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|  |  | **MUTATION**  *A mutation* is a sudden heritable change in the hereditary material of a cell or organism. Mutation may be **genic**, involving deletions, or **molecular changes** within the physical limits of the gene; or **chromosomal**, involving the rearrangement, loss, or duplication of chromosome segments. Most mutations are deleterious and harmful and many are lethal. |  |  |
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|  | For a mutation to be detected some phenotypic change in the plant must occur.   * A visible change in a morphological characteristic plant stature, pericarp color, leaf marking, chlorophyll deficiency, vestigial organ, endosperm texture, spike density, etc.is most easily identified. * Mutations causing minute changes in quantitative plant characteristics, such as size, physiological activity, chemical content, or productivity, are more difficult to identify. Their effects may require measurements on a population of plants rather than a single plant.  |  |  | | --- | --- | | ***TYPES OF MUTATIONS*** |  | |  | | |  | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  | | |  | |  | | | |  | **DOMINANT OR RECESSIVE MUTATION**  ***Recessive Mutation* (*A* » a)**  Gene mutation which result in conversion of a dominant allele (A) into a recessive Allele (a)  ***Dominant Mutation* *(a* » A).**  Gene mutation which result in conversion of a recessive allele (a) into a dominant Allele (A)   * The recessive gene mutation is by far the more common. Recessive mutations are not visible until the plant is in homozygous form (aa). * If the recessive gene mutation occurs in the somatic tissue of a homozygous plant, its effects are not expressed until the next generation when the seed is produced on the portion of the plant in which the mutant allele is carried. * This is because only one gene in the homozygote mutates (*AA* to *Aa*), and the dominant gene remaining in the heterozygote will mask the effect of the mutant recessive allele. After self-fertilization, segregation occurs giving rise to mutant plants (*aa*) in the next generation. i.e. AA:2Aa: aa   **CLASSIFICATION ON THE BASIS OF ORIGIN** |  | |  | | | |  | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  | | |  | |  | | | |  | Mutations may be identified according to their origin, whether *spontaneous* or *induced*. ***Spontaneous Mutation*** is one that occurs in nature purely by chance. Spontaneous mutation is the mechanism by which new genetic traits arise in nature. Frequency of spontaneous mutation is one out of one million 1/1000,000  ***Induced Mutation*** is a type of mutation which is artificially induced as a results from the action of a *mutagenic agent*.  **CLASSIFICATION ON THE BASIS OF SIZE**  ***Major Mutation***  If a mutation size is large enough so that its effects can be observed in a single plant.  ***Minor Mutation***  If the effect of mutation is so small that its effects cannot be observed in a single plant but we a need a group of plants to observe the mutation. Mutations with invisible phenotypic changes. Generally observed in quantitative characters.  **CLASSIFICATION ON THE BASIS OF SURVIVAL**  ***Lethal****:* A mutation which kills all the individuals that carries it. ***Sub-lethal****:* When mortality is more than 50% of individuals that carry mutation. ***Sub-vital****:* When mortality is less than 50% of individuals that carry mutation. ***Vital****:* When all mutant individuals survive.  ***LD-50*** is the mutagen dose which results in 50% mortality of the individuals. This dose is considered standard as sub-lethal mutations are considered to cause enough variation in order to make selection effective  **CLASSIFICATION ON THE BASIS OF DIRECTION**  ***Forward Mutation:*** Any change from wild type allele to mutant form. ***Reverse Mutation:*** A change from mutant allele to wild allele.  **CLASSIFICATION ON THE BASIS OF TISSUE**  ***Somatic Mutation***: A mutation in somatic tissue. ***Germinal Mutation***: A mutation in germ line cell.  **CLASSIFICATION ON THE BASIS OF SITE OF OCCURANCE**  ***Nuclear Mutation***: A mutation in nuclear gene. ***Cytoplasmic Mutation:*** A mutation in cytoplasmic gene.  **CLASSIFICATION ON THE BASIS OF CHARACTER**  ***Morphological:*** A mutation that alters morphological character of an individual. ***Biochemical:*** A mutation that alters biochemical function of an individual.   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  | **INDUCTION OF MUTATION** |  |  | |  | | | |  | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  | | |  | |  | | | |  | ***Mutagenic Agents*** |  | |  | | | |  | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  | | |  | |  | | | |  | *Any agent that causes mutation is called mutagenic agent*  *Ionizing radiations and chemical mutagens have been the principal agents employed to increase mutation frequency in plants.*  ***Ionizing Radiations***  The radiations include X rays, neutrons, gamma rays, ultraviolet, and laser beams.  X rays were used most extensively in early experiments because X ray equipment was widely available and easily operated, and seeds, plants, or pollen could be treated with fairly accurate doses.  Neutron radiation became possible with the development of nuclear reactors. Neutron radiation produces more severe damage to the chromosomes than X rays and is used principally with seeds |  | |  | Gamma rays, emitted from radioactive cobalt or radioactive isotopes, cause less injury to the plant cells and are frequently used for radiation of whole plants or plant parts including pollen. The use of laser beams is a more recent event.  *All kinds of radiation must be used with extreme caution and with experienced operators handling the equipment*.  *The radiation dose is determined by the intensity of the radiations and length of the exposure. It is expressed in Roentgen (r) units, which are a measure of the number of ionizations that occur*.  If an ionization occurs in or near a chromosome, its force can split chemical bonds, causing various structural changes within the DNA, such as a change in a single nucleotide base of a gene (called a *point mutation*),  ***Chemical Mutagens***  Chemicals can cause mutation and these chemicals are often preferred over radiation because   * they are simpler to apply * Produce less damaging effects.   The most widely used chemical mutagen is *ethyl methane sulfonate* (EMS), an alkylating agent. *Ethyl methane sulfonate is a powerful carcinogen and must be used with extreme caution*. Seeds, buds, roots, and dormant cuttings can be treated by soaking in a solution of the chemical mutagen,  Mutation by treatment with EMS is relatively simple as compared to expensive X ray mutation as no equipment is needed.  The precise concentration and treatment duration will vary with the plant part being treated. | | |  | |  | |  |