Pharmacognosy

Cultivation, collection, Processing and storage of drugs of natural origin

Cultivation = Cultivation of medicinal plants requires intensive care and management. The conditions and duration of cultivation required vary depending on the quality of medicinal plant materials required.

Advantages of cultivation –

1) better yield
2) ensure purity and quality

Disadvantages → cost effective

Methods of Cultivation :-

1] Sexual method [seed propagation]
2] Asexual method [vegetative propagation]

1] **Sexual method** = [seed propagation]

it is a technique of plant reproduction that involves the use of seeds to multiply, reproduce or breed seedlings.

Conditions for seed propagation →

1) Good quality seeds
2) free from microbes

3] Seeds should have high germination rate.

Methods for seed propagation-

1] Broad casting methods ⇒ seeds are spread on the cultivation area.

eg- linseed

2] Dibbling method- seeds are sown in holes in ground. eg- Papaya seeds
Castor seeds

3] Miscellaneous method- seeds are sown in nursery beds. They require more care.

eg- Clove, Cardamom. etc

Advantages -(1) It is simple & cheap method

(2) plants are long-lived

(3) new varieties can be created through sexual propagation

(4) method is quicker than others.

Disadvantages - (1) Some seeds are very difficult to germinate.

(2) Some cases takes longer time than asexual

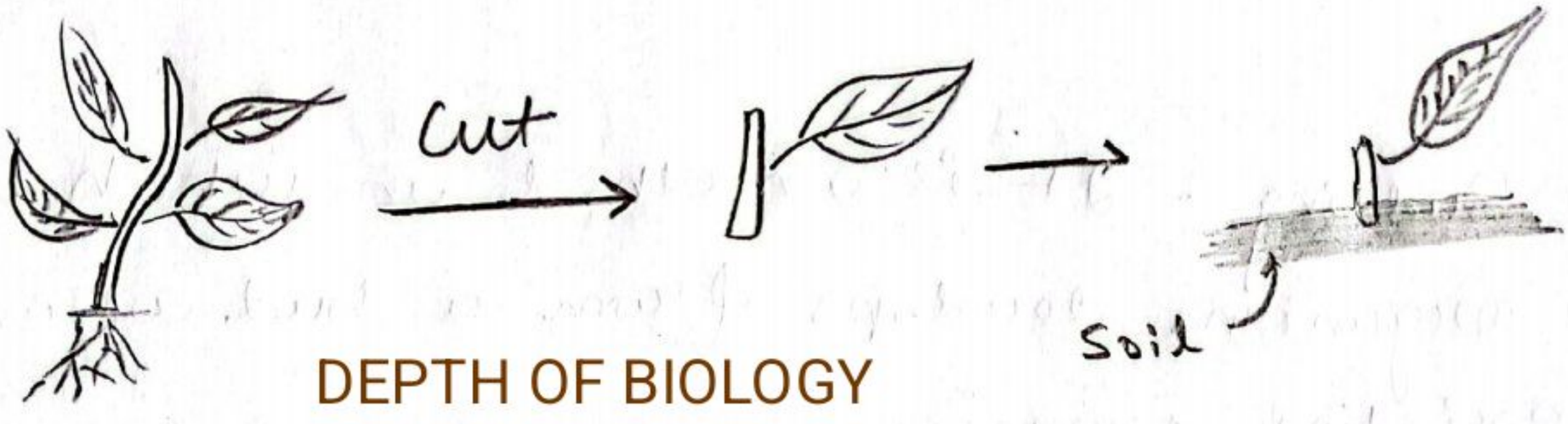
(3) Cost of harvesting, spraying of pesticides is more

2] Asexual methods ⇒ also known as Vegetative propagation

→ This type of propagation is where seed is not needed but a portion of vegetation is used for new growth.

↔ Methods :-

(a) Cutting ⇒ removing a portion of stem and fixing it in soil to allow the growth of roots and buds growing into shoots.

