

RESISTANCE BREEDING

BOT-SPT-2.3.2: Plant Breeding and propagation.

Online Class session: 01 & 02

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Introduction.

In India agriculture is the main part of life, and farmer is back bone of country. Without agriculture human life unimagivable because agriculture is the main source of food for human life. For example today our world is affected by Covid-19, and India is completely locked down, but they give exception for agriculture activities because we need food.

But now a days farmer facing so many problems in agriculture like natural disasters, climatic imbalance, effect of other organisms, etc...

In that way problems of drought, salinity and alkalinity are of major concern among environmental stresses. In order to save farmer we have to improve the characters of plants and make them to adopt in that environment.

DROUGHT RESISTANCE:

- Drought refers to the condition of soil moisture deficiency or water scarcity. Soil drought is more common in the arid and semi arid tropics and in the areas of steep slope. Thus desert areas are more prone to drought conditions.
- drought resistance refers to survival of plants under water deficit or scarcity conditions without injury. Improvement in the drought tolerance ability of a plant is known as drought hardening

Mechanisms of Drought Resistance:

- Drought escape,
- Drought avoidance
- Drought tolerance
- Drought resistance.

1. Drought Escape:

- Simplest and well adopted way of survival under drought conditions is to escape drought. Generally, drought occurs either in the mid or late-crop season.
- Drought escape is most common in case of plants grown in desert regions. They complete their life cycles in 4 to 6 weeks.

2. Drought Avoidance:

- It can be defined as the plants which avoid drought retain high water contents in their tissues or ability of the plant to maintain a favorable internal water balance under moisture stress.
- Drought avoidance leads to reduction in photosynthesis and thereby reduction in the growth of aerial parts. It leads to increase in root development and therefore, is more important than drought tolerance.

3. Drought Tolerance:

- The ability of crop plants to withstand low tissue water content is referred to as drought tolerance. Drought tolerance is more desirable because the crop can produce more yield at lower water potential. In cereals, drought tolerance generally operates during reproductive phase.
- Drought tolerance differs from drought avoidance in several aspects.

4. Drought Resistance:

- Drought resistance is the sum of drought avoidance and drought tolerance. In other words, drought resistance refers to the ability of crop plants to give good yield under moisture deficit conditions.
- Drought resistance is measured in terms of various mechanisms associated with drought tolerance and yield under soil moisture deficit.

Source of Drought Resistance in Plant Breeding

1. Cultivated varieties,
 2. Germplasm collections, and
 3. Wild relatives and wild species.
- Transfer of drought resistance is easy from cultivated variety and germplasm of cultivated species, because such material can be easily used in the breeding programmes. Moreover, there is no problem of cross incompatibility.
 - When the source of drought resistance is a wild species, the transfer of resistance poses several problems such as cross incompatibility, hybrid inviability, hybrid sterility and linkage of several undesirable genes with desirable ones. Wild sources of drought resistance have been reported in wheat, sugarcane, tomato, and several other crops.

Plant Breeding Methods for Drought Resistance

- Breeding methods for drought resistance are the same as for yield and other economic characters. Breeding for drought resistance refers to breeding for yield under soil moisture stress condition. In other words, it refers to yield improvement in environment represented by water deficit.
- Four breeding stages, viz.
 - 1) Introduction
 - 2) Selection
 - 3) Hybridization
 - 4) Mutations

- Measurement of Drought Resistance in Plant Breeding Various procedures are used for measuring drought resistance in crop plants. The most commonly used procedures include:
 1. Leaf water retention
 2. Photosynthesis
 3. Yield performance,
 4. Root lengths of performance.

1. Leaf Water Retention:

- In this method leaves are excised from the plant and are allowed to dry. The slower drying genotypes are considered as drought tolerant. In other words, the high water retainer genotypes are considered as drought tolerant.

2. Rate of Photosynthesis:

- The rate of photosynthesis during and after moisture stress is an important index of drought resistance. The genotypes which have high photosynthetic rate under moisture stress are considered as drought resistant, because such genotypes give higher yield than those having low photosynthetic rate.

3. Yield Performance:

- Superior yield performance under moisture stress conditions is an important and reliable index of drought tolerance. The yield tests should be conducted in drought prone areas at several locations or for several years. These will help in identification of genotypes with drought resistance and also in the elimination of drought susceptible lines.

