Polyploidy

Polyploids are organisms with multiple sets of chromosomes in excess of the diploid number. There are various modes for the origin of polyploids. These mainly include mechanisms such as somatic doubling during mitosis, non-reduction in meiosis leading to the production of unreduced gametes, polyspermaty (fertilization of the egg by two male nuclei) and endoreplication(replication of the DNA but no cytokinesis). Endoreduplication however, is more similar to somatic doubling and is therefore not viewed as a separate mechanism.

Chromosome doubling can occur either in the zygote to produce a completely polyploid individual or locally in some apical meristems to give polyploid chimeras. Somatic polyploidy is seen in some non-meristematic plant tissues as well.(eg: tetraploid and octoploid cells in the cortex and pith *Vicia faba)*. In somatic doubling the main cause is mitotic non-disjunction. This doubling may occur in purely vegetative tissues(as in root nodules of some leguminous plants) or at times in a branch that may produce flowers or in early embryos (and may therefore be carried further down). Spontaneous somatic chromosome doubling is a rare event and the only well documented instance of the same was in case of tetraploid *Primula kewensis* which arose by somatic doubling in certain flowering branches of a diploid hybrid. The phenomenon of chromosome doubling in the zygotes was best described from heat shock experiments in which young embryos were briefly exposed to high temperatures . Zygotic chromosome doubling was first proposed by Winge and the spontaneous appearance of tetraploids in *Oenothera lamarckiana* and amplidiploid hybrids in *Nicotiana* were shown to be a result of zygotic chromosome doubling.

The contribution of natural polyploidy to the creation of new species can best be seen from the stories of various crop plants such as wheat (*Triticum aestivum*), tobacco (*Nicotiana tabaccum*), and upland cotton (*Gossypium hirsutum*)

Mutation

Mutation, an alteration in the genetic material (the genome) of a cell of a living organism or of a virus that is more or less permanent and that can be transmitted to the cell's or the virus's descendants.

A **Mutation** occurs when a DNA gene is damaged or changed in such a way as to alter the genetic message carried by that gene.

A **Mutagen** is an agent of substance that can bring about a permanent alteration to the physical composition of a DNA gene such that the genetic message is changed.

Once the gene has been damaged or changed the mRNA transcribed from that gene will now carry an altered message.

The polypeptide made by translating the altered mRNA will now contain a different sequence of amino acids. The function of the protein made by folding this polypeptide will probably be changed or lost. In this example, the enzyme that is catalyzing the production of flower color pigment has been altered in such a way it no longer catalyzes the production of the red pigment.

Mutation breeding has been successfully utilized for the improvement of crops as well as to supplement the efforts made using traditional methods of plant breeding. Induced mutation is the ultimate source to alter the genetics of crop plants that may be difficult to bring through cross breeding and other breeding procedures. different mutagens have been used to induce genetic variability in various medicinal and aromatic crops.

a high alkaloid producing variety produced by chemical mutagen treatment of seeds followed by rigorous selection in widely cultivated variety 'Nirmal'. Variety Aela was developed in henbane with vigorous growth and yield of more than the normal variety. There was increase in the level of steroidal sapogenin (diosgenin) in *Trigonella corniculata* following chemical mutagenesis using dimethyl and diethyl sulphate.

Variety Sujata was developed through mutagenesis in opium poppy which is non narcotic (opium less and alkaloid free). Thus mutation assisted plant breeding will play a crucial role in the generation of designer crop varieties to address the threats and challenges of present and future needs in medicinal and aromatic crops.

Hybridization

Hybridization is the natural or artificial process of producing hybrids through crossing two individuals from different populations that are genetically different. This process does not change the genetic contents of organisms but rather produces new combinations of genes which could have certain desirable characteristics or phenotypes.

In crop improvement, hybridization is done for one of the following reasons. Firstly, to create a variable plant population for selecting hybrids within these populations with certain desirable combination of characteristics. Secondly, to combine certain desirable characteristics in certain crops into a single individual or thirdly, to exploit and utilize hybrid varieties. Whatever the intension of the breeder, the overall aim of hybridization is always to create genetic variation when two genetically different plants are brought together in the first filial generation.