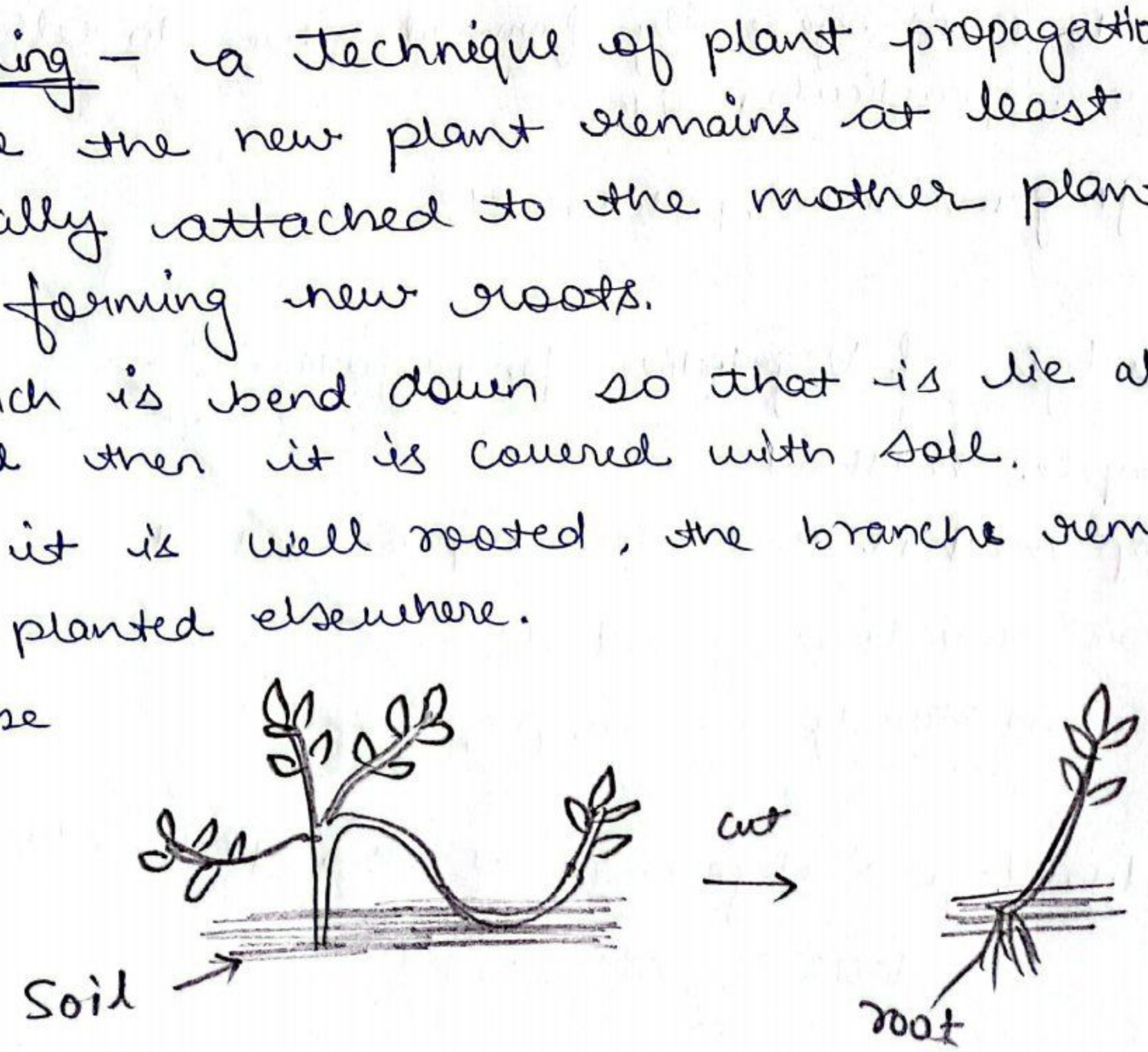


(b) Layering - a technique of plant propagation where the new plant remains at least partially attached to the mother plant while forming new roots.

→ Branch is bend down so that is lie along ground then it is covered with soil.

