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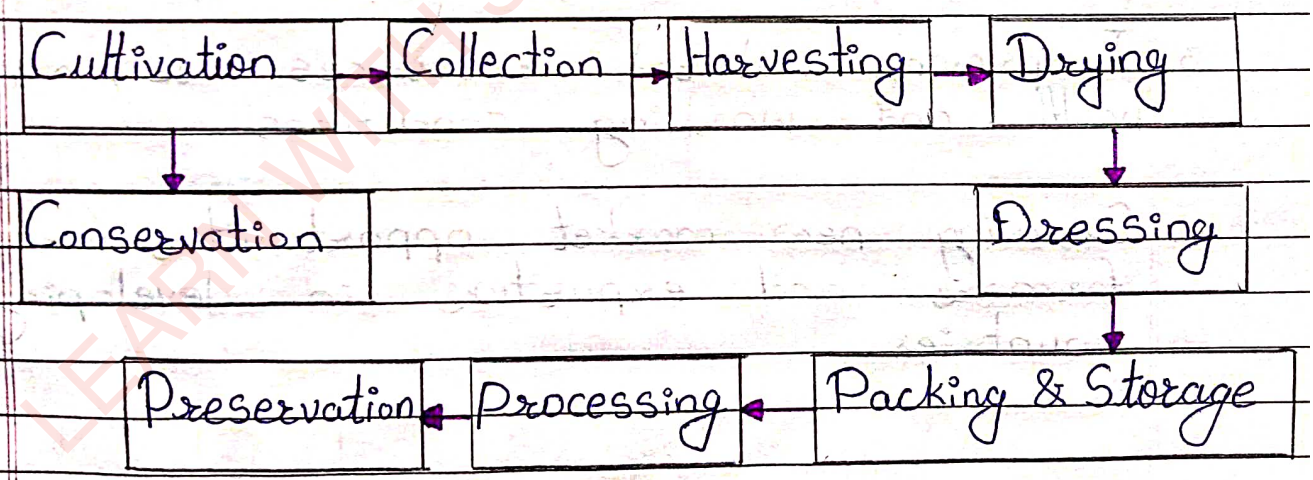
Unit II

- Cultivation, Collection, Processing and Storage of Drugs of Natural Origin.

a - Cultivation and Collection of Drugs of Natural Origin
b - Factors influencing Cultivation of Medicinal Plants.
c - Plant Hormones and their Applications.
d - Polyploidy, Mutation and Hybridization with reference to Medicinal Plants



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- Concept of Good Agricultural Practices GAPs

These are specific methods which, when applied to agriculture, produce results that are in harmony with the values of the proponents of those practices.

- Objectives =

1. Ensuring Safety and quality of Produce in the food chain.
2. Capturing new market advantages by modifying supply chain governance.
3. Improving natural resources use, Workers health and working conditions.
4. Creating new market opportunities for farmers and exporters in developing countries.

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2 Define Cultivation. explain factors affecting on it.

∵ Cultivation:

It is a scientific approach to healthy growth of medicinal plant in large scale.

The growth is defined as Progressive development of the organs with respect to various factors.

- Advantages of cultivations are:

