IRRIGATION AND SALINITY

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WHAT IS FIELD IRRIGATION?

Field irrigation is the large-scale delivery of water using centre pivot, wheel move systems or flooding to irrigate field crops.

WHAT IS SALINITY?

Salinity is a measure of the total amount of salt in the water. When the salt levels are too high, a salinity hazard may exist. Salts in soil and/or water can reduce water availability to the crop to such an extent that yield can be affected. Electrical conductivity or Total Dissolved Solids tests are two means of measuring salinity. The properties of the soil, the ground water and the landscape interact with the salinity of the irrigation water to either increase or decrease the salinity hazard. For a detailed evaluation of these interactions please consult an irrigation specialist.

IS IRRIGATION WATER SALINITY IMPORTANT?

Yes, salinity can cause many problems. Some dissolved solids are worse than others, and the amount of elements in relationship to each other is also important. For example, the relative proportion of sodium cations to other cations can give rise to soil permeability problems. The Sodium Absorption Ratio (SAR) describes the amount of excess sodium in relationship to calcium and magnesium. The total amount of dissolved solids (TDS) should be used together with SAR. TDS levels below 700 mg/L and SAR below 4 are considered safe; TDS levels between 700 and 1,750 mg/L and SAR levels between 4 and 9 are considered possibly safe, while levels above these are considered hazardous to any crop. Toxicity from specific ions comprising the salinity of the water can also be of concern. These issues are summarized in Table 1.

Table 1 Guidelines for interpretations of water quality for irrigation (modified from Ayers and Westcot 1985, Alberta Environment 1998)

Potential Irrigation Problem	Units	Degree of Restriction on Use		
		None	Slight to Moderate	Severe
Salinity *(affects crop water availability)*				
Total Dissolved Solids (TDS)	mg/L	<700	700 - 2,000	>2,000
Electrical Conductivity (EC)	dS/m	<1	36162	>3
SAR				
SAR		0 - 4	4 - 9	>9
Specific Ion Toxicity *(affects sensitive crops)*				
Sodium (Na)	mg/L	<70	>70	
Chloride (Cl)	mg/L	<100	>100	
Boron (B)	mg/L	<0.7	0.7 - 3.0	>3.0
Miscellaneous Effects *(affects susceptible crops)*				
Nitrogen (NO_3-N)	mg/L	<5	5 - 30	>30
Bicarbonate (HCO_3)	mg/L	<90	90 - 500	>500

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Table 2 - Tolerance of selected crops to total dissolved solids in irrigation water, as determined by research in California, U.S.A. (Canadian Council of Ministers of the Environment 1987)

Degree of tolerance	Fruits and berries	Vegetables	Field crops	Forages
Not tolerant				
EC_w <0.7 TDS <500	Strawberry Raspberry	Bean Carrot	Bean	
Slightly tolerant				
EC_w <1.2 TDS <800	Boysenberry Currant Blackberry Gooseberry Plum Grape Apricot Peach Pear Cherry Apple	Onion Parsnip Radish Pea Pumpkin Lettuce Pepper Muskmelon Sweet potato Sweet corn Potato Celery Cabbage Kohlrabi Cauliflower	Cowpea Broadbean Flax Sunflower Corn	Clover (alsike, ladino red and strawberry) Berseen clover Forage corn
Moderately tolerant				
EC_w <2.2 TDS <1,500		Spinach Cantaloupe Cucumber Tomato Squash Brussel sprout Broccoli Turnip		Brome, smooth Alfalfa Big trefoil Beardless Wildrye Vetch Timothy Crested wheatgrass
Tolerant				
EC_w <3.6 TDS <2,500		Beet Zucchini	Rape Sorghum	Oat hay Wheat hay Brome, mountain Tall fescue Sweet clover Reed Canarygrass Birdsfoot Trefoil Perennial Ryegrass
Very tolerant				
EC_w <5.0 TDS <3,500		Asparagus	Soybean Safflower Oats Rye Wheat Sugar beet Barley	Barley hay Tall wheatgrass

WHICH CROPS ARE AFFECTED BY SALINITY?

Crop yield may be substantially reduced when saline irrigation water is used. Some crops are more sensitive to salinity than others. Table 2 lists some examples of sensitive, moderately tolerant, tolerant and very tolerant crops.

