

## **CONCEPT OF RESISTANCE AND DEFINITIONS OF RESISTANCE, SUSCEPTIBILITY AND TOLERANCE. TYPES OF RESISTANCE, HORIZONTAL VERSUS VERTICAL RESISTANCE**

### **1. CONCEPT OF RESISTANCE**

Plants possess many classes of compounds with antimicrobial properties which may confer at least a measure to resistance. Since they are present before microbial challenge they have been termed phyto-anticipins. Two types of evidence have been put forward to support their role as resistance factors. The first is correlatives. The better the correlation between possession of high concentration of the compound and resistance, the more likely it is that the inhibitor is the cause of the resistance. This evidence is strengthened if it can be shown that varying the concentration of inhibitor in the plant leads to variation in resistance. The second type of evidence is genetic and relies upon obtaining mutants that are less sensitive to the inhibitor or insensitive and showing that they are more virulent than the wild type. Such mutants may lack the target of the antimicrobial compound and, in these instances, crossing the mutants with the wild type and showing that virulence and insensitivity are always inherited together constitutes strong evidence that the compound is a resistance factor. Alternatively wild-type pathogens may be transferred with genes which encode enzymes that render the compound non-inhibitory. Here, increased virulence of the transformants would be evidence for the antimicrobial compounds playing a role in resistance.

Plants are primary producers, providing a rich source of nutrients not only for the human population but also for all other organisms that require fixed carbon compounds for sustenance. It is not surprising, therefore, that some of these have developed the ability to parasitize plants, employing such weapons as degradative enzymes and toxins and subverting the metabolism of the host to their own ends. Despite this onslaught plants have survived. They therefore must have adequate mechanisms of defending themselves.

### **A. RESISTANCE**

1. The refusal to accept or comply with something
2. The ability not to be affected by something, especially adversely.
3. Relative to a susceptible plant, disease resistance is the reduction of pathogen growth on or in the plant (and hence a reduction of disease).

4. “Those characters that enable a plant to avoid, tolerate or recover from attacks of disease under conditions that would cause greater injury to other plants of the same species”.
5. “Those heritable characteristics possessed by the plant which influence the ultimate degree of damage done by the disease”.

## **B.SUSCEPTIBILITY**

1. The state or fact of being likely or liable to be influenced or harmed by a particular thing.
2. A person's feelings, typically considered as being easily hurt.
3. The quality or state of being susceptible especially: lack of ability to resist some extraneous agent (such as a pathogen or drug): SENSITIVITY.

## **C.TOLERANCE**

The term disease tolerance describes plants that exhibit little disease damage despite substantial pathogen levels.

Plant disease resistance protects plants from pathogens in two ways: by pre-formed structures and chemicals, and by infection-induced responses of the immune system. While Disease outcome is determined by the three-way interaction of the pathogen, the plant and the environmental conditions (an interaction known as the disease triangle).

Defense-activating compounds can move cell-to-cell and systematically through the plant's vascular system. However, plants do not have circulating immune cells, so most cell types exhibit a broad suite of antimicrobial defenses.

Although obvious *qualitative* differences in disease resistance can be observed when multiple specimens are compared (allowing classification as “resistant” or “susceptible” after infection by the same pathogen strain at similar inoculum levels in similar environments), a gradation of *quantitative* differences in disease resistance is more typically observed between plant strains or genotypes. Plants consistently resist certain pathogens but succumb to others; resistance is usually specific to certain pathogen species or pathogen strains.

## 2. TYPES OF RESISTANCE

### I-ECOLOGICAL RESISTANCE OR PSEUDO RESISTANCE

Apparent resistance resulting from transitory characters in potentially susceptible host plants due to environmental conditions. Pseudo-resistance may be classified into 3 categories

**A. HOST EVASION:** Host may pass through the most susceptible stage quickly or at a time when pathogens are less or evade disease by early maturing. This pertains to the whole population of host plant.

**B. INDUCED RESISTANCE:** Increase in resistance temporarily as a result of some changed conditions of plants or environment such as change in the amount of water or nutrient status of soil

**C. ESCAPE:** Absence of infestation or injury to host plant due to transitory process like incomplete infestation. This pertains to few individuals of host.

### II-GENETIC RESISTANCE

#### A. BASED ON NUMBER OF GENES

- Monogenic resistance: Controlled by single gene
  - Easy to incorporate into plants by breeding
  - Easy to break also
- Oligogenic resistance: Controlled by few genes
- Polygenic resistance: Controlled by many genes
- Major gene resistance: Controlled by one or few major genes (vertical resistance)
- Minor gene resistance: Controlled by many minor genes. The cumulative effect of minor genes is called adult resistance or mature resistance or field resistance. Also called horizontal resistance

#### B. BASED ON BIOTYPE REACTION

- Vertical resistance: Effective against specific biotypes (specific resistance)
- Horizontal resistance: Effective against all the known biotypes  
(Non-specific resistance)

#### C. BASED ON POPULATION/LINE CONCEPT

- Pureline resistance: Exhibited by lines which are phenotypically and genetically similar
- Multiline resistance: Exhibited by lines which are phenotypically similar but genotypically dissimilar

**D. MISCELLANEOUS CATEGORIES**

- Cross resistance: Variety with resistance incorporated against a primary pest, confers resistance to another insect.
- Multiple resistance: Resistance incorporated in a variety against different environmental stresses like insects, diseases, nematodes, heat, drought, cold, etc.

**E. BASED ON EVOLUTIONARY CONCEPT**

- Sympatric resistance: Acquired by coevolution of plant and insect (gene for gene)  
Governed by major genes
- Allopatric resistance: Not by co-evolution of plant and insect. Governed by many genes

**MECHANISMS OF RESISTANCE**

The three important mechanisms of resistance are

- Antixenosis (Non preference)
- Antibiosis
- Tolerance

**A-ANTIXENOSIS**

Host plant characters responsible for non-preference of the **insects** for shelter, oviposition, feeding, etc. It denotes presence of morphological or chemical factor which alter **insect** behavior resulting in poor establishment of the insect.

**B-ANTIBIOSIS**

1. An antagonistic association between two organisms (especially microorganisms), in which one is adversely affected.
2. Adverse effect of the host plant on the biology (survival, development and reproduction) of the insects and their progeny due to the biochemical and biophysical factors present in it. Manifested by larval death, abnormal larval growth, etc.

Antibiosis may be due to

- Presence of toxic substances
- Absence of sufficient amount of essential nutrients
- Nutrient imbalance/improper utilization of nutrients

Chemical factors in Antibiosis- Examples

1. *Gliocladium virens*----- Gliotoxin----- (*Pythium ultimum* and *R. solani*)

2. *Pseudomonas fluorescens*-----Phenazine-carboxylic acid  
(*Gaeumannomyces graminis* var. *tritici*, Take all disease of wheat)
3. *Pseudomonas fluorescens*-----2,4-diacetylphloroglucinol (Damping-off of sugar beet)
4. *Trichoderma* spp.----- 6n-pentyl-2H-pyran-2-one
5. *Trichoderma* spp.----- Harzianopyridone
6. *Gliocladium virens*----Gliovirin

Thick cuticle, glandular hairs, silica deposits, tight leaf sheath, etc.

### **C. TOLERANCE**

Ability to grow and yield despite pest attack. It is generally attributable to plant vigor, regrowth of damaged tissue, to produce additional branches, compensation by growth of neighbouring plants.