1 Cultivation ensures quality and purity of medicinal plants.

2 It gives better healthy yield and therapeutic effects.

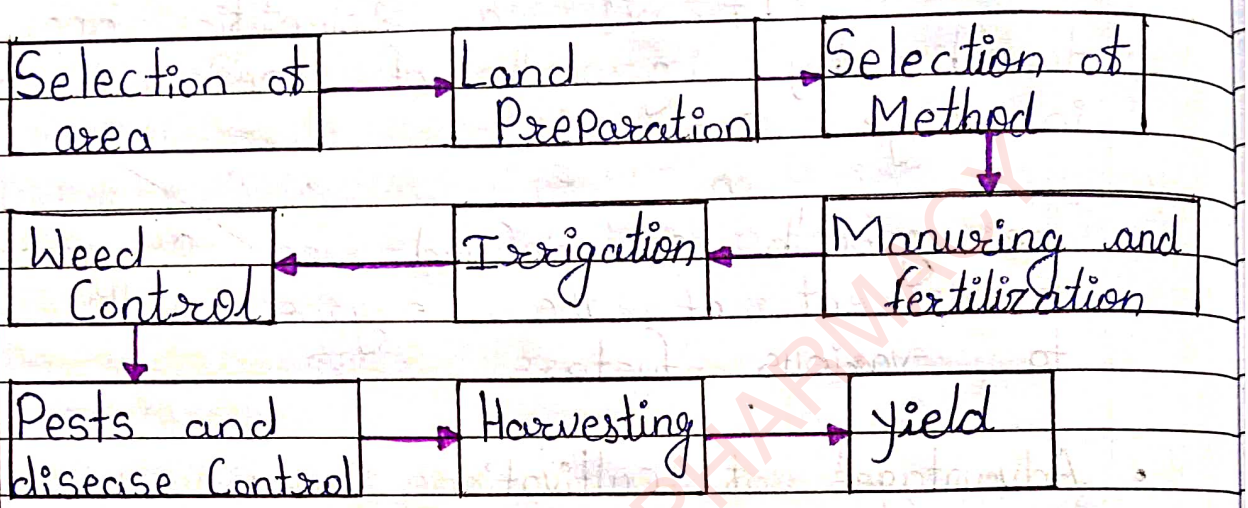
3 It minimizes biodiversity.

4 It supplies the raw materials to the industries throughout the year.

5 It provides disease free plants.

6 It increases industrialization and helps in unemployment problem.

- General steps for cultivation of Plants :



- Methods of cultivation: Generally two types of cultivation are possible.

a Sexual method: In this method plants are cultivated from the seeds and such plants are called seedlings.

seed propogation

This method is also known as seed propogation

Generally good quality seeds of high germination rate should be used for cultivation

eg. Mango, Lichi, Methi, Coriander, papaya, tomato, etc.

⇒ Advantages:

1) It is an easy method to cultivate plants.
2) It gives high yields.
3) Healthy & It gives more number of varieties.

4) It is applicable for both monocot and dicot plants.

⇒ Disadvantages:
1) Sometimes it takes more time to grow.
2) Hybrid plant may not get.
3) Healthy plants may not get from the same field.
4) Assymmetric growth of the plants may occur.

b Asexual method: Vegetative part of plant, such as steam or root, is placed in such an environment that develops new plant.
vegetative propogation. ex. Jasmine, Sugarcane, Potato, banana, rose.

⇒ Advantages =
1) It gives high yield.
2) It develops hybrid Plant
3) It gives fruits and flowers throughout the year.
4) Quality of cultivated plant can improve
5) This method is more useful for monocot plants.

⇒ Disadvantages =

1) It requires a skilled person.
2) Initially temperature and soil nature have to be controlled.
3) This method is time consuming.

Factors Influencing Cultivation of Medicinal Plants

- **Atmospheric factors**
  - Exogenous factor
    - Climate
    - Altitude
    - Humidity
    - Gas Exchange
    - Fertilizers
    - Irrigation
    - Plant hormones
    - Radiation
    - Pests.
  - Endogenous factor
    - Genetics
    - Chemical
    - Race
  - Human factor
    - Labour
    - Transport
    - Finance
    - Market distance
    - Site selection
    - Plant Selection
- **Soil factors**
  - Edaphic factor
  - Biotic factor
    - Beneficial
    - Beneficial

An auxanometer is an apparatus for measuring increase or rate of growth in plants.

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Q. Explain Collection of drug and write the Factors influencing cultivation of Medicinal plant.

▸ Collection of drug :

→ After the sufficient growth of plant, the plant material should be collected at specific time period, to get best quality of product.

→ After collection, the raw material is subjected to ~~primi~~ priliminary processing include -

- Washing
- Removing of extraneous / undesirable materials.
- Cutting
- Drying
- Storing

→ The collected materials should be protected from insected insects, rodents, birds, pests, etc.

