# SALINE AND SODIC SOIL RECLAMATION

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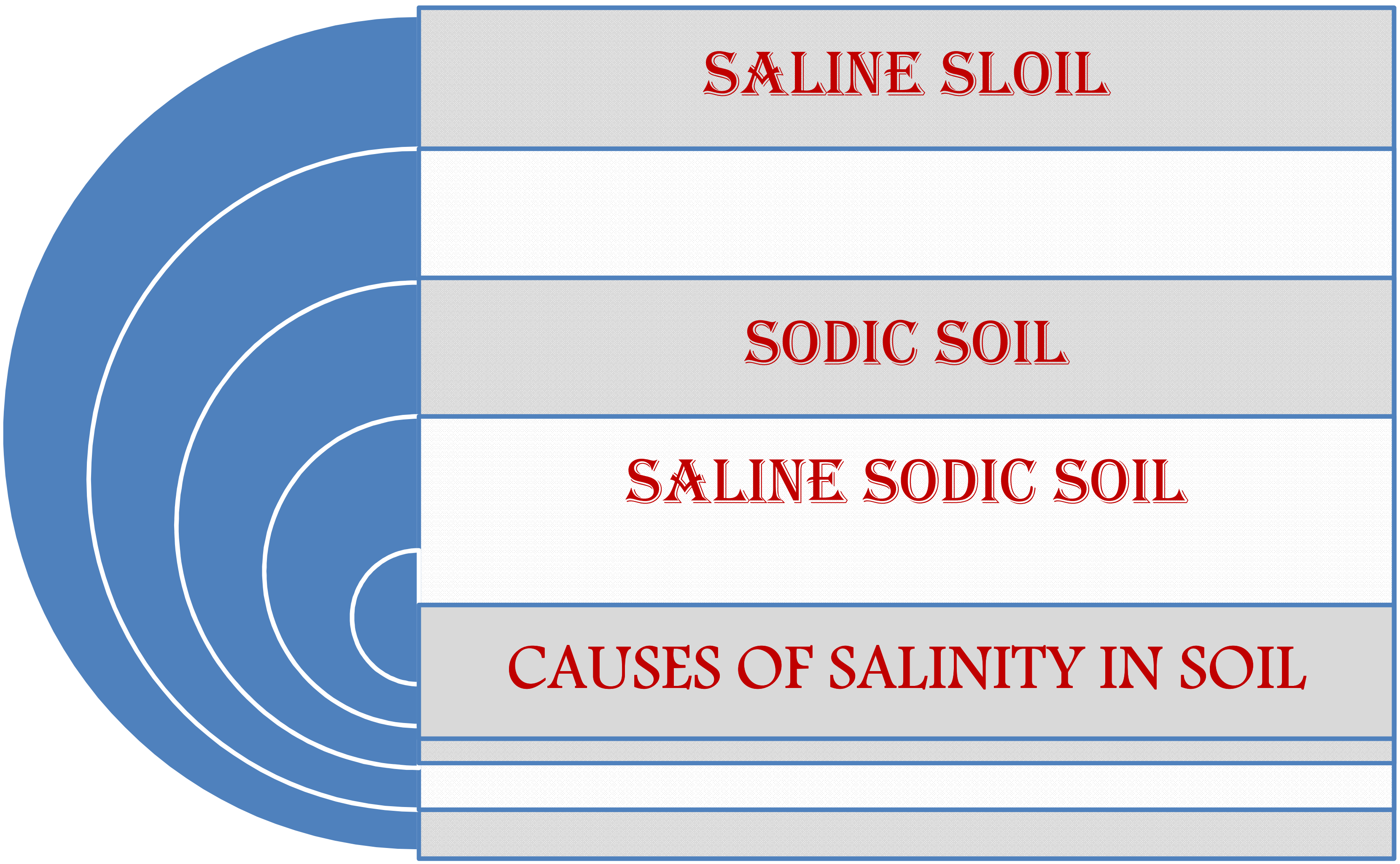
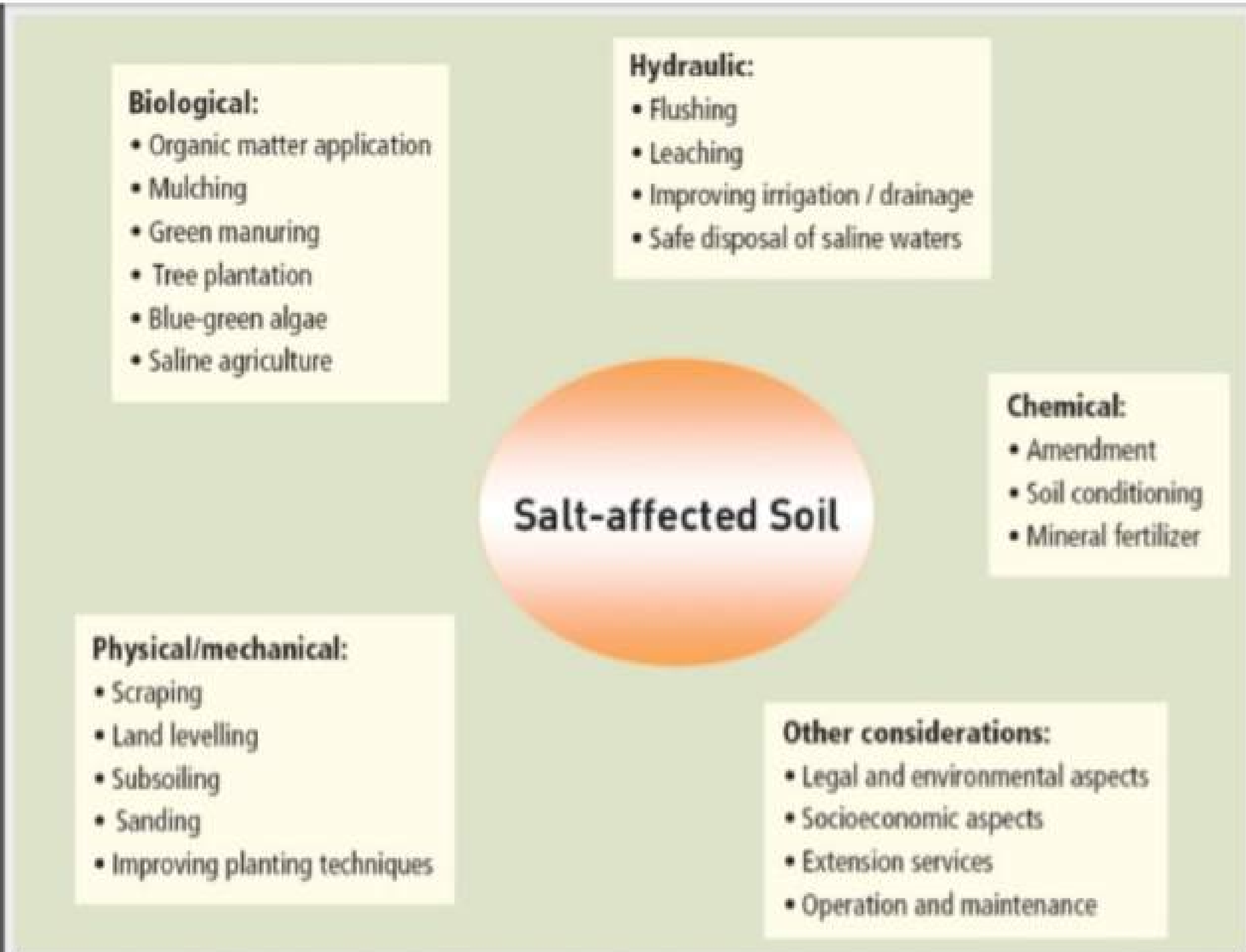
# MAIN THEMES OF SODIC SOIL FORMATION






