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IRRIGATION WATER ANALYSIS GUIDE SHEET

With falling aquifers, mineral salts are concentrated and the quality of natural sources of water is generally very rapidly deteriorating. Bad quality water can do serious long-term damage to soil and ruin crops. It is possible to manage poor quality water with chemical and biological treatments. However, every situation is unique and there are no simple blanket solutions. **In order to develop a successful management plan, the amounts and composition of water impurities must be known.**

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

Total Soluble (Dissolved) Salts/Solids composition is important for proper management: The most-often found CATIONS are Na, Ca, Mg, K and ANIONS are CO₃, Cl, HCO₃, SO₄, NO₃, Fe and B. Important characteristics and their meanings are discussed below:

TOTAL SOLUBLE (DISSOLVED) SALTS - TSS:

Electrical Conductivity (EC) measures the **Total Soluble (dissolved) Salts (TSS)** as mmhos/cm. (1.0 EC = 640 ppm)
PPM = parts of a salt per million parts of water (10,000 ppm = 1% - Sea Water contains about 3% salts).

0 - 299	Very Low	Should be no problem	1200 - 1499	High	Water and Soil management necessary
300 - 699	Low	Seldom of any concern	1500 - 1799	Very High	Emergency use - requires soil treatment
700 - 999	Medium	SAR rating is best guide	Over 1800	Extremely High	May be very harmful to soil and plants with repeated use. Treat water and soil.
1000 -1199	Moderately High	Use good water and soil management.			

The above table gives an average idea on water quality. Below are other factors, which must be considered in making practical decisions:

1. How much salt is in the soil to begin with? (Soil salt tests that identify Soluble Salts are important when mediocre waters are used.)
2. What is the soil type? ("Drainability" [porosity / structure] is extremely important.)
3. What is the rainfall between irrigations? (With good internal drainage, salts can be washed below the root zone.)
4. What is the method of application? (Flood, row, drip or sprinkler.)
5. How salt-tolerant is the crop?
6. Even if TSS is low, what percentage of it is one element or compound? Does it exceed acceptable values?

- **Highly Salt Tolerant:** (> 4.0 E.C.) Bermuda grass, Beets, Spinach, many Cotton varieties, Barley, Asparagus, Date Palm.
- **Medium Salt Tolerant:** (2.0 - 4.0 E.C.) Alfalfa, Tomatoes, Broccoli, Cabbage, Celery, Peppers, Lettuce, Corn, Oats, Grain Sorghum, Potatoes, Sugar Cane, Squash, Cucumbers, Watermelons, Soybeans, Grapes, Radish.
- **Sensitive to Salts:** (< 2.0 E.C.) Citrus, Berries, Avocado, Apples, Beans, Carrots, Onions, Peas, Papaya, Peaches, Pears, Plums.

Only Treatments can assist in the leaching of salts by making chemical changes. Salts must be physically flushed below the root zone. *To do this, the soil must be permeable and sufficient water must be applied.* **Biological Soil Inoculants and water-soluble Silicon products can also be extremely effective!**

SAR - Sodium Adsorption Ratio is the relationship between Sodium and soluble Calcium. A high SAR requires the addition of large amounts of soluble Calcium and perhaps other treatments.

SAR	RATING	SAR	RATING	SAR	RATING	SAR	RATING	SAR	RATING
0-3	LOW	3-6	UPPER LOW	6-9	MARGINAL	9-12	HIGH	12+	EX. HIGH

CHLORIDES, SULFATES and now, especially **BICARBONATES**, are the most predominate kinds of salts. Chlorides are more harmful. They are highly soluble and move easily with water – but may not move much in high CEC / high OM soils. Cl > 300 ppm may burn plants and roots on contact. Some plants are more tolerant and may require Cl as an essential trace element. In calcareous soils, **Bicarbonates** can effectively turn soils to **Stone**.

● SPECIALISTS IN SOIL FERTILITY, CROP NUTRITION and IRRIGATION WATER QUALITY MANAGEMENT. ●
A Full-Service Soil - Plant - Water - Compost - Fertilizer and Heavy Metals Analytical and Consulting Agronomic Laboratory.