→ After collection to prevent it from attacking of microbes, the plant materials are property dried and stored in well Closed ~~cosed~~ container

→ The plant materials can be dried in no. of ways :-

- Sunlight
- Drying in Oven
- Vaccume drying
- In Spray dryer

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▶ factors influencing cultivation of medicinal plants:

1 Light
2 Temperature
3 Humidity
4 Rainfall
5 Soil
6 Pest & Pest management
7 Fertilizer
8 Plant Hormones
9 Mutation
10 Polyploidy
11 Hybridization

1 Light = for the continuation of life of plant it is an important sources of energy.
It influences photosynthesis, opening & closing of stomata flowering, etc.

2 Temperature = It is a crucial factors for controlling the growth, metabolism & and to get the yield of secondary metabolite.
→ Extremly high as well as low temperature disturbs the quality of medicinal plants.
→ Examples - Saffron grows in cold climate.
- Pyrethrum grows in dry weather.

3 Humidity - It also affects the plant cultivation.
→ For the growth of plant optimum humidity is required

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4 Rainfall =
For the proper development of plant, rainfall is required in proper measurements.
→ The main source of water for the soil is rain water.
→ Minerals in the soil get dissolved in water & then absorbed by plants.

5 Soil = It provids ~~medicine~~ mechanical support water & essential food nutrients for the development of plants.
→ It consist of air, water, mineral matters & organic matters.

6 Pests & Peets control -
The pests are undesired plant & animal species that causes a great damage to the plants.
e.g. insects, microbes.

→ Pest control methods =
a) Mechanical method
- Hand Picking
- Heat treatment
- Trapping of pests

b) Chemical control methods -
Use of pesticides
like -
- Insecticides
- fungicides
- Herbicides
- Rodenticides, etc

c Agricultural methods =
These methods involves advanced techniques of plants breeding by genetic manipulations.

7 Fertilizers :
The fertilizers are added to the soil, to supply nutrients for the growth of plant.
→ Types of fertilizers =

- Chemical fertilizers : eg. Urea, ammonium sulphate chloride, etc.
- Biofertilizers : eg. Rhizobium, Azotobacter, Blue green algae, etc.
- Manures : eg animals feces, Cowdung, powdered seaweed, etc.

Soil factor
Edaphic factor
Soil texture
Soil structure
Soil type
Soil aeration
Soil fertility
Soil temperature
Soil pH
Soil Water
Nutrient cycle
C/N ratio

Biotic factor
1) Beneficial micro-organism
2) Benificial organisms.

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Plants hormones & their applications:

plant hormones are phytohormones

- Defination - They are the chemical substances which are responsible for the growth of plant & controlling its physiological process.

They are also called as "Plant growth regulators" or phytohormones.

- Types

The plant hormones are of various types.

- Auxins
- Gibberellins
- Cytokinin
- Ethylene
- Abscisic acid (ABA)

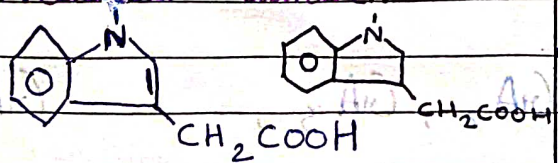
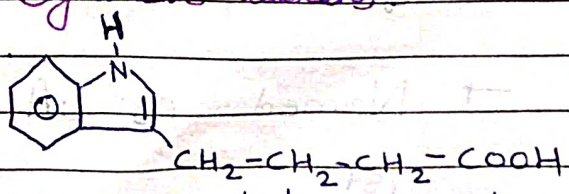
A Auxins -

The term "auxin" is derived from the Greek word "auxein" which means to grow.

It was discovered by "Charles Darwin".

- Bud formation & root initiation

Type of Auxins

1) Natural auxin	2) Synthetic auxins
e.g. 	e.g. 
Indole-3-acetic acid (IAA)	Indole-3-butyric acid (IBA)
(IAA)	(IBA), (NAA) (NAA) - one more.