Integrated management practices for the reclamation of salt-affected soils.

# Reclamation of Saline soil:

**(i)Removal of excess salt by good quality irrign water:**

Ponding and intermittent ponding is more efficient in leaching of

For the success of leaching water table must be sufficiently low

(ii) **Drainage of the soluble salts at surface and subsurface region:**

Surface drainage is for draining of excess rur

Subsurface drainage for lowering the WT

(iii) **Proper water mangement of cropping system are important for c**

## Salt Balance:

It is the balance between the **amount of salt leaving into the soil** throu water . While flushing care must be taken so that the salt balance becom positive. In this background a term is used which is known as **Leaching Requirement (LR).**

**LR----- it is defined as the fraction of irrigatic passing out or drained out through the root zone and expres**

The most common approach to salinity management is to maintain a prescribed *leaching requirement* (LR), defined as

$$\mathrm{LR} = \frac{D_{\mathrm{dw}}}{D_{\mathrm{iw}}} = \frac{\mathrm{EC}_{\mathrm{iw}}}{\mathrm{EC}_{\mathrm{dw}}} \qquad (11.10)$$

where $\mathrm{EC}_{\mathrm{dw}}$ and $\mathrm{EC}_{\mathrm{iw}}$ are the electrical conductivities (salt concentrations) of the drainage and irrigation waters, and $D_{\mathrm{iw}}$ and $D_{\mathrm{dw}}$ are the amounts of irrigation and drainage water. The relationship is based on the assumptions that a salt balance exists (i.e., that $\mathrm{EC}_{\mathrm{iw}} D_{\mathrm{iw}} = \mathrm{EC}_{\mathrm{dw}} D_{\mathrm{dw}}$) and that the plant is a perfect semipermeable mem-

