4915 West Monte Cristo Road
Edinburg, Texas 78541
Telephone: 956-383-0739
Facsimile: 956-383-0730
TPSLab.com
AskThePlant.com

IRRIGATING WITH
SALTY WATER

By Esper K. Chandler, CPAg, SSc and Noel Garcia, CCA

Water shortages force difficult decisions when only salty well or canal water is available to supplement normal water supplies. ***Just how bad is that salty well water?***

Frequent droughts across the Southwest have caused many to seek supplemental and new water sources of questionable or known poor quality. The logic of evaluating each situation requires establishing several criteria for the facts to be considered. University research in Soil Science has established some guides:

A - DETERMINING how much risk is the grower willing to assume by using salty water?
B - EVALUATING the degree of the risks by testing soil, water and plants.
C - SELECTING tolerance standards for evaluating soil, crop and water conditions.
D - DEVELOPING practical management agenda of applied science to lower harmful risks.

These comments will try to simplify and generalize some very complicated scientific equations and tables for practical applications to help control salts in crop-production systems.

Salt Tolerances have been scientifically established as **GUIDES** for the starting points of concern with each crop and soil varying in a dynamic (changing) system. ***The damage from salt is an insidious problem that most often creeps up with unseen damage accumulating with each application of problem water.*** Excessive Sodium in irrigation water also promotes soil dispersion and structural breakdown. Relatively high Sodium content often results in a severe water infiltration problem due to soil dispersion, plugging and sealing of the surface pores in much the same way as does very low salinity water. This is due to lack of sufficient Calcium to counter the dispersing effects of the Sodium.

Excessive Sodium may also make it extremely difficult to supply enough water to meet the crops' water demand. Other related problems such as soil crusting, poor seedling emergence, lack of æration, plant and root diseases, nutritional disorders and weed pressures caused by the low rate of infiltration may further complicate crop management.

Water which tests within reasonable limits of Sodium may be fine for temporary or infrequent use; however, long term and/or frequent use can result in a build-up – usually just above the hardpan, with shallow-rooted crops being often unaffected. Seldom are salts so bad that the damage occurs overnight.

An exception to this however, is when deep-rooted plants such as grapevine, trees, etc. are planted in soil that has accumulated a deep, highly-concentrated layer of salt and the roots immediately come in direct contact upon planting. In this case, death may occur within days or weeks. A 5 – 10 – 20 or 30 percent damage is hard to see, except to the well-trained expert.

Is it better to take a small amount of salt damage which limits production, rather than having severe irreversible drought stress? ***It is POSSIBLE with adequate analysis and experience to manage water, soils and crops to minimize salt damage!*** **Correction requires leaching of salts.**

HARDPAN can be most serious impediment to leaching, as it prevents leachate flow downward into the deep subsoil. Hardpan may be broken up either mechanically with a subsoiler or **biologically** with beneficial soil bacteria **(soil inoculants)** which provide natural biological tillage**.**

There are no magic formulæ to eliminate salt problems. Conditions in each field are different. There are methods, products and procedures to manage salts for minimal harm and long-term corrections. However, leaching will cause the loss of beneficial (fertilizer) salts as well as harmful salts.

Analyze water and soils for not only total salts but also identify the good and bad salts so methods of management can be developed such as:

1 - Bad water can be blended with better quality water to stretch it further.
2 - Treatments can be added to water and soil to help leach the harmful salts.
3 - Manage water applications to speed leaching and prevent accumulation.
4 - Long-term soil improvement to tolerate and eliminate harmful salts.

TESTING WATER to quantify the salt cat-ions and an-ions is essential in determining the degrees of risk. Standard testing procedures for irrigation quality, while furnishing needed facts for making judgments, deal in ranges rather than absolute hard fast rules as there are many interactions.

For water, knowing more than just total soluble (dissolved) salts (solids) is needed to determine how to manage problem salts. The bad salt cat-ion of Sodium (Na) must be balanced with more favorable cat-ions of Calcium (Ca) and Magnesium (Mg) that are seldom harmful but excesses may be. A complicated formula called **SAR** (Sodium Adsorption Ratio) is used but the standards can vary with the soil characteristics (texture) where the water is applied. Potassium (K) is mostly a beneficial cat-ion that contributes to the total of salts. Sodium, Calcium and Magnesium leach rapidly when in the soluble form.

The harmful water salt an-ions of chlorides and bicarbonates can be managed to a degree. Chlorides (Cl) in excess can be the most toxic; however, it is highly soluble and moves easily with the water. Crop tolerances vary widely as does the effect of field and weather conditions. Regular soil and plant analysis can help determine treatments that help minimize harmful effects. Bicarbonates (HCO_3) can be easily managed by acidification (Sulfur) to break them down to water and Carbon Dioxide and prevent accumulations. Chlorides are highly mobile and move rapidly up and down the soil profile. The sulfate an-ion can be beneficial.

Nitrates (NO_3) can be beneficial to crops but harmful in drinking water for man and animals. High nitrates are seldom found in irrigation water, as presently there is a great deal of government regulations to prevent contamination. It is desirable to regularly test drinking water from wells. Nitrates also move rapidly up and down through the soil profile.