There are two main categories of hybridization techniques; sexual and somatic. Sexual hybridization, commonly known as wide or distant hybridization, hybrid combinations are produced within specific taxonomic distances. Sexual hybridization techniques have been used over time to produce better as well as new crops such as triticale, which is a crop species produced from the sexual cross between wheat (*Triticum vulgar*) and rye (*Secale cereale*) However wide/distant hybridizations of individuals in different species and even genera have been achieved. When two species in the same genera are crossed, this is referred to as inter-specific hybridization, while crossing of two individuals in different genera is referred to as inter-generic hybridization. These kinds of crossing are important because they break species barriers for transfer of genes and therefore, make it possible to transfer genomes of one species to another which results in phenotypic or genotypic changes in the progeny

Somatic hybridization on the other hand results when somatic cells are fused instead of gametes. This technique unlike sexual hybridization is done in vitro and requires specific handling of the materials to be fused. Precisely, somatic hybridization is done via protoplast fusion and it has become an important tool for ploidy manipulation in plant improvement schemes after the successful establishment of plant protoplast isolation and fusion techniques, this hybridization strategy was realized, first by fusing the protoplasts of *Nicotiana tabacum* and *Nicotiana glauca*. In the gramineae family, the first ever somatic hybrid plantlet was a protoplast fusion of rice (*Oryza sativa* L.) and barnyard grass (*Echinochloa oryzicola*).

This technique can facilitate conventional breeding, transfer of genes such as disease resistance genes, rapid growth rate genes, more product formation rate genes, drought resistance genes and heat or cold resistance genes, from one species to another, and cultivar development by bypassing some problems associated with conventional sexual hybridization including sexual incompatibility, nucellar embryogenesis, and male or female sterility.

Conservation of medicinal plants

India has one of the richest plant medical cultures in the world. Herbal plants that have been used by Ayurveda, sidda, unani &Tibetan system of health care face an uncertain future due to over exploitation. Conservation is about preventing damage and loss to our cultural heritage.

NEED FOR CONSERVATION

1. Over one and a half million practitioners of the Indian systems of medicine, in the oral and codified streams, use medicinal plants in preventive, promotive and curative applications.
2. Medicinal plants are potential renewable natural resources.
3. Several medicinal plants have been assessed as endangered, vulnerable and threatened due to over harvesting in the wild.
4. While the demand for medicinal plants is increasing, their survival in their natural habitats is under growing threat.

5. Endangered species those, which have already become extinct & the plants, which are on the verge of extinction

Ex-situ conservation it is the conservation and maintenance of samples of living organism outside their natural habitat, in the form of whole plants, seed, pollen, vegetative propagules, tissues or cell cultures.

Ex-situ conservation has several purposes:

a. Rescue threatened germplasm

b. Produce material for conservation biology research

c. Bulk up germplasm for storage in various form of ex-situ facility

d. Supply material for various purposes to remove or reduce pressure from wild collecting.

e. Produce material for reintroduction, reinforcement, habitat restoration and management.

Actions:

a. Identify high diversity areas of medicinal plants, species threatened by genetic erosion and/or over exploitation, and areas prone to natural and/or man made calamities;
b. Solicit support from the local communities and traditional healers in the inventory of medicinal plants and indigenous knowledge
c. Establish field gene banks and botanic garden for rare or endangered medicinal plant species and conventional preservation facilities for storable seeds of medicinal plants
d. Collect and document information on medicinal plant and indigenous knowledge

Methods of preservation are divided according to the type of germplasm

Orthodox type: include small seeded grain crops and vegetables;

a) Long term storage: Storage conditions of -12˚c and 30% RH. Perpetuation of the seed stocks, 30-50 years.
b) Medium term storage: 1˚c and 40% RH.
c) Short term storage: 10°c and 40%RH

Recalcitrant types: Seed cannot be stored under low temperature and low humidity conditions (cocoa, Logan and lichee), here seeds stored in low temperature ranges for short periods such as 1-5 years. Disadv *Loss of seed viability, *Poor germination rate.

Conservation of clonal materials: Tissue culture By genetic modifications (Disease resistant plants Pest resistant plants) Cryopreservation in liquid nitrogen Botanic gardens