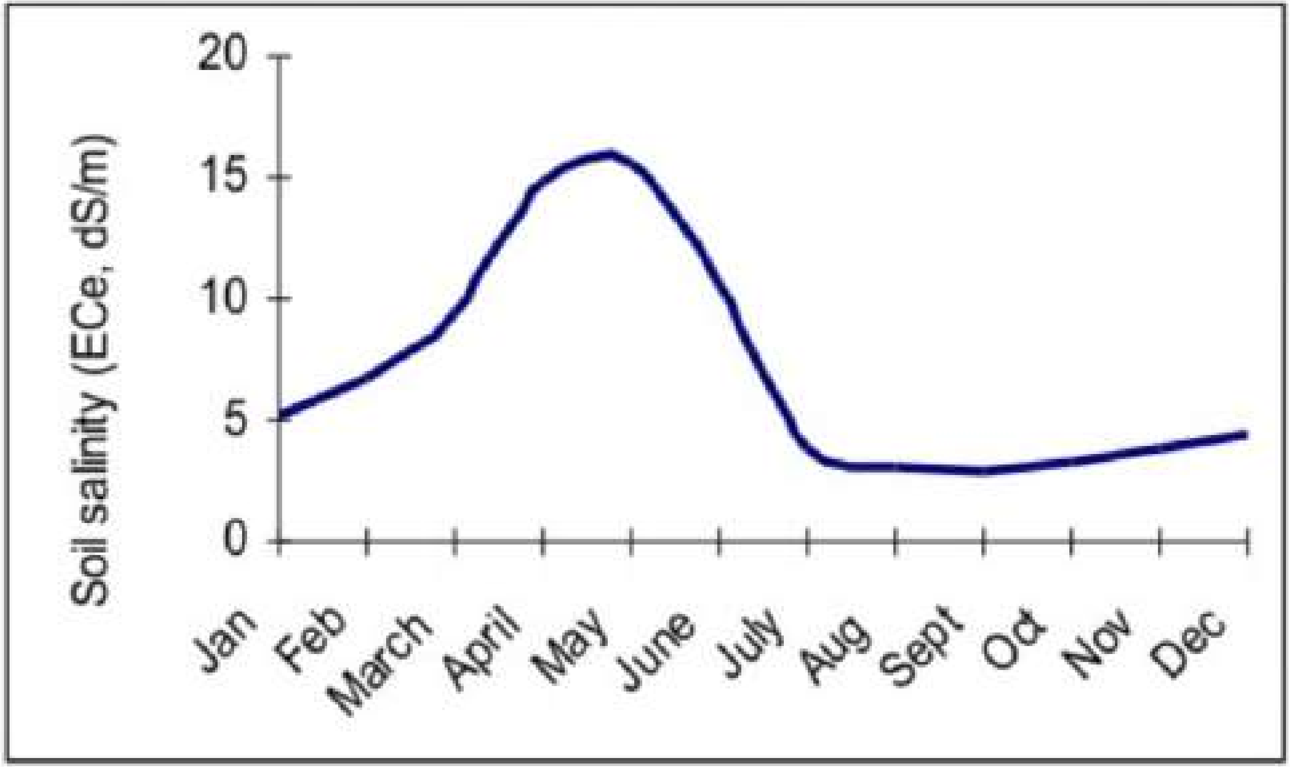
## Validity of eqn 11.10 depends on 3 assumptions

(i)Plant roots are assumed to have perfectly semipermeable membrane, i.e., it allows only water to enter into the cell but not salts

(ii)There should not be any precipitation of the soluble salts

(iii)There will not be any release of soluble salts from the soil

$$\mathrm{TDS}\ (\mathrm{mg\ L^{-1}}) \approx (\mathrm{EC}\ (\mathrm{dS\ m^{-1}}) \times 640$$




**Variation in soil salinity in different months of the year**

## Management strategies for combating SALINIZATION

1. **Soil Management:**

➢ Maintenance of satisfactory fertility levels, pH and structure of soils to encourage growth of high yielding crops;

➢ Maximization of soil surface cover, *e.g. use of* multiple crop species;

➢ Mulching exposed ground to help retain soil moisture and reduce erosion

➢ Crop selection, e.g. use of deep-rooted plants to maximise water extracn.

