

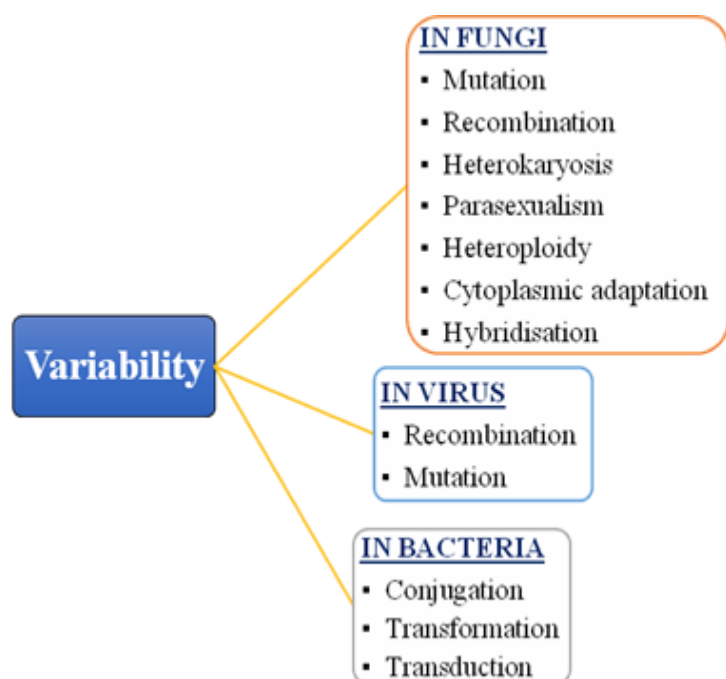
# Variability in Pathogens

Usha I<sup>1</sup>., Sharanabasav H<sup>1</sup>., Padma Priya D. <sup>1</sup> and Rajeshwari<sup>2</sup>

<sup>1</sup>Department of Plant Pathology, Rice Pathology Laboratory, All India Coordinated Rice Improvement Programme, Gangavathi- 583-227, India

<sup>2</sup>Department of Veterinary parasitology, CoVAS Mannuthy, Thrissur- Kerala -680651

\*Corresponding Author: [ushaindrajeet@gmail.com](mailto:ushaindrajeet@gmail.com)



Variability in Plant Pathogens is one of the dynamic and significant aspects of biology: individuals have different characteristics, not fixed *i.e.* phenomenon of Variation. The property or ability of an organism to change its characteristics from one generation to other is called Variability (Agrios). Individuals produced by sexual process including Sexual spores, higher Parasitic plants, Nematodes, Bacteria, Cultivated Plants differ among themselves and from their parents.

## Stages of variation in pathogens

- **Genus:** group of species having common characters
- **Species:** organism with common morphological and phenotypic characters
- **Forma special (f.sp):** individual of morphologically similar pathogen species but attack particular host or group of usually related hosts

- **Race:** sub division of f.sp , based on pathogenicity towards particular set of host varieties/cultivars
- **Biotype:** identical individuals produced asexually by a variant
- **Isolates:** strain that has been isolated from particular area (Kumar and Verma, 2019)

## Terminology

- **Physiological specialization:** - within the species of a pathogen there exist certain individuals that are morphologically similar but differs with respect to their physiology.
- **Physiologic race** - individuals within the species of a pathogen that morphologically similar but differ with respect to their pathogenicity on particular set of host varieties.
- **Forma specialis (f. sp.)** - individuals within the species of a pathogen that are morphologically similar but differ with respect to their pathogenicity on particular host genera. *e.g., Puccinia graminis f.sp. tritici* host specific to wheat.
- **Variability** - it is the property of an organism to change its characters from one generation to the other.
- **Variation** - when progeny of an individual show variation in characters as compared to parents such a progeny is called a variant.
- **Pathotype** - A pathotype is a population of a parasite species in which all individuals have a stated pathosystem character

(pathogenicity or parasitic ability) in common.

- **Biotype** - progeny developed by variant having similar heredity is called a biotype or a subgroup of individuals within the species, usually characterized by the possession of single or few characters in common.

### Variability in fungi

#### Mutation

Mutations are spontaneous. It is a more or less abrupt change in the genetic material of an organism. It represents change in sequences of the bases in DNA either by substitution or by deletion or addition, may be by amplification of particular segment of DNA to multiple copies by insertion or excision of a transposable element into coding or regulatory sequences of the gene. It is fast and expressed soon in single celled organism (mostly recessive) and also reported in the extra nuclear DNA (cytoplasmic DNA).

#### Recombination

Pathogens undergo recombination during sexual processes, causing significant changes. When two haploid nuclei (1N) containing different genetic material unite to form diploid (2N) nucleus called a Zygote, when undergo meiotic division produce new haploid. Recombination of genetic factor occurs during zygote division through cross-over, expressing part of chromosomes, and can also occur during mitotic division of cell in the course of growth of the individual.

