



Effect of Saline Water in Crop Production

N. B. Gohil, B. A. Chaudhary and K. L. Chaudhary



INTRODUCTION

Agricultural production depends on the availability of water, a precious but finite resource. As the world's water resources become increasingly strained, **efficient irrigation becomes more critical**. However, as far as the Agricultural perspective is concerned it often has **salt as a major contaminant**.

- **Crops are commonly sensitive to salinity** so specific standard and management practices must be adopted when irrigating with highly saline water.
- ❖ **What is saline water?**
- **Saline water** is a general term for water that contains a significant concentration of **dissolved salts**.
- The salt concentration is usually expressed in **parts per million (ppm)**.
- If water with high concentration of 100 mg salts/liter, added to the soil, 1 metric ton of salt is added to the soil per ha. Meter of applied water.

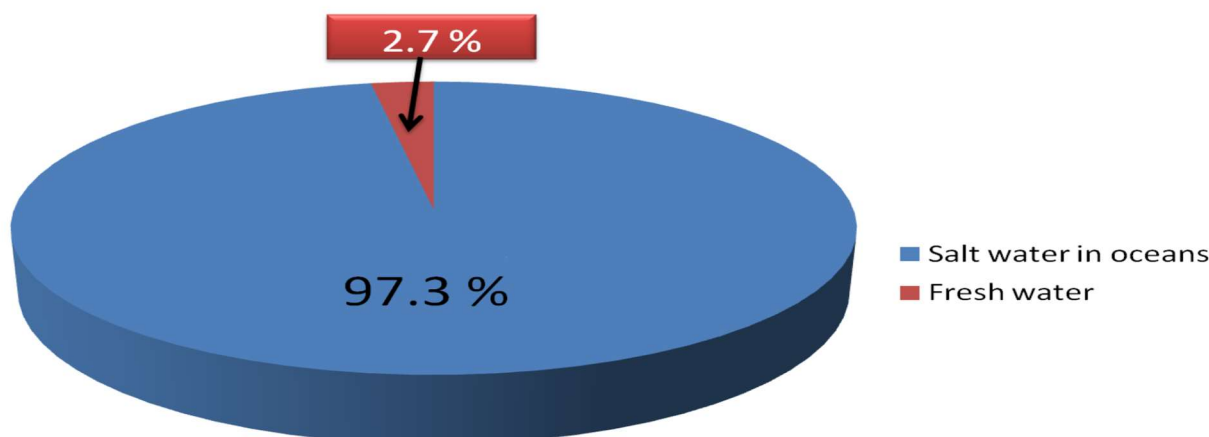


Fig 1. Distribution of world's total water



- Salinity is a major contaminant and the limiting parameter for production of crops. Specially found in both traditional irrigation supplies (surface and ground water) and recycled water.
- The most common and whole plant response to salt stress is generally stunting of growth.
- More severe effects can occur as plants accumulate salt with symptoms of tissue damage in addition to growth suppression.
- Normally the salinity problems are acute in the arid – semi arid and sea shore regions of the country.

Table 1: Intensity of salinity in Gujarat

Sr. No.	Salinity grade	Area (L ha)
1	Light salinity	14.80
2	More than medium	9.70
3	Medium	15.90
4	High or extreme intensity of the salinity	9.60
Total		50.00

By Advance in world archeology

Agrawal, 1982

❖ Major effects of salinity

1. Osmotic effects
2. Specific ion effects or toxicity
3. Nutritional imbalance
4. Soil structure decline

1. Osmotic effects

The reduction of the sum of metric and osmotic potential reduced the water uptake and so the presence of excess salts causes the water deficiency and which leads to physiological drought.





Oil palm damaged by salinity

2. Specific ion effects or toxicity

Injurious effects on the plants may be due to high total soluble salts or toxic conc. of ions. Ions like Na and Cl causes specific toxicity to fruit crops. The yield losses of fruits and nuts are generally greater due to specific ion toxicity rather than due to osmotic effect.