➢ Using crop rotation, minimum tillage, minimum fallow periods

2. **Water Management:**

➢ Efficient irrigation of crops, soil moisture monitoring and accurate determination of water requirements;

➢ Choice of appropriate drainage according to the situation:

a. Surface drainage systems to collect and control water entering and/or leaving the irrigation site;

b. Subsurface drainage systems to control a shallow water table below the crop root zone;

c. Biodrainage: the use of vegetation to control water fluxes in the landscape through evapo-transpiration.

➢ Adequate disposal of drainage water to avoid contamination of receiving waters and the environment.

## 3 imp. methods used to remove soluble salts from the root zone.

(i) **Scraping**: **Removing the salts that have accumulated on the soil surface** by mechanical means

(ii) **Flushing:** **Washing away the surface accumulated salts** by flushing water over the surface is sometimes used to desalinize soils having surface salt crusts.

(iii) **Leaching:**

This is by far the most effective procedure for removing salts from the root zone of soils. Leaching is most often accomplished by ponding fresh water on the soil surface and allowing it to infiltrate. **Leaching is effective when the salty drainage water is discharged through subsurface drains that carry the leached salts out of the area under reclamation.** Leaching may reduce salinity levels in the absence of artificial drains when there is sufficient natural drainage, i.e. the ponded water drains without raising the water table.

**Leaching should preferably be done when the soil moisture content is low and the groundwater table is deep.**

In some parts of India for example, leaching is best accomplished **during the summer months** because this is the time when the water **table is deepest** and the soil is dry. This is also the only time when large quantities of fresh water can be diverted for reclamation purposes.

## 2. Various management practices based on reducing the salt zone for seed germination and seedling establishment:

The early seedling establishment and tillering phase are generally the most sensitive stages to salinity. Any management practice that could provide an environment of reduced salt concentration during these stages would mitigate the salinity effects and benefit the crop by promoting plant densities and early seedling growth. A number of approaches have been used.

2.1. Scraping and removal of surface soil: Due to continuous evaporation the salt concentration is the highest in the surface soil. The top soil can be scraped and transported out of the field. The practice has been used in many areas of the world (Qureshi et al., 2003).

2.2. Pre-sowing irrigation with good quality water: Where available, irrigation with good quality water prior to sowing helps leach salts from the top soil. This helps in promoting better seed germination and seedling establishment. The benefits of this practice were documented in a long-term study by Goyal et al (1999 a,b).

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## 2.3. Appropriate use of ridges or beds for planting:

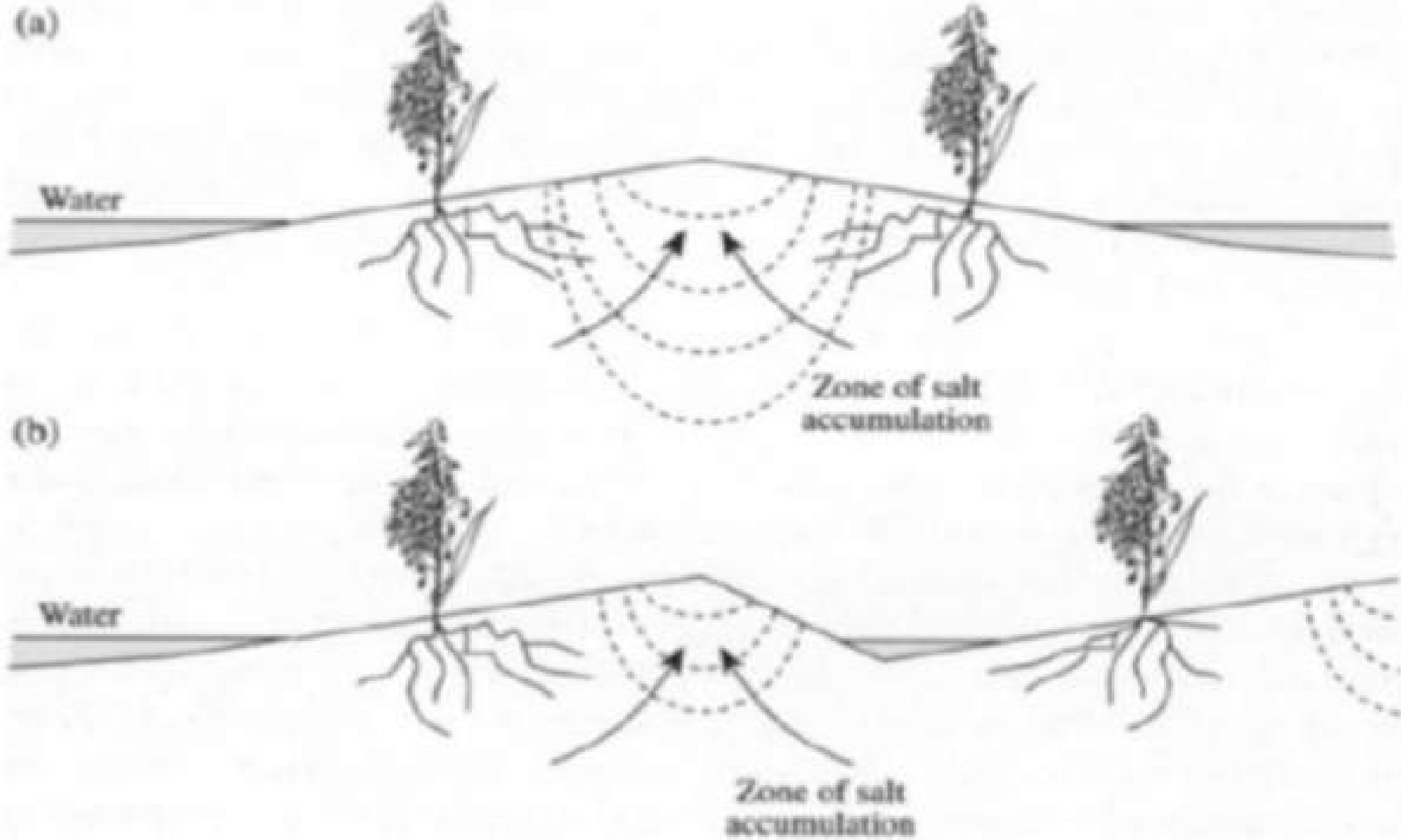
The impact of salinity may be minimized by appropriately placing the seeds (or plants) on ridges.

