TPS Lab

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ASK THE PLANT®
TO GET THE MOST FROM YOUR PLANTS
DYNAMIC CROP NUTRITION®

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SALTY SOIL MANAGEMENT and CEC

Chlorides, Nitrates and Sodium in excess are the major killer salts.

EVALUATING SODIUM SALT – We have found that Sodium is the most predominating problem salt. The best way to evaluate Sodium (as NaCl) is by determining the ratio of CO_2 - extractable Sodium to soluble Calcium and/or Magnesium (Na:Ca and Na:Mg).

A Na:Ca index less than 5 is acceptable. An increasing index indicates declining physical condition for water penetration to leach the soluble Salts. Na:Mg should be less than 20 or less than 10 for sugar crops.

To improve soil structure / condition / tilth, increase the soluble Ca and/or Mg.

EVALUATING NITRATES (NO_3) – For irrigation purposes, nitrates serve as nitrogen fertilizer. It contributes to lower Sodium buildup in the presence of Calcium or Magnesium. Water high in Nitrates is toxic to animals and humans.

EVALUATING CHLORIDES (Cl) – Chlorides are essential for plant growth but is easily found in high supply (preferably < 300 ppm). Cl can be highly toxic in high amounts especially when overhead watering is employed. Some crops may have specific toxicities for chloride in the soil solution. It contributes to lower Sodium buildup in the presence of Calcium or Magnesium. Note however, that Cl is an essential micronutrient and plants require only very small amounts. Accordingly, the natural content of Cl in the soil is normally sufficient.

Cat-ion Exchange Capacity (CEC) depends primarily on texture with slight improvement of about 3.5 for each percent increase in humus. TPSL® rates CEC according to texture. Improving the humic fraction of organic matter is the best way to improve CEC.

Standard Analysis of CEC and Percent Base Saturation depends upon extracting the strongly held and soluble forms of Potassium, Sodium, Calcium and Magnesium cat-ions. Such lab numbers alone do not indicate if a salt problem is caused by poor internal drainage. These values seldom calibrate to plant uptake. The use of Sodium Adsorption Ratio (SAR) and Exchangeable Sodium Percentage (ESP) are better indications of saline/sodic soil problems when analyzing the CEC of your soil. SAR (preferably < 9.0) is the ability of the water to change the soil to a sodic soil.

TPSL® determines levels of available salt cat-ions (many are plant nutrients) in a natural occurring soil solution by using CO_2 as an extraction agent (roots secrete CO_2 which forms weak Carbonic Acid). These salt cat-ions that occur in the root zone soil solution also include water soluble cat-ions that occur in the solution from organic reactions or from strong acids from chemical fertilizer. In-depth soil profile (1' to 4' level in 1' increments) levels need to be compared to best manage salts. CO_2 -extracted nutrients show an excellent degree of calibration to plant uptake.

Water-soluble cat-ions are also determined separately. Then, by using the water soluble along with the extractable values, it can be determined if chemical/biological/organic treatment is needed or if drainage is the first priority. <u>The only CURE is to leach SOLUBLE SALTS.</u>

MANAGEMENT OF SALTS

WATER SOLUBLE CALCIUM (H_2O Ca) is the key to leaching problem salts. It indicates the physical state of the soil in relation to the extractable Sodium (CO_2 Na) ion. Soluble Calcium exchanges on the soil particles with the extractable Na; thereby converting it to a mobile soluble form so the Na can leach. A heavier textured soil will accumulate harmful sodium faster than a lighter textured soil.

SOLUBIZING / LEACHING AGENTS - SULFUR is the major chemical for solubizing Calcium, Magnesium and Sodium. Organic acids from the humic fraction of organic matter are also important and may be a very important aid to salt management. Soluble Ca should be in the ***sulfate*** form, ***not bicarbonate.*** Cattle or poultry (layer litter) manure, humates, Humic Acid, micro-organisms in soil inoculants or compost teas, and others such as Carboxyls (organic acid groups contained in decomposing Organic Matter produced by soil biological activity) and polyacrylimide products can be highly effective in salt management.

Soluble Calcium moves in the profile with soluble Sodium, so treatment with chemicals such as Sulfur should be used in moderate amounts several times a year as soil water drainage is essential in the leaching process.

CHLORIDES – Once the internal drainage is working properly, the extremely soluble chlorides will move with the water down through the soil profile carrying Na along with it. ***It is extremely important to provide sufficient water to wash these ions down through the soil profile and out of the root zone.***

NITRATES – Are very soluble and are easily leached through the soil profile. A "***Trap Crop***"***** can be planted to hold and immobilize Nitrate in the plant biomass to be released during decomposition later, for the next production crop.