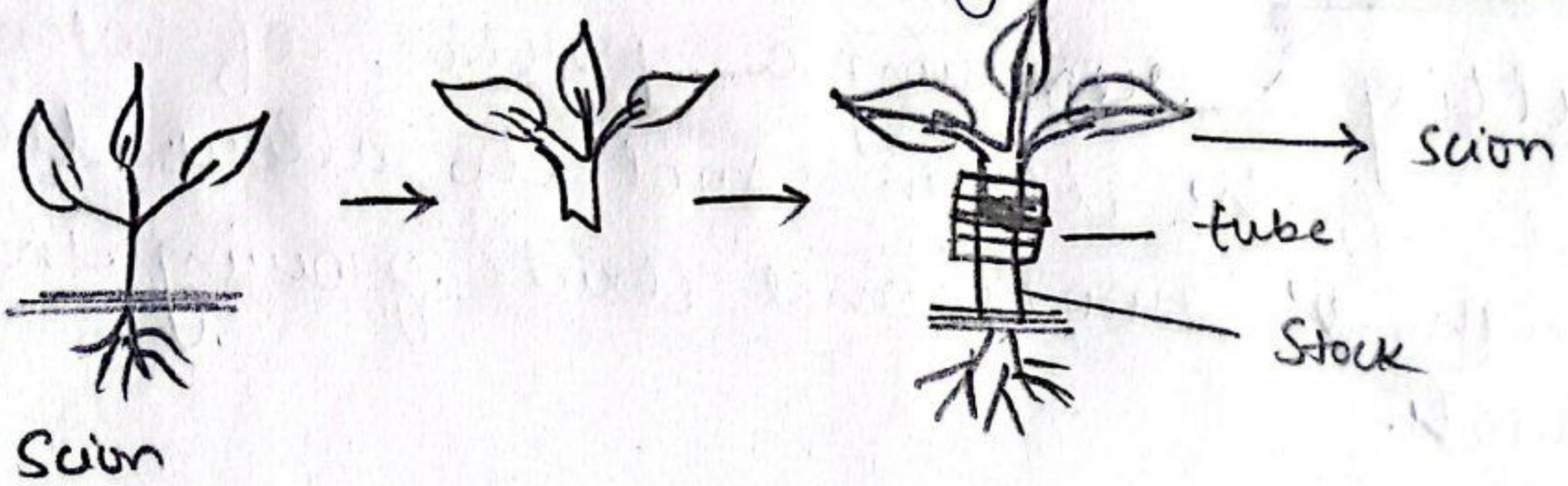
when it is well rooted, the branche removed and planted elsewhere.

eg - Rose



c) Grafting → it is a method of asexual plant propagation that joins plant parts from different plants together so they will heal and grow as one plant.

⟹ In this the stem [scion] part of one plant is fixed on another plant having roots (stock).



d) Budding - It is a method in which a new organism develops from a bud of an existing organism.

- A bud is generally formed due to cell division at one particular site.

eg- ginger, onion, potato etc.

Advantages of Vegetative propagation :-

(1) Simple method
(2) Cheap method and also rapid method
(3) more resistant against disease
(4) Seedless variety can be propagated

Disadvantage → degeneration of the species due to lack of sexual stimulus.

Collection of the drugs

→ It is the most important step. It comes after cultivation.

→ Drugs are cultivated from wild or cultivated plants.

→ Medicinal plant material should be collected during the appropriate season or time period to ensure the best possible quality of both source material and finished material.

Like fruits are collected when they get fully ripened

→ Resin, Gum are collected in dry weather & barks are collected in spring season.

Methods of collection [Harvesting]

The underground drug like roots rhizomes, tubers etc. are harvested by mechanical devices such as digger or lifter.

→ The tubers or roots are thoroughly washed to get rid of earthy-matter.

→ medicinal plants should be harvested under the best possible condition, avoiding dew, rain or high humidity.

Tools for harvesting -

① Hand labour

② Mechanical device - Pickers, mowers, binders

Processing and storage of drugs

Drug is subjected to processing after collection. and then storage.

