

## **LECTURE 2: Evolution of cultivated plants**

The evolution of crop plants has given rise to more diversity and of a more complex nature that can be seen in any comparable group of wild plants.

As Edger Anderson (1960) so widely put it “The origin of a cultivated plants is a process, not an event” and by this he certainly must have meant that evolution of a plant species did not cease, but certainly become more intense and diversified, once it had been domesticated

The origin, the first home of the plants most useful to man and which have accompanied him from the remotest epochs, is a secret as impenetrable as the dwelling of all our domestic animals.

For agriculture to begin, the Candolle thought that the following conditions should be present

1. A suitable plant should be available
2. The climate should not be too rigorous
3. There should be security and a settled mode of living
4. There should be a pressing need for food, such as insufficient game, a restricted terrain (such as enclosed mountain valleys) or no abundant plant that was there for the picking.

### **The contributions of N.I. Vavilov to crop plant origins.**

N.I Vavolov, a Russian (1887-1941), began his studies of crop plants with the very practical purpose of breeding new varieties for the widely differing ecological conditions of the Soviet Union. To do this, he felt it necessary to explore the total genetic diversity of crop plants throughout the world, as well as that of related wild species.

Before Vavilov’s time, plant breeders were content to make crosses and selections based on local varieties, rather than of those from different areas of the world. The collection of living

specimens, which were brought back and evaluated in laboratories and in sub-station in different parts of the well-know research work on plant breeding that, has since been done. For the first time, plant breeders began to look at the genetic diversity of our ancient crop plants as well as related wild species. Very detailed morphological and cytogenetic studies often helped classify the taxonomy of a species very considerably.

Vavilov showed that cultivated species, during the course of their dispersion from their areas of origin, had become differentiation into distinct, morphological, ecological, and geographical groups. Students of the genetics and ecology of cultivated plants then, as now, were interested particularly in Vavilov's agro ecological groups, this classified the multiplicity of crop plant variants on an eco-geographical basis, thus enabling breeders to choose materials with a greater like hood of success in a breeding programme (Vavilov, 1957).

Vavilov described plant breeding as evolution directed by the will of man. Also Frankel defined plant breeding as genetic adjustment of plant to the genetic of time.

### **GENETIC BASIS FOR EVOLUTION OF CULTIVATED PLANTS**

Four main methods have been identified for transforming cultivated plants from their wild progenitors.

1. Mendelian variation by mutation of genes
2. Interspecific hybridization
3. Polyploidy
4. Introgression

**Mendelian variation by mutation of genes:** According to Darwin, variation is mainspring of evolution. Variation arise in natural population and then nature selects the adapted individuals.

Mutation includes only the hereditary changes that involve alterations in genes. Mutations are detected because they bring about phenotypic changes in an organization. Many traits and flowers of commercial use arose due to somatic mutation. E.g golden delicious apples arose from somatic mutation only a few twigs bore such apples and the vegetative propagation of these twigs resulted into a clone of golden delicious apples.

A simple gene mutation is *Pisum sativum* changes in seed coat colour from green to white and flower colour from red to white. Other crops that are product of mutation are core, sugar beet etc.

*N. B. A clone is a vegetative materials used as a variety for continuation. A variety is a group of plant within a spp with identical properties or characteristics. Strain is a group of plant within a variety with more identical properties or characteristics*

**Interspecific hybridization:** distantly related species have contributed little to hybridization except through introgression or well accompanied by allopolyploidy.

N.B. **Introgression** is transfer of genetic materials from one species to another.

**Allopolyploidy:** Is a situation where the genotype of an organism having two different genomes.

B-A- Haploid

BB-AA- Diploid

BBB-AAA- Triploid

BBBB- AAAA – Tetraploid

N.B. **Germplasm:** is the sum total of genetic materials in a spp.

The reasons are:

1 Crossing is difficult because the gene number are not the same

2 The hybrid is sterile AA x BB

(A) (B)

F<sub>1</sub>--AB – homologous chromosome

3 segregation production – are usually inferior to their parents.

**Polyploidy** ∴ this has been very useful in evolution. About 40% of all species of flowering plants are polyploids and one would therefore expect to find the same phenomenon occurring quite frequently in crop plant also. It is often stated that polyploidy occurs more frequently in cultivated than it does in wild species.

Induced polyploidy is used by plant breeders for improving yield especially where luxuriant vegetative growth is useful as in fodders. On many occasions, man has inadvertently selected and multiplied polyploidy materials.

**Table 1: Levels of ploidy in certain widely grown species of field and tree crops**

| <u>Diploid</u> | <u>Polyploids</u>  |
|----------------|--------------------|
| Almond         | Apple (2x, 3x)     |
| Cocoa          | Bananas (2x,3x,4x) |
| Coconut        | Cassava (4x)       |
| Cocoyam        | Coffee (2x,4x)     |
| Maize          | Cotton (2x,4x)     |
| Oilpalm        | Peanut (4x)        |
| Pineapple      | Tobacco(4x)        |
| Rice           | Wheat(2x,4x,6x)    |
| Tea            | Yam (variable)     |

Tomato  
Cabbage  
Barley  
Chicken pea  
Etc

Polyploidy is thus a source of variation and helps in evolution. More recently, allopolyploid has been used by plant breeders to obtain vital habit from one species to another.

Origin of many species and their inter-relationships have been evident due to studies on unto and allopolyploid. Genome is the basic number of chromosomes of a species and is normally haploid. Every production of meiosis is a genome(n). Two species of different genome can be used to produce a hybrid  $AA \times BB = AB$

If the chromosome number is doubled, we have AABB (allodiploidy), AABB-also called Anephidiploid. Allopolyploids are usually sterile because of their two genomes that are so divergent and they fail to pair and doubling of the chromosome restores diploid and also fertility.

**4. Introgression:** Involves transfer of small amount of germplasm from species to species. It is accomplished by hybridization of two species and backcross from the recombinant production (over several prod)to the parental spp. This will result into the transfer of certain features or other from one species to another without impairing the letter's taxonomic integrity. There is a good evidence that maize borrowed characteristics from its wild family/relatives. Teosinte and Tripsacum through a system of introgression. Sorghum, in area of Africa, where it was domesticated, appeared to have absorbed some characteristics from closely related weedy types and vice-versa