Boron (B) is the most feared water salt. Deep well water (over 100 feet) should be tested. Seldom does surface or shallow well water have Boron problems. There is a wide range of crop sensitivity to B. ***Most of the fear of B is unwarranted. It may be leached rapidly with good soil conditions and water management***. Remember that the higher the Organic Matter or the CEC, the slower the rate of leaching. Boron is much more likely to be lacking in most crops and soils than excessive, as in recent years many crop deficiencies of B are being observed. The decline of soil Organic Matter is suspected for these widely occurring deficiencies of Boron and other micronutrients such as Manganese (Mn), Iron (Fe) and less available Calcium (Ca) and Magnesium (Mg).

Other salts such as Phosphorus (P) and Iron (Fe) seldom occur in enough volume to cause irrigation problems but should still be monitored.

TESTING SOILS with the proper methods can reveal salt accumulation and other soil characteristics needed to improve the leaching of harmful salts. Most soil test labs require extra tests to evaluate salt problems. At TPSL®, salt factors are part of our standard tests as salt is a constant problem in the Rio Grande Valley and the coastal areas of Texas soils where there is always salt in the river water, which gets severe at times. There is salt accumulation even on our dryland soils due to our desert environment that occurs most of the time. We find salt problems, and poor soil physical (tilth) and chemical (especially Sodium) conditions in coastal regions (particularly those exposed to hurricanes), many arid regions, and those areas that have to rely upon poor-quality water from whatever source.

In the Rio Grande Valley, and especially the Gulf Coast regions which are subject to hurricanes, salt is a perpetual problem. However, with these regions, as with most places in the World we've tested, ***proper treatment can minimize salt damage.***

The soil is a dynamic system, constantly changing. The use of salty water can be tolerated with management of certain basic principles. Rate of leaching is affected by soil condition (structure) which can be improved. We cannot easily change texture; water, which can leach salts moves downward more rapidly in sand than clay. ***Evaluate soil salt problems with a 4-foot soil profile in 1-foot increment samples***.

We can manage soil conditions (structure/tilth) with soluble Calcium. If adequate soil Ca levels are present, keep it soluble by proper treatment. On non-calcareous soils, adding soluble Calcium from Gypsum and other sources is also possible. This can help keep the harmful salts in the soluble form to speed leaching and prevent accumulation. Soil **Organic Matter** (OM) also greatly improves soil condition (tilth).

There are many soil treatments that improve soil condition for tolerating the use of salty water. Some of the available treatments are **manures, composts, humates, soil inoculants of naturally occurring beneficial soil microorganisms, polymers, carboxyl's, Humic or Fulvic Acid, Sulfur, etc**. A long-term program in rotation may include green manure crops including legumes. Remember that crop rotations do not build soil OM but just slows the degradation, more effort is required to rebuild the generations of soil mining. Test soil and water to determine what can work best for your specific situation.

WATER MANAGEMENT can minimize salt problems. ***Soak deeply but as infrequently as possible*** is a good rule of thumb. This also applies to drip irrigation as soil æration helps push salts out of the major root system which is needed for optimum yields. Even **hydroponic** feeding requires Oxygen to the roots. **Petiole** (leaf stem) **/ Leaf Analysis** can often reveal the effects of a saturated root zone.

Minimum water use allows salts from water to accumulate in the root zone. Either flushing rains or a heavy application of irrigation water is needed to leach (push down) salts down the soil profile.

The only cure for salt problems is to physically move the harmful salts out of the root zone. Treatments with chemicals can only assist this process, by converting the salts to the soluble (movable) form, and then followed by flushing (physically moving) salts out by leaching.
Essential plant nutrients can also be flushed out in the process.

PLANT ANALYSIS in a good leaf or petiole (sap) testing program can also aid management decisions for a profitable crop production program. Many salt problems can be identified and treated before they seriously affect quality and yields. This requires advice from an experienced and properly trained advisor or consultant plus a reliable supplier that has the products when needed. Regular Petiole Testing - ***ASK THE PLANT®*** - is especially beneficial with drip, center pivot and microjets since injection of needed nutrients and soil aids is so fast and easy.

Managing crops and soils properly to minimize effects of salty water can aid faster leaching of salts when a beneficial flushing rain does fall. Recovery of stressed plants is faster. Soil organic matter (humus) improves soil tilth (condition or structure) for better water and root penetration of the soil which can help improve the water use efficiency of plants allowing them to better withstand drought and other stresses. These facts are from university research in Soil Science.

IN SUMMARY - Some salty water can be utilized in conjunction with good water and, soil and plant analysis. Developing a management program for each situation can vary from field-to-field even on the same farm with the same water. Adequate knowledge and experience can prevent the insidious accumulation of salt problems that can cause a sudden crop failure. ***All salt tolerances are variable***, ***influenced by many factors.*** There are no easy magic formulas, but many tools are available to analyze and minimize problems.

See related: ***Salty Soil*** ***Water Guide*** ***Soil Guide***