✱ Washing :- after collection, the drug is washed to remove dirt and soil.

✱ Drying :- it is a process by which excessive moisture is removed from any product which ensures its good keeping quality

- Drug can be dried in — air dried, sun dried, shade dry and artificial dry

→ Natural color of some drugs can be lost in direct sun light. So they dried in shade dry.

→ Drying in artificial heat is most acceptable, it stop enzymatic action & dry more rapidly

✱ dryers- Tray dryer, oven, spray dryer.

Garbling — also called dressing

final step in processing of crude drug.

- It is the process of removing unwanted and extra materials from a drug. such material may be unwanted parts of a plant, dirt and adultrants.
- It is done for better market value.

Storage :- A good quality of drugs can be maintained if they are preserved properly

→ All the drugs should be preserved in well closed containers.

→ Number of drugs absorbs moisture during storage & become susceptible to microbial growth.

→ Drug packed on basis of its constitution & transportation.

Factors affecting Cultivation of Medicinal plant

→ There are some factors which affects the cultivation —

- Light
- Humidity
- Altitude
- Temperature
- Rainfall
- Soil & soil fertility
- fertilizer
- pest and pest control

* Altitude - it is most important factor as increase the altitude, the temperature and atmospheric pressure decreases while the wind, humidity and light intensity increases.

eg- Tea, cinchona —(1000 - 2000 m)
Cinnamon, cardamon (500 - 1000 m)

* Light - it effect photosynthesis & also the opening & closing of stomata

* Temperature → it is also a major factor.
  → respiration rate increases with increases in temperature.
  → rate of photosynthesis is affected by change in temperature.

* Humidity - It is present in form of water vapours.
  It is called atmospheric humidity.
  It also affects the Cultivation.
  — Some plants need cold climate & Some need dry weather.

* Rainfall - Most of plant need water & proper irrigation & sufficient rainfall for development.
  But some plants need less amount of water.
  Eg- Aloe

* Soil - It is natural resource which provide water, nutrients and mechanical support

* Soil fertility → The capacity of soil to supply plant nutrient quantities and proportion required and to provide suitable medium for plant growth is known "soil fertility".

* Fertilizers → fertilizers are added to the soil to supply nutrients for the growth of plants
  - Chemical fertilizers - Urea, ammonium sulphate
  - Manures - cow dung
  - Biofertilizers - blue green algae

* Pest and pest control-

Pests are undesirable plants and animals that cause damage to plants.

for eg - insects, microbes, weeds etc

→ To get good quality plants, we have to control the pests.

Pest control - (i) Mechanical method ⇒ Hand-picking, burning, trapping.

(ii) Agriculture method - advance plant breeding technique

(iii) Biological method - by combating the pests. mostly be insects with other organisms.

