drought tips

Number 92-32

Maintaining Water Quality for Irrigated Agriculture Under Drought Conditions

Under drought conditions water quality may deteriorate as normal water supplies become unavailable. For some crops, irrigating with any available water may be better than not irrigating at all, but for other crops, if water quality is sufficiently poor, it may be preferable to not irrigate.

The guidelines given in this leaflet are meant to help growers quickly determine whether deteriorated water quality is likely to affect crops. Drought Tips 92-197, and 92-18 provide specific water quality information for trees and vines, vegetable and row crops, and field and forage crops, respectively.

Irrigation water quality is affected by the following chemical characteristics:

1. total concentration of soluble salts (salinity), usually expressed as electrical conductivity (EC) in units of mmho/cm or dS/m (1mmho/cm = 1 dS/m).

2. Concentrations of sodium, chloride, and boron (Na and Cl in meq/L and boron in mg/L).

3. Concentration of sodium relative to other cations (sodicity), usually expressed as sodium adsorption ratio (SAR).

Electrical Conductivity (EC)

The EC of an irrigation water is the measure of its salt content, or salinity. The numbers are usually expressed in mmho/cm, although some laboratories use µmho/cm: 1 mmho/cm = 1000 µmmho/cm. The greater the number, the higher the salt content.

Waters with ECs of less than 1 mmho/cm (1000 µmho/cm) can be used on all crops, whereas only a few crops will tolerate a 5 mmho/cm water without some yield loss.

Specific Ion Toxicity

In laboratory reports, chloride and sodium concentrations are given in meq/L, or ppm (mg/L). Published toxicity criteria use meq/L. To convert ppm of chloride to meq/L, divide by 35; for sodium, divide by 23.

The hazard from chloride and sodium toxicity depends on both the crop and irrigation method. Under drip or surface irrigation, most field, forage, vegetable, and row crops are not affected, whereas trees, vines, fruits, and ornamentals are affected. There is no restriction for surface-irrigated crops if the concentration of either chloride or sodium is less than 5 meq/L. Significant restrictions apply if concentrations exceed 15 meq/L.

All crops irrigated with sprinklers are subject to possible injury because of salt absorption by the leaves. There is no restriction if the concentration is 5 meq/L, but significant restriction at a concentration of 15 meq/L. Irrigating with sprinklers at night reduces the problem, while applying small, frequent sprinkler irrigations increases the problem.

Boron toxicity can occur in all crops. While all crops can tolerate 0.5 ppm of boron in irrigation waters, only a few can tolerate boron concentration of 4 ppm over the long term.

Water Infiltration

The rate at which water infiltrates soils is influenced by ECw and SAR of the irrigation water. Water infiltration rates increase as ECw increases and SAR decreases. The following guidelines define the likelihood of water infiltration problems at varying SAR and ECw levels.

	Potential Problem	
	unlikely	likely
SAR	ECw	
0-3	>0.7	<0.2
3-6	>1.2	<0.3
6-12	>1.9	<0.5
12-20	>2.9	<1.0
20-40	>5.0	<2.0

Table 1.

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For example, if the SAR is between 3 and 6, infiltration problems because of water quality are unlikely if ECw is greater than 1.2 mmho/cm, but are likely if ECw is less than 0.3 mmho/cm.

Laboratories report SAR and often also report an adjusted sodium adsorption ratio (SAR_a). SAR_a (sometimes symbolized as R_{Na}), calculated by the procedures given in *Water Quality for Agriculture*, by R.S. Ayers and D.W. Westcot, are the most appropriate numbers to use in Table 1.

Poor quality water can cause the following water infiltration problems:

1. Water with an electrical conductivity less than 0.5 mmho/cm reduces infiltration because of surface crusting and clay dispersion.

2. Switching from a saline/sodic well water to a California Aqueduct water or to rain can cause infiltration problems. The higher SAR levels in the soil, coupled with the reduced salinity of the better water can destroy soil structure and create soil crusts. Runoff can increase and more tillage may be needed to prepare a suitable seedbed.

Applying gypsum to the soil surface at the rate of two to four tons per acre is the most common remedy for both problems. If poor quality waters are used, gypsum should not be applied before the water, but should rather be applied afterward before rainfall occurs or before good water is used for irrigation. Injecting gypsum into the good water at 0.25 tons/acre-feet is also effective. Sulfuric acid or sulphur can be applied to alkaline soils in place of gypsum and dolomite or lime can substitute for gypsum on acid soils.

References

Ayers, R.S. and D.W. Westcot. 1985. *Water quality for agriculture.* Irrigation and drainage paper No. 29. Rome: Food and Agriculture Organization of the United Nations (FAO). 97 pp.

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