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- Functions of Auxins -

→ Promotes cell elongation. (enlargement)
→ It stimulates differentiation in phloem & xylem.
→ It involves in different growth process like
  - leaf growth
  - fruit growth
  - initiation of vascular tissue, etc.
→ It promote cell division at root & shoot apex.

B Gibberellins :

→ They are acidic in nature.
→ They are a class of endogenous plant growth regulator.
→ There are 136 GAs identified from plants, fungi & bacteria.
→ The gibberellins are named GA_1 ---- GA_n in order of discovery.
→ They are present in different organs & tissues like root, shoot, buds, leaves, fruits, etc.
→ Named as GA_1, GA_2, GA_3, ---------- GA_n
→ 1st discovered from fungus "Gibberella fujikuroi".

GA_3 is called as Gibberellic acid.

- Functions =

→ They are able to produce morphological changes in plants.

→ They promote stem elongation.

→ They can cause parthenocarpic (seedless) fruit development.

C Cytokinin:

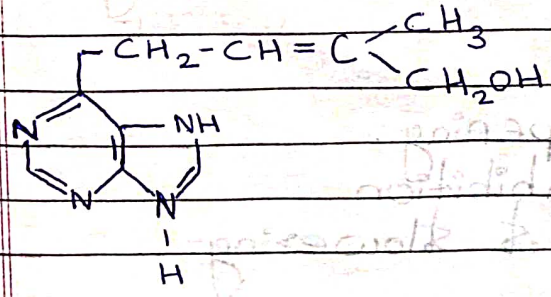
→ They are a class of purine type phyto hormones.

→ They contains purine ring in its structure

→ Cytokinin breaks into
- Cyto (cell) + kinin (Division)
- means cytokinin promotes cell division.

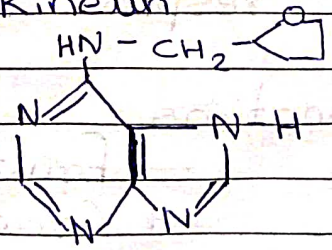
- Types of cytokinin:

1) Natural
eg. Zeatin



(zeatin)

2) Synthetic
eg. Kinetin



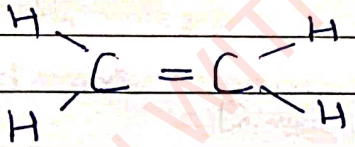
(Kinetin)

- Functions of Cytokinin:

→ They stimulates cell division.
→ Stimulates morphogenicis (shoot initiation / bud formation)
→ allows falling of plants & trees.
→ Stomatal opening.

D Ethylene -

→ They are the volatile hormones, simple organic molecules, present in the form of gas.
→ It is present in ripen fruits, flower, seed, stem, root, leaf, etc.
→ Structure of ethylene -



(ethylene)

→ In 1934, Crane reported that plants synthesize ethylene.
→ In 1935, Crocker proposed that ethylene is responsible for fruit ripening.

- Functions =
  → Fruit ripening.
  → Growth inhibition.
  → Induction of flowering

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E Abscisic acid: Discovered by dormin & Obscicin
→ It is a natural plant growth inhibitor.
→ Also called as ABA.
→ It is a naturally occuring sesquiterpenoid (15-carbon) compound in plants, produced via mevalonic pathway.
→ It is also called as "stress Hormone". It increases the tolerance of plant toward various stresses. It induces the closure of stomata during water stress.

- Functions -
→ It stimulate the closure of stomata (water stress brings about an increase in ABA Synthesis)

→ It promotes falling of leaves.