Where exactly the seeds should be planted on the ridge or bed will depend on the irrigation design.

- If the crop planted on ridges would be irrigated via furrows on both sides of the ridge, it is better to place plants on the ridge shoulders rather than the ridge top because water evaporation will concentrate more salts on the ridge top or center of the bed.

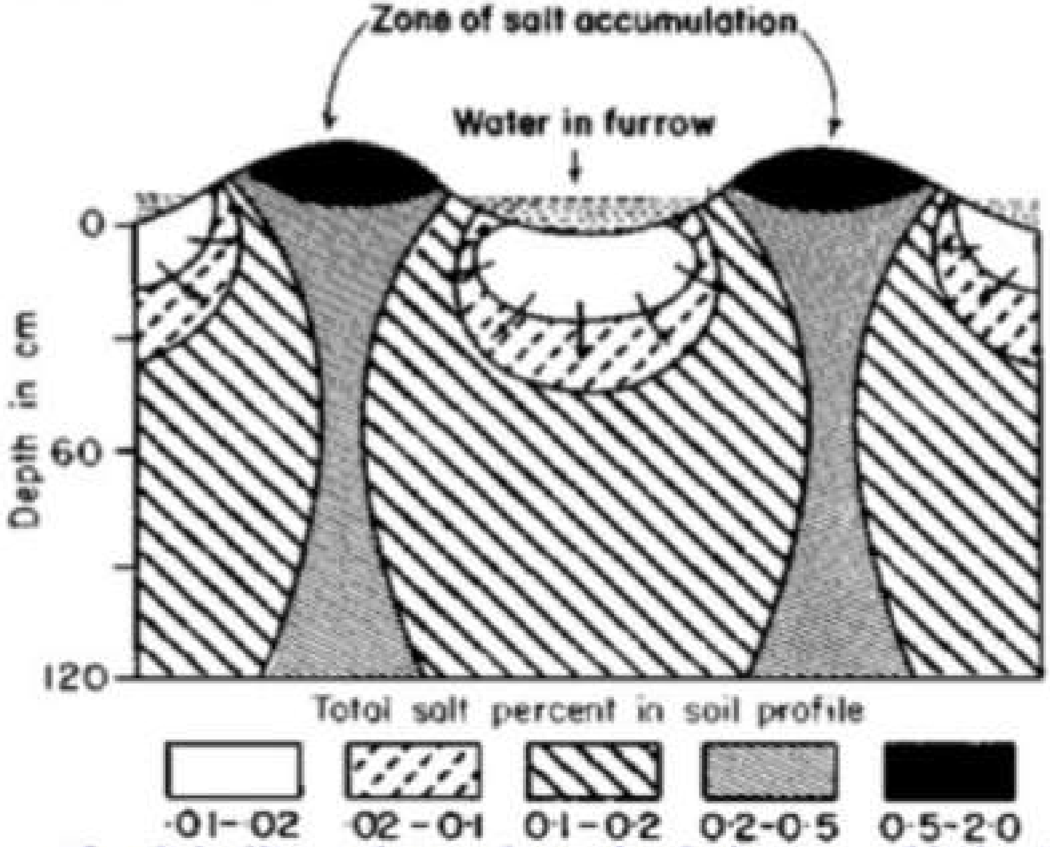
- If the crop is irrigated via alternate furrows, then it is better to plant only on one shoulder of the ridge closer to the furrow that will have water.