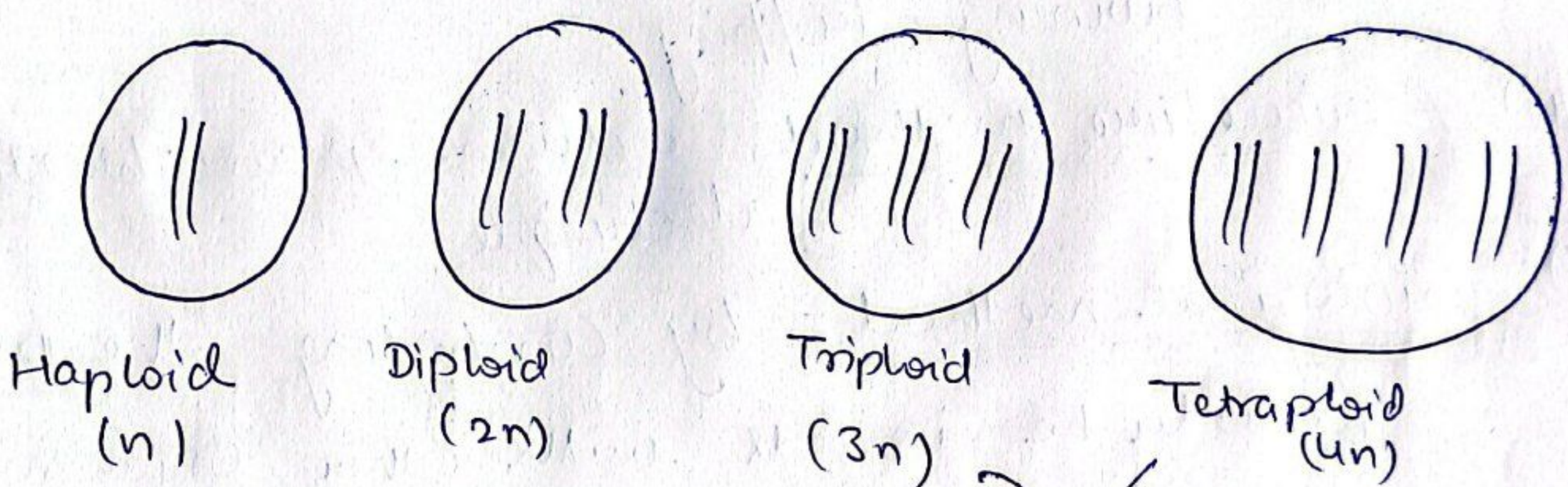
(iv) Chemical method - using pesticides

- Insecticides
- fungicides
- Herbicides

Polyploidy, mutation and hybridization with reference to medicinal plants

→ Polyploidy → Poly - many
→ ploidy - pair of chromosomes

- It is a heritable condition of possessing more than two complete sets of chromosomes.



* Genome - The complete set of DNA (genetic material) in an organism.

Causes → Due to abnormal cell division
→ X-rays, Centrifugation, Temperature
→ Chemicals - colchicine, sulphanilamides, Mercuric chloride.

Classification - On the basis of their chromosomal composition -
(a) Euploids
(b) Aneuploids

a) Euploids :- Eu - true , ploids - genome
→ When a cell has one or more than one complete set of chromosomes.
- Autopolyploidy [polyploidy between same species]
- Allopolyploidy [" " different species]

b] Aneuploids - It is an abnormal condition.
In this total number of chromosomes doesn't equal 46.
→ There is addition or loss of usually 1 or 2 chromosomes.
* Hypoploidy [no. is less] - 2n-1
* Hyperploidy [no. is more] - 2n+1

Application -
- formation of new species
- greater significant to medicinal plant.
- These plants are healthier, stronger.
- increase morphine concentration in opium
- increase the yield of secondary metabolites in plants.

Mutation :- A mutation is a change in DNA sequence of an organism.
→ This gives rise to a new genetic traits.
* mutant - a cell or an organism which shows the effect of mutation.

Mutagens → Agents which cause mutation
* also called mutagenic agents

Types of mutation :- (i) Spontaneous mutation
(ii) Point mutation
(iii) frameshift mutation

(i) Spontaneous :- occur due to some unknown reason from nature.
eg - plant, bacteria, virus etc.

(ii) point mutation - occur in genome when a single base pair is added, deleted or changed.
eg - sickle cell anaemia

(iii) frameshift :- an insertion or a deletion of nucleotide occurs, this could result in alteration of the reading frame. It completely changes the amino acid sequence.

Artificial mutation :- this type of mutation is induced by various mutagens artificially

* Physical mutagens - radications - X-rays, ionizing radiations, U.V. rays
- Physical conditions - temperature

* Chemical mutagens - Nitrogen mustard, formaldehyde Nitrous acid, Manganese Chloride

Applications - for new variety including resistance to disease.

→ mutation affects the chemical composition of medicinal plant

→ High yield of morphine by applying chemical mutagens in opium.

Hybridization ⇒ It is the technique of breeding two different individuals of the same or other species in order to achieve the desired changes in the organisms.

→ It is technique to combine the character of different plant, it produce new combination of genes.

Types of hybridization -

(i) Intra-varietal hybridization - In this crossing is done blw the plant of same variety.

