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# **BREEDING FOR SALT TOLERANCE**



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**Salt Tolerance:** refers to the ability of plants to prevent, reduce or overcome injurious effects of soluble salts present in their root zone.

It is a global problem as saline and alkali soils are found in almost all the countries of the world, more in Semi Arid Tropic (SAT) of world.

Problem of salinity can be overcome by two ways:

1. Soil reclamation : costly, time consuming and short lived
2. Resistant varieties : less costly, more effective, long lasting require longer period to develop.



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## **Behavior / characteristics of plants to salt :**

1. Land races more tolerant than High yielding varieties. Tolerant plants varieties are found in salt affected areas
2. Salt tolerance capacity differs from species to species. Also genetic differences exist among cultivars for their salt tolerance capacity.
3. Different crop plants show differential response to salinity
4. Higher ploidy level crops are more tolerant than lower ploidy level crops.  
Eg. Hexaploid wheat more tolerant than tetraploid  
Tetraploid Brassica more tolerant than diploid Brassica
5. In rice tall, coarse grained, late maturing varieties- more tolerant



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6. In sugarcane different strains have differential tolerance;  
Barley is more tolerant than wheat.

**a. Highly tolerant crops:** Sugabeet, sunflower, barley (grain), cotton, datepalm, asparagus

**b. Moderately Tolerant crops:** Barley (Forage), rye, sorghum, wheat, safflower, soybean

**c. Moderately sensitive:** Rice, corn, foxtail millet, cow pea, peanut, sugarcane, tomato, potato, sweet potato, radish, alfalfa, cabbage

**d. Extremely sensitive:** Citrus, straw berry, melon, peas, other legumes, apple, rajmabean, carrot, okra, onion (orange)



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## **Symptoms of plants to salt stress :**

1. Retardation / cessation of growth
2. Necrosis
3. Leaf abscission
4. Loss of turgor
5. Ultimate death of plant

## **Mechanisms of salt tolerance :**

2 types of mechanisms

1. **Salt Tolerance** : Plants respond to salinity stress by accumulating salt, generally in their cells or glands and roots etc.



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2. **Salt avoidance** : plants avoid salt stress by maintaining their cell salt concentration unchanged either by water absorption eg. Rice, chenopodiaceae family or by salt exclusion eg. Tomato, soybean, citrus, wheat grass

**Glycophytes** (Non-halophytes) plants owe their resistance primarily to avoidance. Eg. Barley

**Hallophytes** (plants that grew in salty or alkaline soils) show tolerance by ion accumulation mechanism



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## Breeding methods

Breeding methods are same but breeding strategies are

1. Breeding for yield potential should have greater emphasis than breeding for salt resistance per se (As screening is done on the basis of yield reduction in stress environment as compared to non-stress Environment.).
2. Selection should be done in stresses target environments (As abiotic stress resistance is an important part of Environ. Fitness & is bound to be location specific i.e. it is related to narrow adaptation.



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## Screening Techniques

Common methods are

1. Sand culture by using nutrient solution in sand & irrigation with saline water
2. Solution culture by using solution culture tanks (Hydroponic culture)
3. Microplot techniques by using small microplots

Microplot Techniques: By using small microplots of size 6 x 3 x 1 m (CSSRI, Karnal, Haryana) at central soil salinity Research Institute.

Then Multilocation Trial (MLT) conducted over seasons to get more reliable results. Genotypes which survive better under salinity are considered tolerant & tested further.



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## **Selection criteria**

1. Germination (%) in saline medium
2. Dry matter accumulation (seedling / plant dry wt.) / Early vigour
3. Leaf senescence or death – Estimated by total dead leaf area or No. of dead leaves
4. Leaf necrosis
5. Leaf ion content
6. Osmoregulation (Determined as maintenance of turgor under stress) Measured as proline or CHO accumulation or accumulation of glycine, betaine etc.
7. Yield – Economic yield



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## **Problems**

1. Creation of reliable controlled salinity Env.
2. Scoring for salinity resistance
3. Genetic control – it is complex & polygenic
4. Mechanisms of resistance poorly understood. Salinity may have interaction with other stresses.