Sloping beds may be slightly better on highly saline soils because seed can be planted on the slope below the zone of salt accumulation.

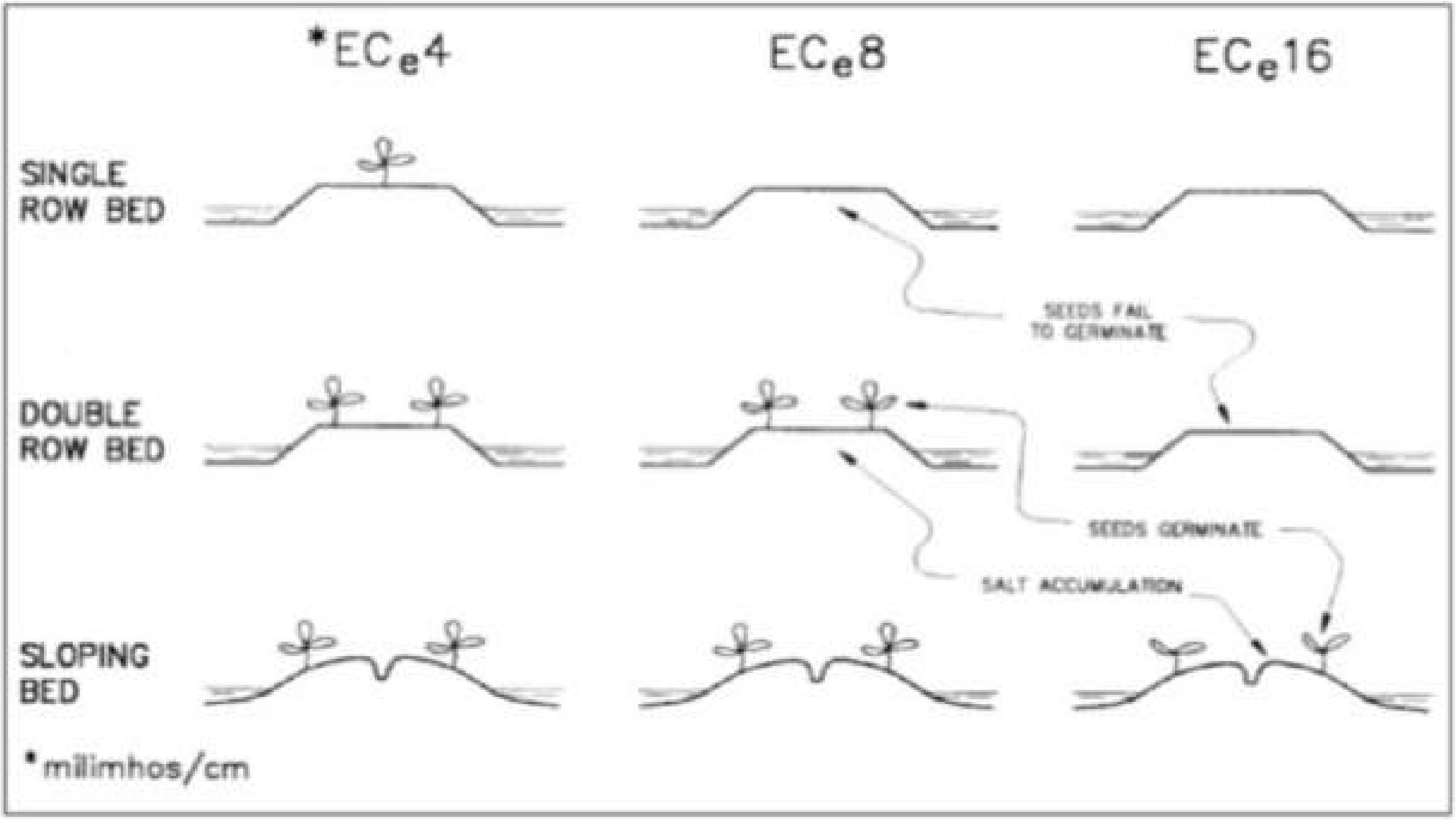



Microtopography of ridge and furrow systems designed to avoid salinity damage to crops: (a) paired crop rows on broadly sloping ridges, (b) single crop rows on asymmetric ridges (from White 1987)

Certain modifications of the furrow irrigation method including planting in single/double rows or **on sloping beds**, are helpful in getting better stands under saline conditions. With **double beds**, most of the salts accumulate in the centre of the bed **leaving the edges relatively free of salts**.




