***Mutations in Plant Breeding lec3***

* ***Mutation: A heritable change in the genetic material of a cell.***

***Chromosome breaks or rearrangements involve large-scale mutations. If the mutation occurs in body (somatic) cells, the results affect only the individual bearing those cells; if the mutation is in germ like cells, the change can be transmitted to offspring.***

* ***Point Mutation: A mutation resulting from a change in a single base pair in the DNA molecule, caused by the substitution of one nucleotide for another.***
* ***Deletion mutation: A mutation caused by the removal of one or more nucleotides from a gene or chromosome.***
* ***Insertion mutation: A mutation caused by the insertion of at least one extra nucleotide base in a DNA sequence.***
* ***Forward mutation: Any mutation which renders a formerly functional gene nonfunctional. This is the opposite of a back mutation.***
* ***Back mutation: A mutation that causes a mutant gene to revert to its original wild-type base sequence.***
* ***Lethal mutation: A mutation that disrupts a critical gene, thus killing the developing organism.***
* ***Frame-shift mutation: A mutation involving a change in the reading frame.***
* ***Reading Frame: The codon sequence determined by reading nucleotides in sets of three from a specific start codon.***

***A given nucleotide sequence has three possible ways of being read as a series of codons; however, usually only one will result in an mRNA that does not have a premature stop codon.***

* ***Open Reading Frame: A DNA sequence following a start codon that is not interrupted by stop codons and potentially is translatable into a protein.***

***The existence of open reading frames usually is inferred from the DNA (rather than RNA) sequence. Abbr.: ORF. Synonym: Unassigned reading frame (URF).***

* ***Suppressor mutation: A mutation that counteracts the effects of a prior mutation, either in the same or in a different gene.***

***An intragenic suppressor mutation can compensate for a prior frame-ship mutation by restoring the original reading frame in the gene. An extra genic suppressor mutation is usually a gene coding for a mutant t RNA with an altered anticodon.***

***The mutant anticodon does not recognize a chain-terminating mutation, which would result in synthesis of a truncated polypeptide, but rather continues translation due to insertion of either the correct original amino acid or an acceptable substitute into the polypeptide, which retains at least partial function.***

***Mutant: A phenotypic variant resulting from a change in its DNA.***

* ***Why are we interested in Mutants?***

1. ***Source of variation***
2. ***To understand the workings of wild-type genes by seeing what affects it.***

***Note: The source for all breeding material begins with mutations, whether the mutation occurs in a modern cultivar, landrace, plant accession, wild related species, or unrelated organism.***

***Mutagenic Agents:***

1. ***Ionizing***

***Work by ionization (production of ion pairs) when they interact with matter or by excitation, and with it the transfer of energy. Ionizing radiation can cause: gene mutation; chromosome aberrations; changes in chromosome number; inhibition of cell division; induction of mitotic activity; death of nuclei or cells; partial or complete sterility; retardation or stimulation of growth rate; and the induction of abnormal growth. Greatest risk: Hazardous.***

***Sources for Ionization:***

* 1. ***X-rays***
  2. ***Gamma rays***
  3. ***Neutrons***
  4. ***Beta particles***
  5. ***Alpha particles***
  6. ***Protons or deuterons***

***2- Ultra-violet radiation***

***Usually does not cause ionization, but induces mutations through a process of excitation. Usual mutations are chromosomal aberrations, typically with terminal regions (as compared to X-rays which result in chromosomal breaks through-out the chromosome). Problem with UV radiation: low penetration through tissue, which usually limits use to pollen grains.***

***3- Chemical***

***Typically associated with gene changes rather than chromosome aberrations:***

* 1. ***Alkylating agents (Usually Ethyl Methane Sulfonate - EMS)***
  2. ***Epoxides***
  3. ***Alkaloids***
  4. ***Peroxides***
  5. ***Formaldehyde***
* ***Effects of Mutagens***

1. ***Changes in genes***
2. ***Structural changes in chromosomes***
3. ***Physiological disturbances***

***Typically performed on seed, which is planted for evaluation (exception being vegetatively propagated crops). The first generation plant is usually designated M1, and succeeding generations designated M2, M3, etc… Most induced mutations are recessive, therefore you must evaluate M2 generations and later (or use haploids).***

* ***Role of*** [***Mutation***](http://www.preservearticles.com/2011080310003/what-is-the-role-mutation-in-plant-breeding-and-evolution.html) ***in*** [***Evolution***](http://www.preservearticles.com/2011080310003/what-is-the-role-mutation-in-plant-breeding-and-evolution.html)***:***

[***Mutation***](http://www.preservearticles.com/2011080310003/what-is-the-role-mutation-in-plant-breeding-and-evolution.html) ***play a key role in*** [***evolution***](http://www.preservearticles.com/2011080310003/what-is-the-role-mutation-in-plant-breeding-and-evolution.html) ***and origin of new species. According to the*** [***mutation***](http://www.preservearticles.com/2011080310003/what-is-the-role-mutation-in-plant-breeding-and-evolution.html) ***theory as propounded by Hyge de Vries (1901), a new species arise not by gradual accumulation of small variations, but by the appearance of permanent and sudden change in character which is unpredictable. He explained the process as the*** [***mutation***](http://www.preservearticles.com/2011080310003/what-is-the-role-mutation-in-plant-breeding-and-evolution.html)***.***

***While working on the*** [***plant***](http://www.preservearticles.com/2011080310003/what-is-the-role-mutation-in-plant-breeding-and-evolution.html) ***named Oenothera Lamarkiana de Vries marked sudden heritable changes and put forwarded that:***

***a) New species arises due to*** [***mutation***](http://www.preservearticles.com/2011080310003/what-is-the-role-mutation-in-plant-breeding-and-evolution.html)***s.***

***b)*** [***Mutation***](http://www.preservearticles.com/2011080310003/what-is-the-role-mutation-in-plant-breeding-and-evolution.html) ***brings the chances of selection.***

***c)*** [***Mutation***](http://www.preservearticles.com/2011080310003/what-is-the-role-mutation-in-plant-breeding-and-evolution.html) ***takes place nearly at all directive and may involve any character.***