HIGH SODIUM LEVELS (Saline/Sodic) contribute to breakdown of Soil Structure (compaction), Osmotic Stress and reduced nutrient uptake.

For example, In a calcareous alkaline soil, the phosphate can quickly tie up into **Tricalcium Phosphate** which is an **unavailable** form of phosphate. The phosphate is "locked" on the soil colloid along with other nutrients like Calcium, Magnesium and Sodium.

When ***beneficial soil microbes*** **(soil inoculants)** are applied to the soils along with a food source and energy source they form enzymes, organic acids and bio-chemical chelators that aid in "unlocking" nutrients as well as harmful Sodium. Since the Calcium ion is stronger than Sodium, the Calcium displaces Sodium at the cat-ion exchange site thus solubizing (releasing) itself from the soil colloid.

By the same token, the beneficial microbes improve the structure by increasing the **glomalin** (microbes secrete this glue-like protein) in the soil thereby allowing the soil aggregates to form in different pore sizes which improve the soils infiltration rate. Smaller pores hold water and larger pores allow better drainage and air. Now that we have a better soil structure as well as soluble forms of Sodium – Calcium and Magnesium, we can displace the harmful Sodium beyond the major root zone.

SULFUR (S) is very beneficial to high pH, calcareous soils. Oxidation of elemental S produces Sulfuric Acid that dissolves carbonates, thereby releasing Ca and Mg, which helps leaching and adds fertility to the soil. By lowering the soil pH, trace mineral compounds (micronutrients) become available for plant uptake. Care needs to be exercised, however, as too much S / Sulfuric Acid can collapse the soil structure through dissolution and consequent leaching. It should be applied in small amounts at regular intervals.

INTERNAL DRAINAGE of good soil tilth is the major need for leaching salts. Take an in-depth 4-foot soil profile in one-foot increments for soil suitability determination for natural percolation or if drainage tiles would be beneficial. A drainage outlet is beneficial for speeding internal water drainage.

SOIL TILTH (Condition / Structure): Affects water and root penetration for Maximum Economic Yields (MEY) and quality. Subsoil tilth is improved by biological activity when fed humic substances and energy (sugar and amines); Soil Inoculants help to solubilize Calcium, Sodium and Magnesium to aid cat-ion exchange and to help leach harmful salts through subsoil's and break-up hard pans.

The importance of Soil Structure cannot be overstated. Structural development and maintenance are crucial to good crop development. It relies entirely upon biological activity together with Organic Matter and Humic content.

A ***Trap Crop*** is one that can germinate and grow after harvest of the primary crop to immobilize the remaining nutrients in the soil – *i.e.*, convert them to an organic, essentially non-leachable form. They must: (1) grow quickly, and (2) produce many roots to absorb the excess nutrients. Mostly, these are grasses.

Ryegrass is a great one, oats (possibly, Black Oats), and millet are other possibilities. Most of the research work has been done on cool season grasses planted after soybeans, corn, etc. But warm season grasses, like the millet, may be used after a spring-harvested crop (winter wheat). There are others.

BIOLOGY PLAYS AN ESSENTIAL RÔLE IN SOIL REMEDIATION.

SOIL INOCULANTS - Activators (in the absence of adequate soil humus or in sterile conditions) of more naturally occurring beneficial soil micro-organisms (plus humus and energy) and/or enzymes, hormones, polymers, wetting agents, Lignin and Carboxyls may improve nutrient uptake and the soil's physical condition (tilth) for better plant performance, disease resistance and salt leaching. Feeding microbes with humic substances, carbohydrates, and other organic materials aid soil tilth and releases soil nutrients while helping some bacteria fix atmospheric N. [A combination of products may be best -- Follow product labels on your own test plots for the most effective products.]

These soil inoculants are sold under several brand names such as *Medina*, *Bio-S.I.*, *Bio Inoculant*, *Impact*, *Super Bio*, *SC-27*, *BioZone*, *AgBlend*, *Soil Life*, compost teas and many more.

Humic Substances alone such as Humic Acid can also aid in the remediation of saline and sodic soils.

Verify the Sodium is leaching with TPSL®'s *Plant Natural*™ Soil Analysis that identifies both soluble and exchangeable (extractable) forms of salts. Continue above treatment until the soil test indicates complete remediation.

Use Good Water Management by soaking thoroughly, but as infrequently as possible, to physically push salts down away from the major root zone. Deep watering can help prevent surface salt build-up by leaching soluble salts from previous irrigation.

WATER QUALITY and VOLUME are ultimately essential to any Salty Soil remediation program.

What's In Your Water Becomes Part Of Your Soil.®

Related papers: **SALTY WATER** **SOIL GUIDE** **WATER GUIDE** **SOIL BIOLOGY** **ORGANIC MATTER**