(ii) Inter-varietal [Intraspecific] - crossing ~~the~~ is done between the plants of different varieties.

(iii) Interspecific [Intrageneric] - In this crossing is done between different species of same genus.

Procedure of hybridization -

→ Selection of two parents plants

↓

- Then **emasculation** is done
  - ↳ removal of stamens / anthers or killing of pollen grains of a flower without affecting female reproductive system.

- **Bagging** → emasculated flower is bagged immediately to avoid pollination. It is done by paper or fine cloth.

- **Tagging** → Emasculated flowers are tagged properly after bagging.
  - → Circular or rectangular tags may be used.
  - → It contain information of that plant.

↓

→ **Crossing [pollination]** ⇒ pollination is done by collected male pollen grains

↓

Then seeds collected from mother plant & grow better offsprings

Application - To get good quality of plant
- → for crop improvement
- → producing disease resistance plant
- → increase the yield of medicinal plants

Conservation of medicinal plants

- Medicinal plants are valuable natural resources.
- They are disappearing at high speed.
  So it is necessary to conserve these plants.

Threats to medicinal plants -

- Excessive use
- harm by insects, diseases, fungi etc
- over exploitation.

Methods for conservation of medicinal plants

1) In-situ conservation
2) Ex-situ conservation

(i) **In-situ** - The conservation of a species in its natural species..

- Maintenance and recovery of viable population of species in their original place

eg- national parks, biosphere reserves, natural reserves, sacred grooves

→ Its maintainance cost is very high

(ii) **Ex-situ** - Conservation of a species outside its natural habitat in the form of whole plant, seeds, pollen, vegetative propagules, cell or tissue.

Eg- seed bank, gene bank

Methods - (a) Cryopreservation [freeze preservation]

In this, liquid nitrogen having temp. -196°C is used.

→ At this temp. zero mutation or non-dividing state occurs at plant cells or tissue.

→ In this seeds, pollens, tissue are preserved.

(b) Cold preservation - In this, genetic material of plant is conserve at temp. 1-9°C.

→ It is simple & economical.

c) Tissue culture - It is invitro technique for propagating plant species under aseptic conditions.

d) Gene bank & seed bank - use for storage of seeds, embryo, cells, DNA etc.

→ Temp. is controlled in this.

(e) low pressure & low oxygen storage -

→ In low pressure, atmospheric pressure is lowered. This system is suitable for storing plant material for short & long term.

- In low oxygen - in this oxygen level is reduced & atm pressure maintained at 260 mm Hg by adding Nitrogen gas

- Plant growth regulators are small, simple molecules of diverse chemical composition
  - Auxins – indole compounds
  - Cytokinins – adenine derivatives
  - Gibberellins – terpenes
  - Abscisic acid – Carotenoids
  - Ethylene – gases
- **Growth proming activities of PGR** – Cell division, cell enlargement, pattern formation, tropic growth, flowering, fruiting & seed formation
- Plant growth promoters → Auxin, Gibberellin, cytokinin,
- Growth inhibiting activities of PGR – dormancy, Abscission, response to wound & stress.

Plant-growth inhibitor – Abscisic and

- **Ethylene - is both promoter & inhibitor** but it is largly an inhibitor
- **Auxin - was isolated by F.W. Went from coleoptile of oat seedling**
- **Bakane (foolish seedling)** disease caused by ***Gibberella fujikuroi***
- E.Kurosawa – indentified & discovered. gibberellic acid.
- **Skoog** & **Miller** – identification & crystallisation of cytokinin
- Natural source of cytokinin → extract of vascular tissues. Yeast extracted, coconut milk or DNA
- Abscisic acid → inhibitor – B, Abscission–II and dormin.
- Cousins → reported volatile subtances froms ripened oranges.
- **First isolation of Auxin – from human urine**
- Synthesis – at growing apices of stem mainly & slight on root apicess

- Natural Auxin – IAA, IBA
- Synthetic auxin – NAA, 2, 4-D

- **Auxin functions** → Root initiation on stem cuttings
  → Promotion of flowering in pineapple
  → Prevents early stage fruits & leaf fall but promote abscission of older mature leaves & fruits.
  → Promotion of Apical dominance that is why decapitation usually results in to profused branching which is used in tea plantation & hedge making.
- Induce parthenocarpy – in tomatoes
- Used as herbicides e.g. 2, 4-D destroy Dicot weed
- Xylem differentiation & cell division promotion.