SODIUM affects the soil in an undesirable manner. It tends to make the soil hard and impermeable, thus the leaching of salts is difficult. Soluble Calcium has the opposite effect. The amount of Sodium that will be absorbed by the soil from the irrigation water depends primarily upon **Sodium Adsorption Ratio (SAR)** - the relationship between Sodium and soluble Calcium. A high SAR requires addition of high amounts of soluble Calcium. The need for Calcium also depends upon total salts in the water, as well as bicarbonates and sulfates. Soil soluble and extractable Calcium must also be known to manage salts properly.

BICARBONATES & CARBONATES should be lower than Calcium and Magnesium because as irrigation water moves through the soil, salts become more concentrated. More and more water is lost due to evaporation and absorption by the roots. Calcium Carbonate will precipitate because it is of low solubility. The excess carbonates left in the water will then combine with the Sodium to form Sodium Carbonate - leading to the formation of **Black Alkali**. More soluble Calcium must be added to make up for the precipitated Calcium Carbonate.

Considering the various factors determining Calcium needs, **TPSL®'s Comprehensive (Daubeny) Soil Test** recommends the amount of Calcium needed in each case. The most suitable Calcium treatment may be Gypsum, Sulfur or other materials containing Sulfur – and biological inoculants. They can liberate Calcium from the soil, provided there is a supply of Calcium Carbonate in the soil.

BORON is an essential trace element necessary for the transport of Calcium within the plant **BUT**
Excessive amounts of BORON are toxic to plant growth.

PLANT BORON EVALUATION TABLE

RATINGS	SENSITIVE (in ppm)	SEMI-TOLERANT (in ppm)	TOLERANT (in ppm)
LOW	Below 0.40	Below 0.80	Below 1.40
MEDIUM	0.40 – 1.00	0.80 – 1.50	1.50 – 2.50
HIGH	1.00 – 1.80	1.50 – 2.80	2.50 – 3.50
VERY HIGH	Above 1.80	Above 2.80	Above 3.50

BORON SENSITIVITY OF CROPS

- **Sensitive:** Citrus, Avocado, Pecans (accumulates in leaf with age), Beans, Garlic, Onions, Cowpeas, Peanuts, Sweet Potato, Strawberry, Sunflower, Sesame.
- **Semi-tolerant:** Broccoli, Carrots, Cucumber, Pepper, Potato, Cabbage, Celery, Corn, Squash, Cantaloupe, Cauliflower, Radish, Turnip.
- **Tolerant:** Tomato, Alfalfa, Parsley, Beets, Cotton, Sorghum, Asparagus.

BORON in high levels is most often found in wells and lakes over 100 feet deep.

BORON is readily leached from the soil, **except when there are high levels of Organic Matter present**.

Organic Matter holds Boron. Good tilth (condition / structure) from humus and soluble Calcium in the soil is essential to aid the leaching of all salts. Chemical treatment and physical flushing also promotes leaching.

TOTAL SOLUBLE SALTS for animals should not exceed:

PPM	STOCK	PPM	STOCK	PPM	STOCK
3,000	Poultry	7,000	Dairy Cattle	8,400	Horses
10,000	Beef Cattle	12,000	Sheep		

When no other water is available and cattle are forced to drink from a poor quality water supply, they may adjust to 10,000 to 15,000 PPM of Total Soluble Salts (depending upon composition). Older cattle can tolerate more salts than younger ones.

NITRATES (NO₃) are toxic to Infants above 10 ppm - Adults 15 ppm - Cattle in amounts above 45 ppm.

SOIL & WATER MANAGEMENT:

WATER – Consider the above and soak as deeply but as infrequently as possible to leach salts, but avoid water-logging the plant root zone.

SOIL - Maintain high soluble Calcium for improved soil condition (structure) to aid air, water and root penetration. Use a soil test that determines soluble Calcium to determine best and most economical treatment. Organic Matter (humus) and soil inoculants also aid soil tilth (structure).