4. Root length performance:

- Some of the plants longer and wider root length its because these shows the searching for moisture in all available conditions in all directions. Plants which bears long roots can absorb water from underground water table also

SALINITY RESISTANCE:

- Salinity is one of the most serious factors limiting the productivity of agricultural crops, with adverse effects on germination, plant vigor and crop yield.
- Salinization affects many irrigated areas mainly due to the use of brackish water. Worldwide, more than 45 million hectares of irrigated land have been damaged by salt, and 1.5 million hectares are taken out of production each year as a result of high salinity levels in the soil

- **Salinity** occurs through natural or human-induced processes that result in the accumulation of dissolved salts in the soil water to an extent that inhibits plant growth.
- **Sodicity** is a secondary result of salinity in clay soils, where leaching through either natural or human-induced processes has washed soluble salts into the subsoil, and left sodium bound to the negative charges of the clay.

Salinity can be overcome by

- Soil reclamation : Costly, time consuming & short lived.
- Resistance varieties : Less costly, more effective, long lasting but require longer period to develop.

Mechanism of salinity resistance

- 1. Salt tolerance:** In this mechanism plants show that they even absorb the salt content through water they store them in cells, salt glands or in the roots. So that salt doesn't affect plants. For example halophytes show the storage of salt in glands (Ion accumulation mechanism).
- 2. Salt avoidance :** In this type plants themselves avoid the absorption of salt content from water by some adaptations or mechanism. For example glycophytes (non-halophytes) don't allow the salt content to enter into the plants. Ex: Barley.

Sources of Salinity resistance

- Cultivated variety
- Germplasm collection
- Related species

Classified based on Salt tolerance

1. High tolerant crops:

Sugar beet, Barley, Cotton, Date palm, Asparagus

2. Moderately tolerant :

Barley, Rye, Sorghum , Wheat, Safflower, Soybean

3. Moderate Sensitive :

Rice, Corn , Foxtail millet, Cowpea, Peanut,
Sugarcane, Tomato, Potato, Radish, Cabbage

4. Extremely Sensitive :

Citrus, Strawberry, Melon, Peas, Carrot, Okra, Onion

BIOTIC RESISTANCE

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BIOTIC RESISTANCE

- It can be defined as the resistance power of the plant developed by itself or by breeding against biotic stress.
 - Ex: Disease resistance.

BIOTIC STRESS

- It can be defined as stress to the plant by other living organisms, such as bacteria, viruses, fungi, parasites.

Disease resistance.

- As we know agriculture is facing so many problems, among them plant diseases are also. Every year 15% of the yield will be lost by diseases only.
- The main reasons for diseases in plants are the pathogens. The main disease causing agents are fungal, bacterial and viral pathogens. Some times they may damage entire crops.

Fungal diseases

- *Puccinia triticana*- Brown rust in cereals like wheat, barley etc.
- *Glomerella tucamensis*- red rot of sugar cane.
- *Phytopthera infestans*- late blight of potato

Bacterial disease

- *Xanthomonas compestris*- Black rot in cruciferons

Viral disease

- Tobacco mosoic virus: Mosoic disease in Tobacco plants.

Factors responsible for causing disease in plants.

- Host genotype
- Pathogen genotype
- Environmental factors

Breeding for Disease resistance

- It can be defined as the breeding 2 plants of same species or relatively same plants in which one of the plant may have the ability to resist against certain disease.
- Plant diseases are caused by pathogens that vary in nature and may be microscopic or readily visible (e.g., virus, plant, animal).
- Six general groups of causal agents of disease, which represent six general approaches to breeding for pest resistance, may be identified as: airborne fungi, soil-borne fungi, bacteria, viruses, nematodes, and insects.

- Plant species vary in their susceptibility to diseases caused by pathogens or pests in each group. Cereal crops tend to have significant airborne fungal disease problems, while solanaceous species tend to experience viral attacks.
- Breeding for resistance to fungi, especially airborne fungi, is the most prominent resistance breeding activity.

Types of breeding methods

- Conventional methods.
 - First we screen the germplasm for the source of resistance.
 - Then we carryout the artificial hybridization of the high yielding crop varieties with these disease resistant varieties.
 - The progenies are selected and evaluated for high yield and disease resistance.
 - Then the progenies are tested and released as new varieties.
 - Ex: Himgiri:- disease resistance against leaf rust.

- Genetic engineering method
 - It is a highly evolved method. Because in this method we can breed the genes of two different varieties.
 - Ex: Rx1 gene of maize plant can be breed with rice which leads to the development of disease resistance against bacterial street disease caused by *Xanthomonas oryzae*

- Mutation breeding

- In this methods physicals agents are used like chemicals, gamma radiations etc.
- Since these changes are heritable, the plants with desired charecters are then selected and used as a source in breeding of new plants. This type of breeding is known as mutation breeding.
- Ex: in Mung bean resistance to yellow mosoic virus is done by mutation breeding.