Gibberellins

- More than 100 gibberellins reported from different organisms.
- GA_3 is first gibberellins to be discovered and most extensively studied.
- Elongate and improve shape of fruits like apple
- Delay in Senescence, thus fruit-can be left on the tree longer so as to extend the market period.
- Increase yield of sugarcane as much as 20 tonnes per acre.
- Speed up malting process for brewing industries.
- Early maturing in conifer so leading to early seed production.
- Promote bolting (internodal elongation) in beet, cabbages and other rosette plants.

Cytokinins

Kinetin (Synthetic cytokinin) modified form of adenine obtain from **autoclaved herring sperm DNA**

Zeatin (Natural cytokinin) isolation from **corn-Kernels** and **coconut milk.**

- Natural cytokinin synthesised in regions where rapid cell division occurs-like Root apices, developing shoot buds, young fruits etc.
- Promote - new leaves, Chloroplast in leaves, lateral shoot growth, Adventitions shoot formation
- Overcome apical dominance
- Promote nutrient mobilisation so helps in delay in leaf senescence.

ETHYLENE• Gaseous PGR (Plant Growth Regulator)

- Synthesised largely by tissues under going senescence and ripening fruits.
- Ethylene leads to • horizontal growth of dicot seedling
  • Swelling of axis
  • apical hook formation.
- Promotion of senescene and abscission of plant organs especially leaves and flowers
- Highly effective in fruit ripening
- Enhance rate of respiration during fruit repering (climatic respiration)
- Break seed & Bud dormancy
- initiates germination of peanut seeds & sprouting of Potato tubers.

- Rapid internode/petiole elongation in deep water rice.
- Root growth (especially adventitious) & Root hair formation.
- Initiation of flowring and synchronisation of fruit setting in pineapples.
- Induce flowering in Mango
- Most widely used PGR in agriculture because it regulate so many physiological processes.
- Most widely used form of Ethylene is – **ETHEPHON**

- It hasten (acceleration) fruit ripening in tomatoes and apples
- Accelerate abscission in flower & fruits (thinning of cotton, cherry & walnut).
- Promote female flower formation in cucumber to increases their yield.

ABSCISIC ACID

- General plant growth inhibitor and inhibitor of plant metabolism.
- Inhibit seed germination
- Stimulate closure of stomata
- Increase stress tolerance so called Stress hormone
- Induce seed dormancy
- ABA helps seeds to withstand desiccation and other unfavourable growth factors.
- ABA act as an antagonist of GA

- Role of PGR could be complimentary or antagonistic
- Role of PGR could be individualistic or synergistic
- Events where more than one PGR interact to affect the event →
  - Dormancy in seeds/Buds
  - Abscission
  - Senescence
  - Apical dominance
- PGR play inter cellular intrinsic control
- Several External factors like temperature and light, control growth and development via PGR.

PHOTOPERIODISM : –

Influence of relative duration of light & dark on flowering.

LDP – needs light exposure more than critical light period.

SDP – needs light exposure less than critical light period.

DNP – No correlation between exposure of light durations & induction of flower.

- Duration of light & dark are equally important
- Site of perception of light & dark duration are leaves.
- Hypothetically – any hormonal substance move from leaves to shoot apex to induce flowering.

VERNALISATION : –

Qualitative or quantitative dependance of flowering on low temperature exposure

- It prevent precocious reproductive development late in growing season.
- It enables the plant to have sufficient time to reach maturity
- Vernalisation applicable on winter varieties of wheat, rye & barley as well as biennials such as sugarbeet, cabbages & carrots