PROBLEMS RELATED TO IRRIGATION WATER QUALITY

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(1) Salinity – The main problem related to irrigation water quality is the water salinity. Water salinity refers to the total amount of salts dissolved in the water but it does not indicate which salts are present in it.

High level of salts in the irrigation water reduces water availability to the crop (because of osmotic pressure) and causes yield reduction. Above a certain threshold, reduction in crop yield is proportional to the increase in salinity level. Different crops vary in their tolerance to salinity and therefore have different thresholds and yield reduction rates.

The most common parameters used for determining the irrigation water quality, in relation with its salinity, are EC (Electrical Conductivity) and TDS (Total Dissolved Solid).

TDS ppm or mg/L	***EC dS/m***	***Salinity hazard***
<500	<0.8	Low
500 – 1000	0.8 – 1.6	Medium
1000 – 2000	1.6 – 3	High
> 2000	> 3	Very high

Solution: Frequent and less interval irrigation through pure water, leaches down the salts below the crop root zone in the soil under saline soil condition.

(2) Sodium hazard and irrigation water infiltration –

The parameter used to determine the sodium hazard is SAR – Sodium Adsorption Ratio. This parameter indicates the amount of sodium in the irrigation water, in relation to calcium and magnesium. Calcium and magnesium tend to counter the negative effect of sodium.

(I) High SAR levels might result in a breakdown of soil structure and water infiltration problems. Soil tends to seal and to become hard and compact when dry.

(II) Ironically, higher salinity reduces the negative effect of sodium on soil structure. So, when sodium levels in the soil are high in relation with calcium and magnesium, i.e SAR is high, flushing the soil with good irrigation water quality will only worsen the problem.

(III) Recommended to avoid using water with an SAR value greater than 10 (mmoles l^{-1})

Reclamation of the soil which become Alkaline due to Na Hazard:

(1) **Sulfur Addition:** For reducing the soil pH, add sulfur to the soil to reduce the alkalinity. Application of aluminium sulfate, iron sulfate etc. also reduces the sodium hazard.

(2) **Organic manure:** Application of organic manure like FYM, vermicompost, green manure etc. also helps in reducing the alkanity of soil.

(3) **Raised Beds:** Plantation and sowing of crops on raised beds save the plants from alkanity upto certain extent.

(4) **Fertilizer:** Sulfur coated urea, Ammonium sulfate, not only lowers the pH but also adds nitrogen to the soil.

(5) **Use of Alkanity Resistant Crops:** Rice and berseem are the crops which are resistant to this soil.

(3) Specific Ion Effects (Toxic Elements)

In addition to salinity and sodium hazards, certain crops may be sensitive to the presence of moderate to high concentrations of specific ions in the irrigation waters or soil solution. Many trace elements are toxic to plants at very low concentrations. Both soil and water testing can help to discover any constituents that might be toxic. Direct toxicity to crops may result from some specific chemical elements in irrigation water, e.g. boron, chloride, and sodium are potentially toxic to plants. The actual concentration of an element in water that will cause toxic symptoms varies, depending on the crop.

When an element is added to the soil through irrigation, it may be inactivated by chemical reactions. Alternatively, it may buildup in the soil until it reaches a toxic level. An element at a given concentration in water may be immediately toxic to a crop. Or, it may require a number of years to accumulate in the soil before it becoming toxic.

(I) Sodium Toxicity:

(1) Sodium toxicity can occur in the form of leaf burn, leaf scorch and dead tissues running along the outside edges of leaves.

(2) In tree crops, a sodium concentration (in excess of 0.25–0.5%) in the leaf tissue is often considered to be a toxic level of sodium. Correct diagnoses can be made from soil, water and plant tissue analysis.

(3) The crops/plants listed as sensitive (ESP < 15) include beans, maize, peas, orange, peach, mung bean, mash, lentil, gram and cowpea.

(4) Semi-tolerant plants (ESP 15–40) include carrot, clover, lettuce, berseem, oat, onion, radish, rye, sorghum, spinach, tomato,

(5) Tolerant plants (ESP > 40) include alfalfa, barley, beet, Rhoades grass and Karnal (Kallar) grass.

(II) Boron Toxicity:

(1) Boron is essential to the normal growth of all plants, but the amount required is low. In order to sustain an adequate supply of boron to the plant at least 0.02 ppm of boron in the irrigation water may be required.

(2) However, to avoid toxicity, boron levels in irrigation water should, ideally, be lower than 0.3 ppm.

(3) Plants grown in soils high in lime may tolerate higher levels of boron than those grown in non-calcareous soils.

(4) Symptoms of boron injury may include characteristic leaf ‘burning’, chlorosis and necrosis, although some boron sensitive species do not develop obvious symptoms. Boron toxicity symptoms first appear on older leaves as yellowing, spotting, or drying of leaf tissues at the tips and edges. The drying and chlorosis often progresses toward the center of the leaf, between the veins as boron accumulates over time.

(5) Irrigation water with boron >1.0 ppm may cause toxicity in boron sensitive crops.

(6) Boron levels that have developed in the soil water (saturation extract of soils) through irrigation can have a range of effects on crop yields.

(7) Wilcox (1960) presented three classes of crops with regard to boron toxicity: tolerant (2–4 ppm), semi-tolerant (1–2 ppm), and sensitive (0.3–1 ppm).
(8) Fruit crops are among the most boron sensitive, and yields of citrus and some stone fruit species are decreased by boron even at soil solution concentrations less than 0.5 ppm.
(9) Effects of boron (B) concentration in irrigation water on crops

Boron concentration (ppm)	**Effect on crops**
< 0.5	Satisfactory for all crops
0.5–1.0	Satisfactory for most crops
1.0–2.0	Satisfactory for semi-tolerant crops
2.0–4.0	Satisfactory for tolerant crops only

(III) Chloride Toxicity:

(1) The most common crop toxicity is caused by chlorides in irrigation water. The chloride (Cl^-) anion occurs in all waters; chlorides are soluble and leach readily to drainage water.

(2) Chlorides are necessary for plant growth, though in high concentrations they can inhibit plant growth, and can be highly toxic to some plant species. Water must, thus, be analyzed for Cl^- concentration when assessing water quality.

(3) Cl^- levels in irrigation water and the effects of Cl^- on crops. In sensitive crops, symptoms occur when Cl^- levels accumulate in leaves (0.3–1.0% on a dry weight basis).

(4) Cl^- toxicity on plants appears first at the leaf tips (which is a very common symptom for chloride toxicity), and progresses from the leaf tip back along the edges as severity of the toxic effect increases. Excessive necrosis is often accompanied by early leaf drop or even total plant defoliation.

(5) Chloride (Cl^-) level less than 70 ppm of irrigation water is safe for the crops and more than 350 ppm causes the serious problem.