→ Inhibits shoot growth.
It shows Inhibitory action
→ Seed and bud dormancy.
closing the stomata
(Dormancy — the state in which a plant is alive but not actively growing)

[• One more point of ABA
- In 1963, Fredrick Addicott & his associates, two compounds isolated named as Abscisin I & Abscisin II.
— Abscisin II is called as Abscisic acid]

Polyploidy:

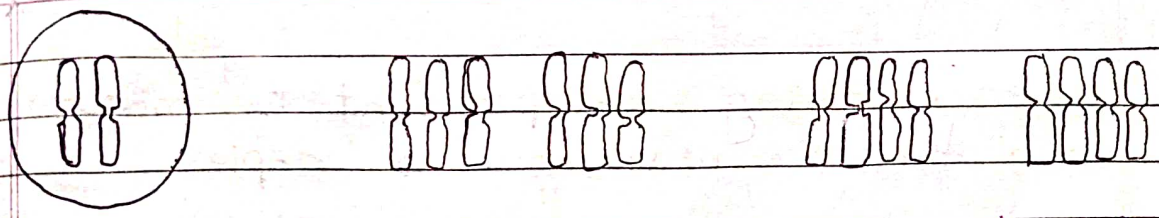
Defination = The state of a cell or organism having more than 2 sets (haploid) of homologous chromosomes is known as polyploidy.

Poly + Ploidy
↓ ↓
many pair of Chromosomes.

→ means polyploids are organism with multiple sets of chromosomes.

→ Most of the eukaryotes are diploid & have 2 pair of chromosome in which one set / pair is inherited from each parent.

But in case of polyploidy, a cell contains more than 2 sets/pair of chromosomes.



(Diploid) 2n (Triploids) 3n (Tetraploids) 4n

Polyploid

→ It may occurs due to abnormal cell division.

- Classification of Polyploids:
  Based on the chromosomal composition, polyploids are classification on 2 classes:

1) Euploids → a) Autopolyploidy
   → b) Allopolyploidy
2) Aneuploids

1) Euploids
   → It is a condition when a cell or an organism has one or more than one complete set of chromosomes.

2. Aneuploids –
   → The abnormal condition in which one or more chromosomes of a normal set of chromosomes

are missing or present in more than their usual no. of copies

Euploids are further classified as -
a) Autopolyploidy - Combination of genomes from Single species.
b) Allopolyploidy - Combination of genomes from different species.
(Auto = Self, Allo - different)

Approx 50-70% of angiosperms dergone polyploidy during their evolutionary process.

Polyploidy is important for plant evolution.
↓
(means change in the characteristics of Species).

- Methods of induction of polyploidy in plants :

1. Physical agent = e.g. X-rays, temperature (heat / cold temperature)
2. Chemical agents = e.g Sulphenilamide, veratrine hexachlorocyclohexane, colchicin, nitrous oxide, etc.

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Help in the conservation of plant
It helps in crop domenstication as it found high in vegetative content.

▶ Applications of Polyploidy :
→ Creation of new crop species.
→ To increase the yield / content of secondary metabolite in plant.
- e.g. Chemically induced polyploidy (by the help of colchicin)
Variation in composition of constitu-ents in plant.

e.g. - increase in tropane alkaloid in belladonna, cinchona, lobelia, etc.
- in Digitalis increase in content of Lanatoside A & B.
- in opium, increases in content of morphine concentration.

Mutation

Defination: A mutation is ~~present~~ permanent alteration / changes in the genetic material or character of an organism.
(sudden change in genetic sequence)

→ A Dutch botanist "Hugo De Vries" coined the term mutation.

→ It causes changes in the characteristic-s of a species.

→ It could be beneficial to improve the yields of phytoconstituents in plants.

→ The individuals showing these changes are known as "Mutants".

→ The agents / factors causing mutation are known as "Mutagens".

- Type of mutation -

1 Spontaneous mutation - ① Point ② Insertion ③ deletion } mutation

2 Point mutation -
   a) Silent mutation
   b) Missence mutation
   c) Nonsense mutation

3 Frame-shift mutation

4 Induced mutation

1) Spontaneous mutation
   - It occurs naturally without any cause.

2) Point mutation
   - Also called as base substitution.
- It occurs when a single nucleotide is replaced with a different nucleotide.