**The pattern of salt built up depends on bed shape and irrigation method.**
Seeds sprout only when they are placed so as to avoid excessive salt build up around them (Bernstein et al., 1955)




**Pattern of salt build-up as a function of seed placement, bed shape and irrigation water quality.**

3. General management practices to reduce the impact of soil salinity on crop performance: In addition to the management practices mentioned above, the following approaches may help reduce salinity impacts.

3.1. Mulching:

Mulching with crop residue, such as straw, reduces evaporation from the soil surface which in turn reduces the upward movement of salts. Reduced evaporation also reduces the need to irrigate. Consequently fewer salts accumulate.

3.2. Deep Tillage:

Accumulation of salts closer to the surface is a typical feature of saline soils. Deep tillage would mix the salts present in the surface zone into a much larger volume of soil and hence reduce its concentration and impact. Many soils have an impervious hard pan which hinders in the salt leaching process. Under such circumstances "chiseling" would improve water infiltration and hence downward movement of salts.

leaching fraction (LF) of the soil under irrigation, i.e. the proportion of applied water moving below the root zone.

## Soil type and average root zone leaching fraction

| Soil type | Average root zone LF |
|---|---|
| Sand | 0.6 |
| Loam | 0.33 |
| Light clay | 0.33 |
| Heavy clay | 0.2 |