#### Heterokaryosis

In some fungi, hyphae or parts of hyphae contain nuclei, which are genetically different, generally of two different kinds. This condition is known as heterokaryosis. The phenomenon is commonly brought about by hyphal anastomosis

between mycelia of two parental genotypes e.g., *Rhizoctonia solani*. In Ascomycotina and Basidiomycotina, some fungi possess cells containing numerous nuclei and these may be heterokaryotic. The underlying implication of this state is that the fungus may respond to selection by varying the proportion of the dissimilar nuclei in the cells.

#### Parasexualism

First demonstrated by Pontecorvo (1956) in *Aspergillus nidulans*. It is a process by which genetic recombination can occur within fungal heterokaryon. In heterokaryotic fungal mycelium there is always the opportunity for dissimilar nuclei to fuse and produce diploids or what is known as mitotic recombination. Mitotic recombination can then occur producing a random re-assortment of genetic material that is released in progeny after haploidization. This sequence of events has been described in the parasexual cycle (genetic recombination without meiosis).

#### Stages of the parasexual cycle are numbered as follows

- (1) Hyphal conjugation (plasmogamy)
- (2) Heterokaryosis
- (3) Nuclear fusion (karyogamy)
- (4) Mitotic recombination and nondisjunction
- (5) Haploidization and nuclear segregation leading to homokaryosis.

#### Heteroploidy

Heteroploidy is the existence of cells tissues or whole organisms with numbers of chromosomes per nucleus. Heteroploids may be haploids, diploid, triploid or tetraploids *i.e.*, have one or more extra chromosomes from normal euploid number e.g.,  $N+1$ ; This represents a normal situation in eukaryotes.

## Variability in Viruses

### Recombination

Occurs mostly during replication  
Reassortment. May results from mixed infection of two strains of the virus.

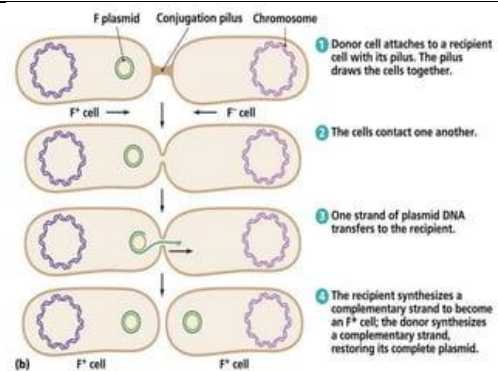
### Mutation

Results from nucleotide changes in the coding regions due to addition or deletion or replacement. Ultimately leads to functional changes in the genes.

**Table 1: Variability in Bacteria**

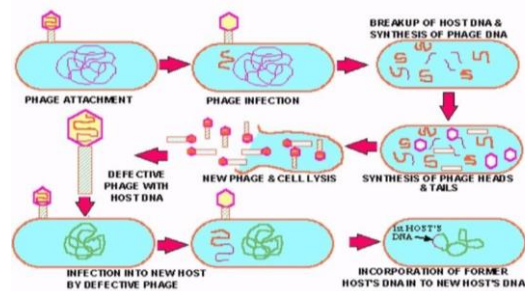
### Conjugation:

Transfer of DNA from one bacterial cell to another. Donor cell (F<sup>+</sup> or Hfr) transfers DNA to recipient cell (F<sup>-</sup>). Two compatible bacteria come in contact and exchange the portion of plasmid or chromosome through Conjugation Bridge or pilus.



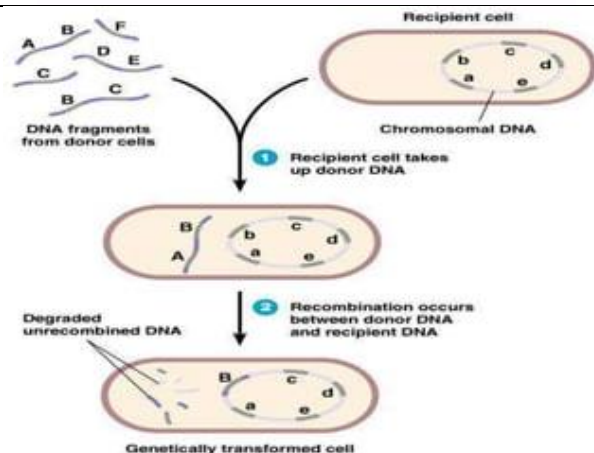
### Transduction:

Process by which DNA is transferred from one bacterium to another by a virus (bacteriophage).



### Transformation:

Process of horizontal gene transfer by which some bacteria take up foreign genetic material (naked DNA) from the environment.



\* \* \* \* \*