HOW IS CROP YIELD AFFECTED BY SALINITY?

A graphic representation of the effects of salinity on crop yield is shown in Figure 1 below. A sensitive crop may have a yield reduction of 80% under a specific salinity condition, while a moderately tolerant crop may have no yield reduction. It is therefore important to know which crops may tolerate the salinity of the water.

SALINITY IN SASKATCHEWAN

Most surface waters in Saskatchewan (rivers, lakes, dugouts) are typically suitable for irrigation because the TDS and SAR levels are relatively low. Unfortunately, most high producing aquifers are not suitable for irrigation since they are located within the deeper strata where both TDS and SAR levels are high.

WHERE CAN I GET MY WATER ANALYZED?

Commercial laboratories that are able to analyze the composition of chemicals in irrigation water include: Envirotest Laboratories (Saskatoon), BDS Laboratories (Qu'Appelle), and Saskatchewan Research Council (Saskatoon). Specialized water analysis concerning the nutrient requirements of specific crops can be obtained from several U.S. Chemistry Laboratories including Scott's Testing Laboratories (Pennsylvania).

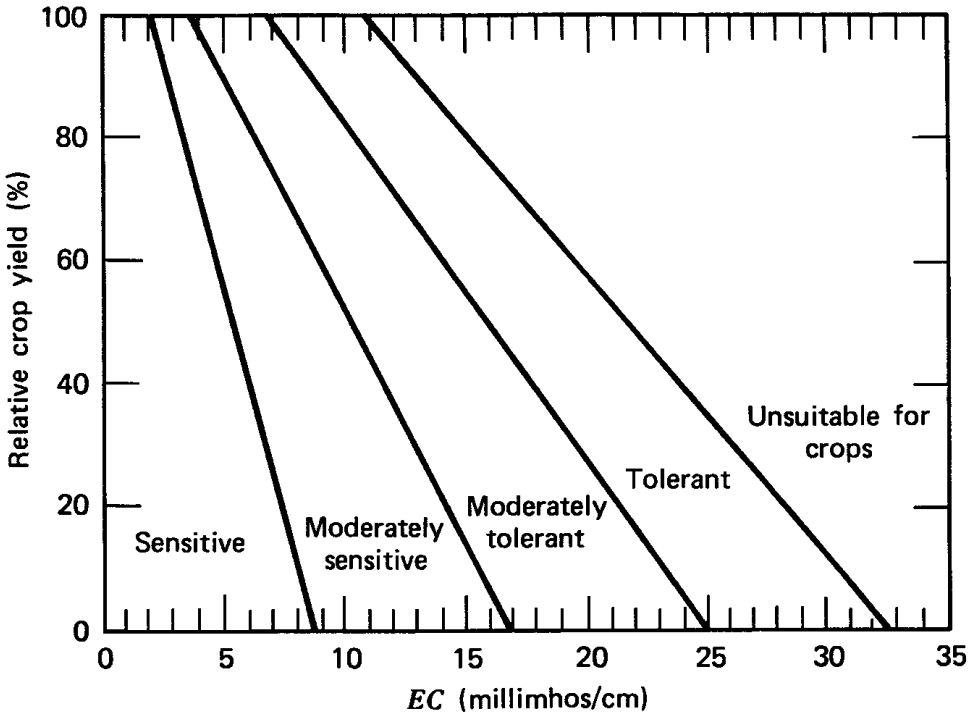

Fig. 1 Relative crop yield related to salinity (Ayers and Westcot 1987)
(to obtain TDS values in mg/L, multiply the EC value by 700)

THE BIGGER PICTURE

In order to irrigate in a sustainable fashion, it is essential to know the quality of the water. Even water of reasonable quality may negatively affect the soil if salinity levels concentrate over time. This can translate into crop reductions with time. General issues of water quality are discussed in the fact sheet *Field Irrigation and Water Quality*. When considering whether or not to incorporate irrigation as a farming practice, it is important to consult an irrigation specialist to assess water quality characteristics, land unit suitability, soil loading, and crop limitations.

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No Endorsement Given: This report should not be taken as an endorsement by the authors or their agencies of any of the guidelines, products or services mentioned herein.

Information from several different sources was used to produce this fact sheet including:

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