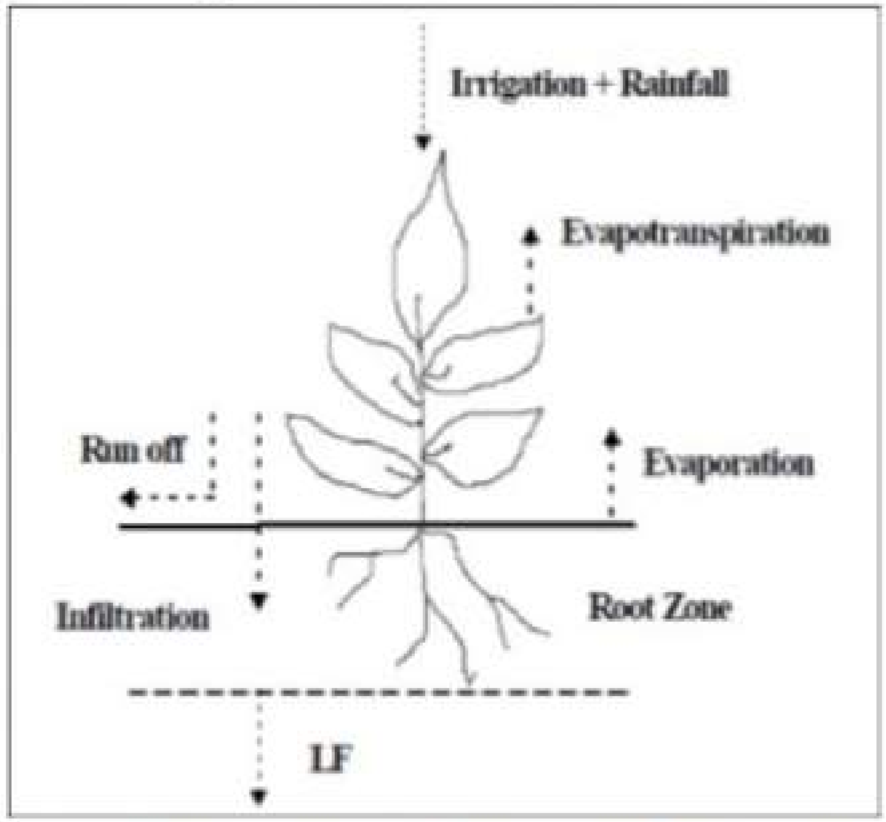



Figure 2—Diagram of the leaching fraction (LF) concept

### 3.3. Incorporation of Organic matter :

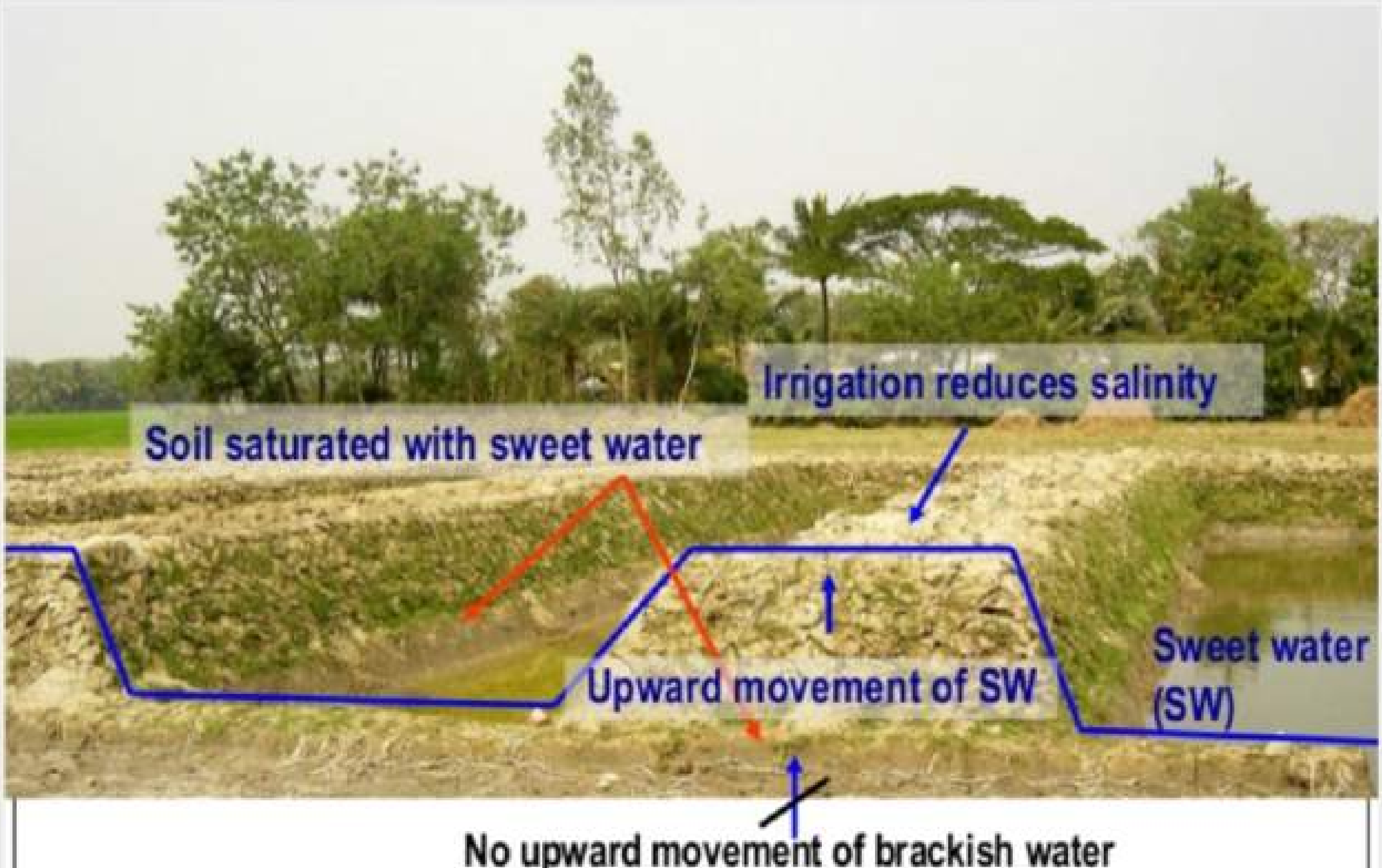
Incorporating crop residues or green-manure crops improves soil tilth, structure, and improves water infiltration which provides safeguard against adverse effects of salinity. In order for this to be effective, regular additions of organic matter (crop residue, manure, sludge, compost) must be made.

**Table 2. Leaching requirement for typical irrigation waters in California as related to salt tolerance of crop (taken from J.D. Oster, G.J. Hoffman and F.E. Robinson, California Agriculture, October 1984).**

| Salinity of applied water (dS/m) | Leaching requirement | | | |
|---|---|---|---|---|
| | Sensitive crop | Moderately sensitive crop | Moderately tolerant crop | Tolerant crop |
| 0.05 (freshwater canal) | 0.01 | 0.01 | 0.01 | 0.01 |
| 0.3 (California aqueduct) | 0.05 | 0.02 | 0.02 | 0.02 |
| 1.3 (Colorado River) | 0.14 | 0.07 | 0.04 | 0.02 |
| 5.0 (reused drainage) | not possible | 0.27 | 0.15 | 0.10 |

Conservation farming practices to control soil salini

- Reducing summer fallow
- Using conservation tillage
- Adding organic matter to the soil
- Planting salt-tolerant crops




## Reduce effect of degradation due to land shaping


WE NEED EVERYONE'S HELP TO STOP POLLUTION
IT'S YOUR WORLD... HELP KEEP IT CLEAN!


THANK YOU