Modern Breeding Methods

Apart from the conventional plant breeding, we also have non-conventional. These non-conventional methods are called Modern Breeding.

1. Plant Tissue Culture: This is the ability to raise a whole plant from a segment of mother plant e.g. a whole plant can be raised from small meristematic tissues (stem tip, root tip, leaves). When this one is done, such plant segment that are capable of been developed into a whole cultivated in a medium are said to be totipotent. Totipotency is a condition whereby a plant segment is cultured in a medium to develop into a whole plan. Plant tissue culture techniques helps in:

i. Rapid crop multiplication

ii. It is used in plant purification because disease and virus free plant segment can be removed for protoplast culture or adventurous apomixes

iii. Tissue culture is used to correct hybridization barriers such as male sterility and cross incompability through somatic hybridization.

Male sterility means the absence or non-functioning of the male part of a plant. It means pollen may be present and functionless or totally absent. Cross incompability is a condition whereby the pollen is fixed and present on the plant but the physiological barriers prevent fertilization such that seed cannot be produced.

2. Plant Engineering: Aspect of tissue culture technique used to transform a plant segment to improve another part of that plant. This is called surgery.

3. Mutation Breeding: This is used to bring about variability in apart from hybridization and introduction. It is a breeding method employed when all other methods have failed. One can induce mutation in plant. Genotypes by uv, Gamma rays (γ), x-rays, ultra-violent rays, chemical mutagene like formaldehyde, phenol, pyrimidine, nitrous acid. Note that many mutations are detrimental to their

carries and disadvantageous to their carriers, such mutation can be eliminated by natural or artificial selection.

4. Apomixis: This is the reproduction and seed production that does not involve cross fertilization even in the presence of sex organs, this leads to vegetative propagation. It happens in crops like cassava, yam and flowers.

CONCEPT AND GENETIC BASIS OF BREEDING FOR DISEASE/INSECT RESISTANCE/TOLERANCE

- The breeding of disease- and insect- resistant organism has received more popular attention than any other phase of breeding because of the damage that diseases and insects can wreak on plants and animals.
- A healthy crop and livestock will help in increasing and stabilizing supplies of food and industrial raw materials.
- Several control methods have given effective control of disease and insect which include manipulation of agricultural practices (avoiding of monoculture, crop rotation, inter-cropping etc), biological control, chemical protection, however, where satisfactory disease resistant/tolerant individual are available, they are preferred over other means of control because they add little or nothing g to the cost of production. Also disease resistance is built into the plant and is there ready to provide protection.
- Breeding for disease- and insect- resistant/tolerant plants and animals will therefore be inevitable task.

Note:

- Resistance is the ability of the host to prevent any multiplication of products of the parasite – preventing the parasite from invading the organism and thriving on it
- Tolerance is another kind of genetic resistance. Some individual are susceptible to a pathogen which develops on them. However, these cultivars tolerate the attack without suffering a significant yield reduction.

- It is not a simple task to develop a cultivar resistant to several pathogenic species belonging to the same genus and it even more difficult to achieve resistance to pathogens from different genera. This is why the development of individual possessing tolerance to at least some pathogens in an important part of plant breeding.

For a successful planning of breeding programs designed to develop disease-resistant organism/individual it is important to note the following phenomena:

✓ Variations in the pathogenic capabilities of parasitic organisms i.e. parasites can differ in their pathogenicity

✓ Differences within host species in resistant to infectious disease i.e. organism differ in their ability to avoid disease – the host-pathogen relationship

SOURCES OF DISEASE RESISTANCE

➢ Breeding programs designed to produce resistant varieties must start with resistance-conferring genes. The resistance most useful in breeding is that found in varieties of the same species. When new diseases or races of established diseases appear, searching through the diversity of germplasm collections of varieties may provide success in locating adequate sources of resistance.

➢ In case adequate resistance does not appear to exist in cultivated species, then the breeder has two alternative sources to which he can turn for resistance.

- Searching for resistance in related species or genera.
- Inducing resistance through mutagenic substances.

➢ In breeding for disease resistance/tolerance it is important to be able to correlate genotype and phenotype. This is critical in breeding for disease resistance/tolerance because all genotypes are indistinguishable in the absence of the parasite. Therefore, programs of breeding for disease resistance/tolerance most involve the introduction of the causal organism to induce the symptoms that will allow genotypes conferring adequate resistance to be distinguished from susceptible genotypes.

Breeding for disease resistance/tolerance

- Any of the various methods of breeding appropriate for the crop in question can be used in developing disease or insect resistant varieties, once resistance-conferring genes have been found.
- When adequate resistance is not found in commercial lines, but only in types that cannot be used commercially because of their unsuitable agricultural properties, either the backcross or pedigree methods of breeding are usually selected.
- With either method one of the parents is chosen for its good characteristics, and the other parent is selected on the basis of demonstrated high level of resistance to a maximum number of races and minimum number of genes controlling resistance.
- If the resistant parent is a wholly un-adapted type, the backcross method is the logical choice as a breeding procedure.

If, on the other hand, the breeder is satisfied that the resistant parent can also contribute to improved adaptation, quality, or productivity he may choose the pedigree or bulk methods of handling the segregating generations.