They are of 3 types:

a Silent mutation -
- In this, the mutation in DNA do not have an observable effect on the organism.

b Missense mutation -
- In this single amino acid is change in the protein.
- It changes the activity of the protein.
- It may be harmful or beneficial.

c Non-sense mutation -
- It occures when the sequence of nucleotides in DNA is changed in such a way that stops the normal sequence of amino acid in final protein.

3 Frame - shift mutation - [Insertion mutation]
- It is caused by the deletion or insertion of a base pair in a DNA sequence.

4 Induced mutation -
- The mutation can be artificially produced by the agents called "mutagens".

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▶ Mutagens: mutagenes are agents that bring about a permanent alteration to physical composition of a DNA gene. The mutagens are of 2 types. they are -

a) Physical mutagens
b) Chemical mutagens

a Physical mutagens -

i) Ionizing radiations - e.g. X-ray, γ-ray, & cosmic rays.

ii) Non-ionizing radiations - eg. U.V. rays.

b Chemical mutagens -

i) Alkylating agents - Nitrogen & Sulphur mustard, ethylsulphonate, ethylethane sulphonates.

ii) Nitrous acid

iii) Acridine

▶ Applications of mutation in medicinal plants:

→ High content of solasodine is produced by applying radiation & chemical mutagens to Solanum khasianum.

→ High yield of morphine is obtained by applying chemical, mutagens, in opium (papaver somniferum)

→ Improve the disease resistance in crop

→ Best way to induce new character.

→ Ionizing radiation is widely used to treat the seeds for crop improvement.

→ Capsaicin content is increased in capsicum using chemical mutagens.

→ Applying radiation in dioscorea in Diosgenin content can be increased.

Hybridization

Defination =

The combination or crossing of two genetically dissimilar plants to create a hybrid is called as Hybridization.

It is the process through which hybrids are obtained

Types - Hybridizations may be of following type:

i) Intra-varietal hybridization:
The crosses are made betⁿ the plants of the same variety.

ii) Inter-Varietal hybridization:
The crosses are made between the plants belonging to two different varieties.

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Intra-generic hybridization:

The crosses are made between two different species of the same genus.

❖ Procedure of Hybridization:

It involves the following steps.

1) Selection of parents
2) Emasculation
3) Bagging
4) Tagging
5) Crossing
6) Harvesting and storing the F_1 Seeds
7) Raising the F_1 generation.

1 Selection of Parents:

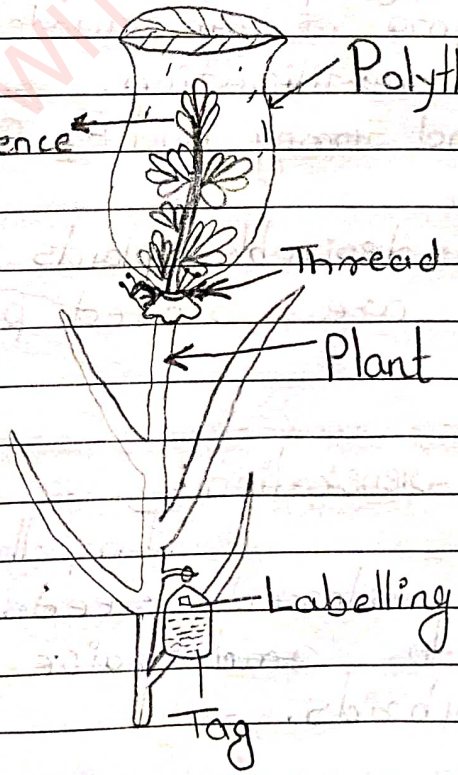
- Two parents should be selected.
- One should be well adopted the nature of other variety.
- Other variety should be have the characters which is absent in 1st variety.

2 Emasculation:

- It can be defined as the removal of stamens or anthers or the killing of the pollen grains of a flower without affecting the female reproductive organs.

3 Bagging - The emasculated flower is immediately bagged to avoide pollination by any foreign pollen.

- The bags may be made of paper, butter paper, glassine or fine cloth.
- The bags are tied to the base of the stalks of the flower with the help of thread, wire or pins.
- Both male and female flowers are bagged separately to prevent contamination in male flowerrs are cross-polination in female flowers.