Tip burning due to chloride injury in a young seedling of mango



Salinity toxicity on Mangos teen

Table 2. Chloride and sodium concentrations in irrigation water causing foliar damage.

Sensitivity	Chloride (mg/l)	Sodium (mg/l)	Affected crop
Sensitive	<178	<114	almond, apricot, plum, citrus.
Moderately sensitive	178-355	114-229	grape, pepper
Moderately tolerant	355-710	229-458	sapota
tolerant	>710	>458	sugar beet, date palm

3. Nutritional imbalance

Salinity induce elemental nutritional deficiencies or imbalances in plants. The specific effects vary among species. Imbalance may be result from the effect of salinity on nutrient availability, competitive uptake, transport or partitioning within the plant or may be caused by physiological inactivation of a given nutrient.



Potassium deficiency symptoms on a Barhee variety of Datepalm

4. Soil structure decline

Saline water is often high in sodium, causing sodic soil. This can potentially lead to soil dispersion and decline in permeability resulting in transient water logging within the root zone (Rengasamy and Olsson, 1991). For many crops, water logging greatly increases the uptake of toxic ions exacerbating the salinity effects. (Boland *et al.*, 1996; Stevens and Prior, 1994)



Salt damage on surface

EFFECTS OF SALT ON DIFFERENT AGRICULTURAL CROPS

When concentration of the salt exceeds threshold value,

- Growth rate and size of the plant progressively decreased
- Plant becomes stunted with restricted lateral shoot development.
- Reduction in size of the leaves and fruits
- Decrease in fresh and dry weight of different plant parts



- Reduction on number of leaves resulted to low yield.
- Generally leaves becomes thicker than normal
- The top growth suppressed more than the root growth

Table 3. Percent leaves injured in mango seedling caused by different concentration of salt.

Concentration	NaCl	Na ₂ SO ₄	Mixture
Control	10.05	10.05	10.05
2 m mhos/cm	46.18	3.92	40.27
4 m mhos/cm	66.48	10.20	47.51
6 m mhos/cm	76.16	19.37	54.49
8 m mhos/cm	75.34	31.97	70.48
10 m mhos/cm	98.91	44.10	58.39
Mean	62.07	19.95	46.86

HAU, Hissar

Jindal (1972)

Table 5: Effect of various salinity treatments on survival percentage in guava

Salt	Survival percentage				Mean
	Concentration (%)				
	0.175	0.350	0.525	0.700	
NaCl	100.00	100.00	00.00	00.00	50.00
Na ₂ SO ₄	100.00	100.00	100.00	66.66	91.66
Na ₂ CO ₃	100.00	100.00	00.00	00.00	50.00
NaCl + Na ₂ SO ₄	100.00	100.00	66.66	33.33	74.99
Na ₂ SO ₄ + Na ₂ CO ₃	100.00	100.00	66.66	33.33	74.99
Na ₂ CO ₃ + NaCl	100.00	100.00	00.00	00.00	50.00
NaCl + Na ₂ SO ₄ + Na ₂ CO ₃	100.00	100.00	00.00	00.00	50.00
Mean	100.00	100.00	33.33	19.04	---
Control	100.00				

IARI, New Delhi.

Desai and Singh (1975)

**Conclusions:**

- Salinity is the major problem for the cultivation of Agricultural crops in large number of states in India i.e. Gujarat, Maharashtra, Rajasthan etc. which reduce the plant growth.
- NaCl was more injurious to leaves of mango seedlings as compared Na₂SO₄ and mixture of salts.
- Number of buds/vine was also reduced by 0.6% NaCl in different cultivars of grape.
- In guava salt concentration increase to 0.525% increase mortality and reduce the growth of plants.
- Saline water also reduces the nut yield and nut size of pecan tree.
- NaCl was more toxic as compared to Na₂SO₄ in many fruit crops.
- In citrus, Macrophylla and Rough lemon was more resistant to salts and mixture of salts.
- Increasing level of salts adversely affected the morphological character in plants. This is perhaps due to more Na accumulation in the root zone of plant which might decrease uptake of other essential nutrient which ultimately affected the growth of fruit crop adversely.

