

BREEDING FOR DISEASE RESISTANCE

Disease is an abnormal condition in the plant produced by an organism

Host : Plant affected by disease.

Pathogen : Organism that produces the disease.

Damage due to disease

- i) Reduces total Biomass leading to yield loss
- ii) Stunted growth
- iii) Sterility

Need for disease resistance breeding

- i) To prevent yield loss
- ii) High cost reduction
- iii) Prevention of environmental pollution

Kinds of disease reaction :

i). **Susceptible reaction** :

Disease reaction is profuse, if unchecked it may lead to total yield loss.

ii) **Immune reaction** :

Host does not show the symptoms of a disease

iii) **Resistance reaction** :

Infection and establishment takes place but growth of the pathogen in the host is restricted

iv). **Tolerance** :

Host is attacked by the pathogen in the same manner as the susceptible variety but there may not be yield loss.

Vertical and horizontal resistance

These terms were introduced by Van der plank.

Vertical resistance :

It is also known as race specific, pathotype specific or specific resistance

Vertical resistance is generally determined by major genes and is characterised by pathotypic specificity. Pathotype specificity denotes that the host carrying a gene for vertical resistance is attacked only by that pathotype which is virulent towards the resistant gene, to all other pathotypes the host will be resistant.

Only two types of disease reaction can be seen i.e. immune or susceptible reaction. When virulent pathotype becomes frequent. There may be epidemics.

Vertical resistance is not long lasting.

Horizontal resistance :

It is race non specific, pathotype non specific or general resistance.

Horizontal resistance is governed by polygenes, that is many genes with small effects and it is pathotype non-specific.

Horizontal resistance does not prevent the development of symptoms but it slows down the rate of spread to the disease in the population.

HR is more stable compared to VR.

Mechanism of disease resistance :

a) **Mechanical** : Certain mechanical or anatomical features of host may prevent infection. E.g. Closed flowering habit of wheat and barley prevents infection by spores of ovary infecting fungi.

b) **Hypersensitivity** : Immediately after infection several host cells surrounding the point of infection die. This leads to death of pathogen also. Phytoalexins present in plant body is responsible for hypersensitivity reaction.

c) **Antibiosis** : Presence of some toxic substance. This is more correct for insect resistance. E.g. Gossypol content in cotton.

d) **Nutritional factors** : The reduction in growth and spore formation may be due to nutritional factors of the host.

Genetics of disease resistance :

a) **Oligogenic resistance :**

Resistance is governed by one or few major genes and resistance is generally dominant. The action of major genes may be altered by modifiers.

Gene for gene relationship

Flor (1956) proposed this based on his work in linseed rust. According to this for every resistance gene present in the host, the pathogen has a gene for virulence. Susceptible reaction will result when the pathogen is able to match all the resistant genes with virulence gene.

	R ₁	R ₂	R ₃	R ₄
Susceptible	V ₁	V ₂	V ₃	V ₄
Resistance	R ₁	R ₂	R ₃	R ₄
		V ₂		V ₄

b) Polygenic inheritance :

The genes show both additive and non - additive effects and there is large environmental effects.

c) Cytoplasmic inheritance :

T cytoplasm - Maize
Tift 23A cytoplasm - Cumbu
Susceptible to disease.

C and M cytoplasm of maize resistant to *Helminthosporium*.
L 111A and 732 A cytoplasm resistant to downy mildew in cumbu.

Methods of disease resistance breeding

1. Plant introduction :

Resistant varieties from other can be directly introduced for cultivation. E.g. IR 20 rice resistant to blast.

2. Selection :

This may be from local land races or from introduced cultivars. E.g. Co 4 Gobi Anaikomban resistance to blast. NCAC 17090 ground nut resistant against leaf spot.

3. Hybridisation and Selection:

- a) Intervarietal - Co37 Rice resistant to blast
- b) Inter specific - Powdery mildew resistance in *Sesamum*
- c) Inter generic - *Atylosia* for root rot in red gram.

Depending on gene action the selection procedure may vary. If the resistance is governed by polygenes, then pedigree method of selection is to be followed.

If the resistance is governed by major genes linked with other undesirable characters we have to go for back cross method of breeding. Here again for dominant gene the back cross method is different from recessive gene governed traits.

1. Mutation breeding

Co2. Ground nut tolerant to late leaf spot disease.

2. Polyploidy breeding:

Nicotiana crosses for resistance against leaf spot..

3. Tissue culture method.

Resistance reaction can be screened easily in test tubes and resistant lines can be mass multiplied. E.g. Banana, Cardomum.

Screening techniques for disease resistance

Depending on mode of spread of disease the screening technique may differ. The screening can be done both at screen or glass house level and field level. The different screening techniques are as follows.

Soil borne diseases :

Wilt, root rot are produced by soil borne fungi. In this case sick plot technique is followed. Susceptible varieties can be grown and infected plants can be ploughed *insitu* to maintain optimum condition for infection.

Air borne diseases:

E.g. Rust, Smut, mildews, blights.

For ground nut rust, infestor rows can be sown 15 days earlier as border rows and the disease will infest the susceptible infestor rows. After 15 days the varieties tested to be are to be sown. Spraying the spore suspension from affected leaves will also increase the load.

Seed borne disease :

Smut, bunt etc. Artificial inoculation can be done by soaking the seeds in solution of pathogen under *vaccum* condition.

Insect transmitted diseases.

Insect transmitted diseases :

E.g. virus diseases, Red gram sterility mosaic virus. Sap transmitted. Here the stapling technique is used. Leaves from affected plants can be stapled to the entries to be tested. The insect feeding in susceptible leaf will transmit virus to test entries.