**Lec 6 Classical and Modern in plant breeding**

* **One major technique of plant breeding is selection, the process of selectively propagating plants with desirable characteristics and eliminating or "culling" those with less desirable characteristics.**
* **Another technique is the deliberate interbreeding (crossing) of closely or distantly related individuals to produce new crop varieties or lines with desirable properties. Plants are crossbred to introduce** [**traits**](https://en.wikipedia.org/wiki/Trait_(biological))**/**[**genes**](https://en.wikipedia.org/wiki/Gene) **from one variety or line into a new genetic background.**

**Classical breeding relies largely on** [**homologous recombination**](https://en.wikipedia.org/wiki/Genetic_recombination) **(is the production of offspring with combinations of traits that differ from those found in either parent) between chromosomes to generate** [**genetic diversity**](https://en.wikipedia.org/wiki/Genetic_diversity)**.**

**The classical plant breeder may also make use of a number of *in vitro* techniques such as protoplast fusion,** [**embryo rescue**](https://en.wikipedia.org/wiki/Embryo_rescue)**(is one of the earliest and successful forms of** [**in-vitro culture**](https://en.wikipedia.org/wiki/In-vitro_culture) **techniques that is used to assist in the development of plant embryos that might not survive to become viable plants)or mutagenesis to generate diversity and produce hybrid plants that would not exist in** [**nature**](https://en.wikipedia.org/wiki/Nature)**.**

**Traits that breeders have tried to incorporate into crop plants include:**

1. **Improved** [**quality**](https://en.wikipedia.org/wiki/Quality_(business))**, such as increased nutrition, improved flavor, or greater beauty.**

**2. Increased** [**yield**](https://en.wikipedia.org/wiki/Crop_yield) **of the crop.**

1. **Increased** [**tolerance**](https://en.wikipedia.org/wiki/Physiological_tolerance) **of environmental pressures (**[**salinity**](https://en.wikipedia.org/wiki/Salinity)**, extreme** [**temperature**](https://en.wikipedia.org/wiki/Temperature)**,** [**drought**](https://en.wikipedia.org/wiki/Drought)**).**
2. **Resistance to** [**viruses**](https://en.wikipedia.org/wiki/Virus)**,** [**fungi**](https://en.wikipedia.org/wiki/Fungus) **and** [**bacteria**](https://en.wikipedia.org/wiki/Bacteria)**.**
3. **Increased tolerance to** [**insect**](https://en.wikipedia.org/wiki/Insect) **pests.**
4. **Increased tolerance of** [**herbicides**](https://en.wikipedia.org/wiki/Herbicide)**.**
5. **Longer storage period for the harvested crop.**

* **Modern plant breeding**

**Modern plant breeding may use techniques of molecular biology to select, or in the case of genetic modification, to insert, desirable traits into plants. Application of biotechnology or molecular biology is also known as Molecular breeding is the application of** [**molecular biology**](https://en.wikipedia.org/wiki/Molecular_biology) **tools, often in** [**plant breeding**](https://en.wikipedia.org/wiki/Plant_breeding)**.**

**The areas of molecular breeding include:**

* [**QTL mapping**](https://en.wikipedia.org/wiki/QTL_mapping)

[**QTL mapping**](https://en.wikipedia.org/wiki/QTL_mapping) **or association mapping**

**Quantitative trait loci (abbreviated as QTL) or quantitative trait genes or minor genes or major genes is a section of** [**DNA**](https://en.wikipedia.org/wiki/DNA) **that correlates with variation in a** [**phenotype**](https://en.wikipedia.org/wiki/Phenotype) **.**

**involved in controlling trait of interest is identified. the process is known as mapping.**

**Mapping of such genes can be done using** [**molecular markers**](https://en.wikipedia.org/wiki/Molecular_markers)**.**

**QTL mapping can involve single large family, unrelated individuals or multiple families .**

**The basic idea is to identify genes or markers associated with genes that correlate to a phenotypic measurement and that can be used in marker assisted breeding / selection.**

