

BREEDING FOR ABIOTIC STRESS RESISTANCE (Drought, Cold, Salinity and alkalinity)

1. Temperature stress

a. Cold resistance / tolerance : This is applicable in case of rice grown in Gudalur taluk of Nilgiris and Cumbum valley. Numerous methods have been developed for the evaluation of cold hardiness. This included artificial low temperature and freeze tests. However, none them is useful for single plant selection. This is a handicap for the breeder. Testing the segregating lines under field condition is the most suitable one. But this will be time consuming and often favorable conditions may not be available.

b. High temperature : Due to high temperature seed set may be affected. In case of male sterile lines, the sterility may be broken down. In this case also testing single plants for high temperature resistance is time consuming and skill is required. Tests like heat test with leaf discs and desiccation tolerance test are followed.

2. Water stress

a. Low water i.e., Drought resistance : This is more important for all the dry land crops. 75% of area is cultivated under rainfed conditions and drought tolerance is more important.

Drought resistance in crop plants can be divided in to three categories.

- i. Drought escape - ability of a plant to complete its life cycle before serious soil and plant water deficit occurs.
- ii. Drought tolerance with high tissue water potential
- iii. Drought tolerance with low tissue water potential

Drought resistance in crop plants are more due to physiological conditions of plant like stomatal aperture and photosynthetic rates, root characteristics. Various techniques have been developed to test drought resistance. One e.g. is accumulation of proline in leaves. Because of the high skill needed in evaluating the single plants the process is tedious.

b. Excess water: This is the case in places like tail end areas of Cauvery delta. here the paddy varieties must have long stem - i.e., deep water paddy. The screening procedure is done both under field conditions and laboratory conditions .

3. Chemical stress

a. Salinity and alkalinity : Screening for salinity and alkalinity can be done more successfully by in vitro techniques. Raising the seedling in test tube containing different concentration of salt is done in case of rice. This is followed in case of pesticide and herbicide tolerance also.

4. Wind tolerance

Wind with high velocity may cause evaporation of soil moisture and tip drying in many crops. But this stress is not a serious problem in Tamilnadu.

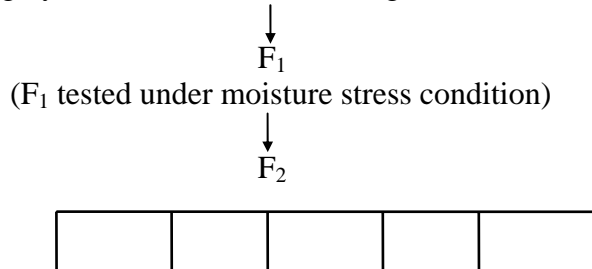
5. Difficulties in abiotic stress breeding

- i. Screening techniques require high skill and they are time consuming
- ii. Creation of artificial conditions is expensive.

- iii. Under field screening, nature may or may not provide optimum condition for screening.
- iv. In many cases *in vitro* techniques are to be followed which is expensive.
- v. Abiotic stress breeding depends mostly on physiological traits which are often not stable.

B. Breeding for Drought resistance variety

High yield x High cuticular wax content (Poor cuticular Transpiration)



- 1. Progeny rows screened in moisture stress nursery in two locations
- 2. Selection based on cuticular wax and no agronomic characters are considered

↓
F₃

Selected single plants - Screened under normal conditions for yield and then associated characters

↓
F₄

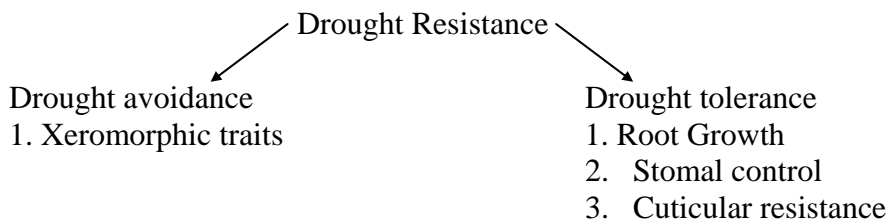
Selected single plants - Screened under stress situation

↓
F₅ - Normal condition - yield
↓
F₇/F₈

- 1. Homogeneity with relative resistance to drought and with considerable yield
- 2. Converge genes for yield and drought resistance

C. Breeding for Drought Resistance

- 1. Breeder search for a source for Drought resistance
- 2. Yield should be a secondary character Economic Parts
- 3. Partitioning of photosynthates Vegetative Parts
Total Dry matter should be taken as a criterion for selection.



- (water permeability of leaf cuticle
4. Stomatal No.
(transpiration low, low stomatal
frequency and high photosynthetic rate)
5. Cell turgor (Inhibit plant growth)
(root water absorption \Leftrightarrow stomatal water
loss)

D. Screening for salt tolerance

Rice varieties of differing salt tolerance level : IR.20 & IR.50 (susceptible)
: Co 43 & Manoharsali (Moderately tolerant)
: Dasal & Pokkali (highly tolerant)

1. Salinized soil method

Crosses were made between susceptible and moderately tolerant; susceptible x highly tolerant; and moderately x highly tolerant types. The parents along with F1 progenies and subsequent segregating progenies have to be screened for their tolerance.

Plastic tubs (45 x 30 x 45 cm) with 10kg of soil was taken one with normal soil and others salinized with 6 liters of 0.3 % NaCl solution, so that the electrical conductivity was raised to 4.9 M m/cm uniformly in all the tubs. Then the plant materials (labeled 20 day old seedlings) to be tested are planted in the tub with a spacing of 15 x 10 cm so that each tub carries 6 seedlings. Normal cultural practices were followed and irrigated daily to maintain a water level of 1 cm above the soil level. Once a week the soil between the plants was carefully raked to facilitate mixing and aeration. The plants were grown to maturity and data were recorded for yield characters. The cultivar which recorded a grain yield on par with culture in control is selected as tolerant.