Bagging and Tagging.

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4 Tagging =
- The emasculated flowers are tagged just after bagging.
- Generally circular tags of about 3 cm are used.
- The tags are attached to the base of flower with the help of thread.
- The information given on tag must be as brief as possible

5 Crossing or Pollination:
In this method, pollens from the male ~~gamet~~ parent are placed on the receptive stigma of emasculated flowers to bring about fertilization.

6 Harvesting and Storing and F_1 Seeds:
Crossed heads or pods of desirable plants are harvested. Its seeds are stored properly with tags.

7 Raising the F_1 Generation:
In the comming season, the stored seeds are sown separately to ~~raid~~ raise the F_1 generation hybrids.

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Applications of Hybridization:

- For crop improvement.
- To get good quality of plants
- To produced disease resistance, herbicide resistance, her and many other quality character.
- To enhance the yield of phyto-constituents in medicinal plants.
- Examples:

→ Increase in the solasodine, content by the hybridization of Solanum incanum and Solanum melongena.

→ Hybridization of cinchona succirubra and Cinchona ledgeriana, yields more amount of quinine.

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Conservation of medicinal plants:

- Medicinal plants are also called medicinal herbs and are used in traditional system of medicine since prehistoric times.

- Plant synthesize hundreds of chemical compounds. for functioning like,

  Defence against - insects
  - fungi
  - Diseases, etc

- The medicinally plants are globally valuable sources of herbal products & they are disappering at a high speed.
  So it is very necessary to conserve the plant species which are medicinally important.

→ the conservation of medicinal plants involves

Collection
↓
propagation
↓
Characterization
↓
Evaluation
↓
Disease elimination
↓
Storage

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↓

Distribution

- Method of Conservation:
  1) In-Site conservation
  2) Ex-Site Conservation

1) In-Site Conservation -

It is the process of protecting an endangered plant species in its natural habitat or environment by biosphere reserves (national parks or gene sanctuary).

→ It is applied to conservation of agricultural biodiversity by using farming practices.

→ The maintainance cost of it is very high.

2) Ex-Site Conservation:

→ It is the process of protecting an endangered species of plant outside its natural habitat / environment by removing the part of plant & placing it in a new location within the care of humans.

→ In this the genetic materials obtained from seeds or from invitro cultures (plant cells, tissues, or organs) can be preserved under gene banks under optimum condition

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There are several methods for the Ex-Site conservation of plants are -

a) Cryopreservation
b) Cold-preservation
c) Low-pressure and low oxygen storage.
d) Tissue culture technique
e) Gene bank
f) Seed bank

a Cryopreservation =

→ It is also called as freez-e preservation.

→ It involves the use of liquid nitrogen having -196°C temperature at which zero metabolism or non-dividing state occurs of plant cells & tissue under it.

→ It is the seeds, pollen, tissue or embryos are stored in liquid nitrogen.

b Cold Preservation:

→ Cold storage refers to the conservation of germplasm or genetic material of plant at temp. betⁿ 1-9°C.

→ This method is simple, economical & having better survival rate of plants cells or tissues.

→ In vitro developed shoots or fruits of plant have been stored by this method.

C Low pressure & Low oxygen Storage:

→ It is an alternative method to cryopreservation & Cold storage.

→ In Low pressure Storage (LPS), surrounding atmospheric pressure is lowered & these, system is suitable for storing plant materials for short and long term.

→ In low oxygen storage (LOS), the oxygen level is reduced & the atmospheric pressure is maintained at 260 mm Hg. by adding inert gas like nitrogen.

d tissue culture technique -

→ Plant tissue culture is a quick & very efficient invitro technique for propagating plant species under aseptic environment.

→ Mainly used to conserve endangered species ~~under~~ & production of disease free clones of plant.

e Gene Bank & Seed Banks:

→ This technique is used for the storage of seeds, tissue culture, embryos, cells, DNA, etc in a temperature & moisture controlled environment.