying the slope of the ground or by adding barriers to block or slow down water movement on the surface. This is only beneficial for soils that drain well; otherwise, waterlogging can occur.

Tip #4: Install French drains

As water accumulates on the soil surface, evaporation can leave salts behind. To reduce the amount of standing water, homeowners and lawn care companies can install French drains. French drains (Figure 3) are mesh-covered perforated pipes buried beneath a layer of sand or gravel in problematic areas of lawns. As excess water filters into the pipe, it is then transported from the soil to a discharge outlet. The water must leave the drainage pipe to prevent waterlogging. With the addition of French drains to a salt-affected lawn, drainage and leaching ability is increased. Then, with adequate precipitation or irrigation, it is only a matter of time before excess salt is removed.

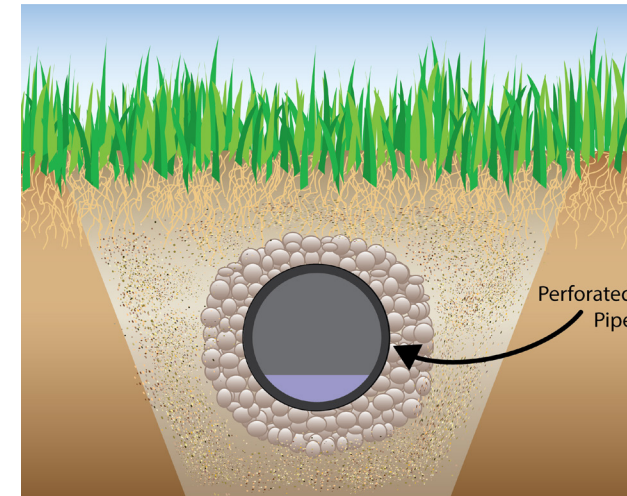


Figure 3. Cross-section diagram of a French drain.

Tip #5: Plant salt-tolerant species

Some turfgrass species tolerate high salinity better than others. Salt-tolerant grasses help manage high salinity in the home lawn; these can be used for future plantings and winter overseeding. There are several salt-tolerant turfgrass species for Oklahoma lawns (Table 1).

Tip #6: Aerify and top dress

Aerification, also known as aeration, is the process of mechanically removing soil cores or creating small holes in the soil (Figure 4). This improves drainage by reducing soil compaction and allowing turf roots to expand. Topdressing an aerified lawn with sand or low-salinity compost fills the holes, which furthers quick drainage and easy penetrability for roots. Many lawn care companies offer aerification and topdressing services to improve overall lawn health and ease existing salinity problems.

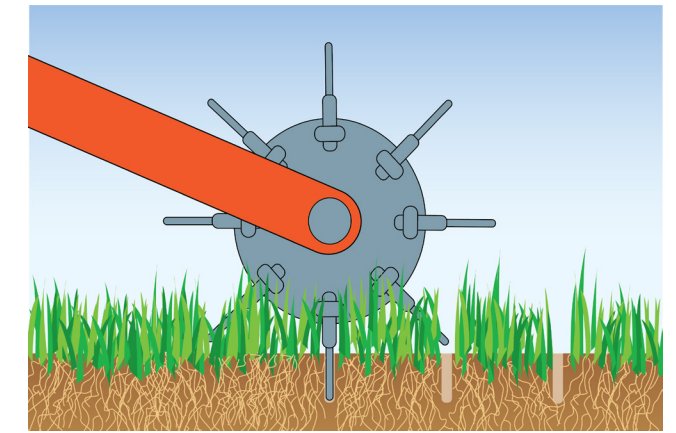


Figure 4. Cross section diagram of the aerification process.

Tip #7: Manage irrigation usage

Irrigation can either improve or worsen salinity issues in home lawns. Below are three helpful tools for successfully managing irrigation:

- **An irrigation planner:** Over-irrigation can result in waterlogging and adding excessive salts to soil, while under-irrigation may lead to reduced leaching and buildup of salts in the root zone. Irrigation planners help accurately identify the irrigation requirement of home lawns. The Oklahoma Mesonet provides a turfgrass irrigation planner (<http://bit.ly/2fl4h2Y>) based upon local weather conditions.
- **A smart controller:** A tool that helps with the timing and amount of water to be applied is the smart controller. Smart controllers take advantage of weather and/or soil moisture data in order to make accurate irrigation decisions. Note that some types of soil moisture sensors perform poorly under high salinity conditions. Oklahoma Cooperative Extension Service publication HLA-6445, "Smart Irrigation Technology: Controllers and Sensors"

Table 1: Tolerance of common turfgrass species (adapted from Harivandi et al., 1992; Martin, n.d.)

<i>Turfgrass Species</i>	<i>Salinity Tolerance</i> ¹	<i>Recommended Location</i>	<i>Recommended Lawn Site</i>
Warm-Season			
Bermudagrass	Tolerant	Statewide	Full Sun
St. Augustinegrass	Tolerant	Far Southern OK	Full Sun to Light Shade
Buffalograss	Moderately Tolerant	Western OK	Full Sun
Zoysiagrass	Moderately Tolerant	Eastern OK	Full Sun to Light Shade
Cool-Season			
Perennial ryegrass	Moderately Tolerant	Central to Northern OK	Shaded or Irrigated ²
Tall fescue	Moderately Tolerant	Statewide	Shaded or Irrigated
Kentucky bluegrass	Sensitive	Central to Northern OK	Shaded or Irrigated

¹ The salinity tolerance listed for warm-season grasses should be compared to the salinity tolerance of other warm-season grasses. Generally, warm-season grasses are more salinity tolerant compared to cool-season grasses. The salinity tolerance listed for cool-season grasses should only be compared to the salinity tolerance of other cool-season grasses and should not be directly compared to the listed salinity tolerance of warm-season grasses.

² Perennial ryegrass is typically utilized in Oklahoma for winter overseeding only and is not recommended for primary lawn use.