* [**Marker assisted selection**](https://en.wikipedia.org/wiki/Marker_assisted_selection) **and genomic selection**

**Marker assisted selection or marker aided selection (MAS) is an indirect selection process where a trait of interest is selected based on a marker (morphological, biochemical or DNA/RNA variation) linked to a trait of interest (e.g. productivity, disease resistance, abiotic stress tolerance, and quality), rather than on the trait itself. This process is used in plant and animal breeding. Markers may be :**

* [**Morphological**](https://en.wikipedia.org/wiki/Morphology_(biology)) **- These markers are often detectable by eye,. Examples of this type of marker include the presence or absence leaf sheath coloration, height, grain color, aroma of** [**rice**](https://en.wikipedia.org/wiki/Rice) **etc. In well-characterized crops like** [**maize**](https://en.wikipedia.org/wiki/Maize)**,** [**tomato**](https://en.wikipedia.org/wiki/Tomato)**, pea,** [**barley**](https://en.wikipedia.org/wiki/Barley) **or** [**wheat**](https://en.wikipedia.org/wiki/Wheat)**, tens or hundreds of genes that determine morphological traits have been mapped to specific chromosome locations.**
* **Biochemical- A protein that can be extracted and observed; for example,** [**isozymes**](https://en.wikipedia.org/wiki/Isozyme) **and storage** [**proteins**](https://en.wikipedia.org/wiki/Protein)**.**
* [**Cytological**](https://en.wikipedia.org/wiki/Cytological) **- The** [**chromosomal**](https://en.wikipedia.org/wiki/Chromosomal) **banding produced by different** [**stains**](https://en.wikipedia.org/w/index.php?title=Staining_(cell)&action=edit&redlink=1)**; for example,** [**G banding**](https://en.wikipedia.org/wiki/G_banding)**. is a technique used in** [**cytogenetics**](https://en.wikipedia.org/wiki/Cytogenetics) **to produce a visible** [**karyotype**](https://en.wikipedia.org/wiki/Karyotype) **by staining condensed** [**chromosomes**](https://en.wikipedia.org/wiki/Chromosome)**. It is useful for identifying genetic diseases through the photographic representation of the entire chromosome complement.**

**Genetic transformation or Genetic engineerin**

**Transfer of genes make it possible for horizontal transfer of genes from one organism to another. thus plants can receive genes from humans or algae or any other organism. this provides limitless opportunity in breeding crop plants.**

**A number of methods are available to transfer DNA into plant cells. Some** [**vector**](https://en.wikipedia.org/wiki/Vector_(molecular_biology))**-mediated methods are:**

* [***Agrobacterium***](https://en.wikipedia.org/wiki/Agrobacterium)**-mediated transformation is the easiest and most simple plant transformation. *Agrobacterium* is a** [**genus**](https://en.wikipedia.org/wiki/Genus) **of** [**Gram-negative**](https://en.wikipedia.org/wiki/Gram-negative)[**bacteria**](https://en.wikipedia.org/wiki/Bacteria) **established by H. J. Conn that uses** [**horizontal gene transfer**](https://en.wikipedia.org/wiki/Horizontal_gene_transfer) **to cause** [**tumors**](https://en.wikipedia.org/wiki/Tumors) **in plants.** [***Agrobacterium tumefaciens***](https://en.wikipedia.org/wiki/Agrobacterium_tumefaciens) **is the most commonly studied** [**species**](https://en.wikipedia.org/wiki/Species) **in this genus. *Agrobacterium* is well known for its ability to transfer** [**DNA**](https://en.wikipedia.org/wiki/DNA) **between itself and plants, and for this reason it has become an important tool for** [**genetic engineering**](https://en.wikipedia.org/wiki/Genetic_engineering)**.**
* **Plant tissue (often leaves) are cut into small pieces, e.g. 10x10mm, and soaked for 10 minutes in a fluid containing suspended *Agrobacterium* The bacteria will attach to many of the plant cells exposed by the cut. The plant cells secrete wound-related phenolic compounds which in turn act to upregulate the virulence operon of the Agrobacterium.**