

UNIT-II

CULTIVATION, COLLECTION, PROCESSING AND STORAGE OF DRUGS OF NATURAL ORIGIN & CONSERVATION OF MEDICINAL PLANT

Points to be covered in this topic

- CULTIVATION AND COLLECTION
- FACTORS INFLUENCING CULTIVATION
- PLANT HORMONES
- POLYPLOIDY
- MUTATION AND HYBRIDIZATION
- CONSERVATION OF MEDICINAL PLANT



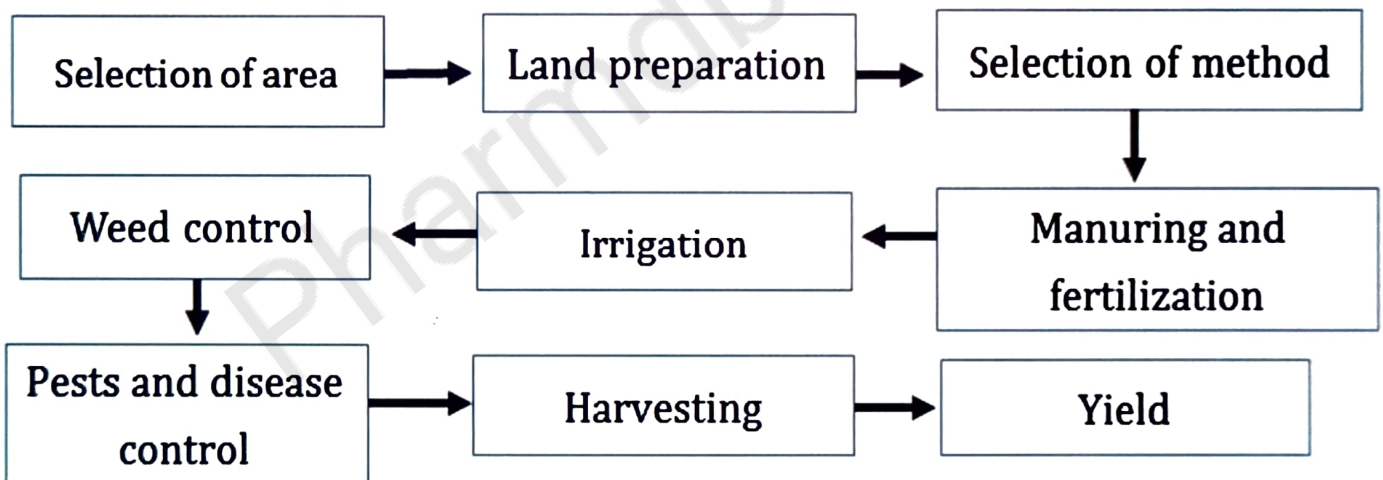
❑ CULTIVATION OF DRUG

- 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

- Cultivation ensures **quality and purity** of medicinal plants.
- It gives better **healthy yield and therapeutic effects.**
- It minimizes **biodiversity.**
- It supplies the **raw materials** to the industries throughout the year.
- It provides **disease free plants.**
- It increases **industrialization** and helps in **unemployment problem.**

❖ Steps for cultivation plants:



❖ Methods of cultivation:

(a) Seed propagation (Asexual propagation):

- In this method plants are cultivated from the seeds and such plants are called **Seedlings.**
- Generally **Good quality seeds of high germination rate** should be used for cultivation.
- Seeds should be free from other **seeds and impurities.**

Examples : Mango, Lichi, Methi, Coriander, papaya, tomato.



Methi



papaya



Lichi

➤ **Advantages:**

- It is an easy method to **cultivate plants**.
- It gives **high yields**.
- It gives more number of **varieties**.
- It is applicable for both **monocot** and **dicot plants**.

➤ **Disadvantages:**

- Sometimes it takes **more time to grow**.
- **Hybrid plant** may not get.
- **Healthy plants** may not get from the same field.
- **Asymmetric growth** of the plants may occur.

(b) Vegetative propagation (Asexual method) :

- Vegetative part of plant, such as stem or root, is placed in such an environment that develops new plant.

Examples: Jasmine, sugarcane, potato, banana, rose.



Jasmine



sugarcane

➤ **Advantages:**

- It gives **high yield**.
- It develops **hybrid plants**.
- It gives **fruits and flowers throughout the year**.
- **Quality** of cultivated plant can improve.
- This method is more useful for **monocot plants**

➤ **Disadvantages:**

- It requires a **skilled person**.
- **Initially temperature and soil nature** have to be controlled.
- This method is **Time consuming**.

❑ **COLLECTION OF DRUG**

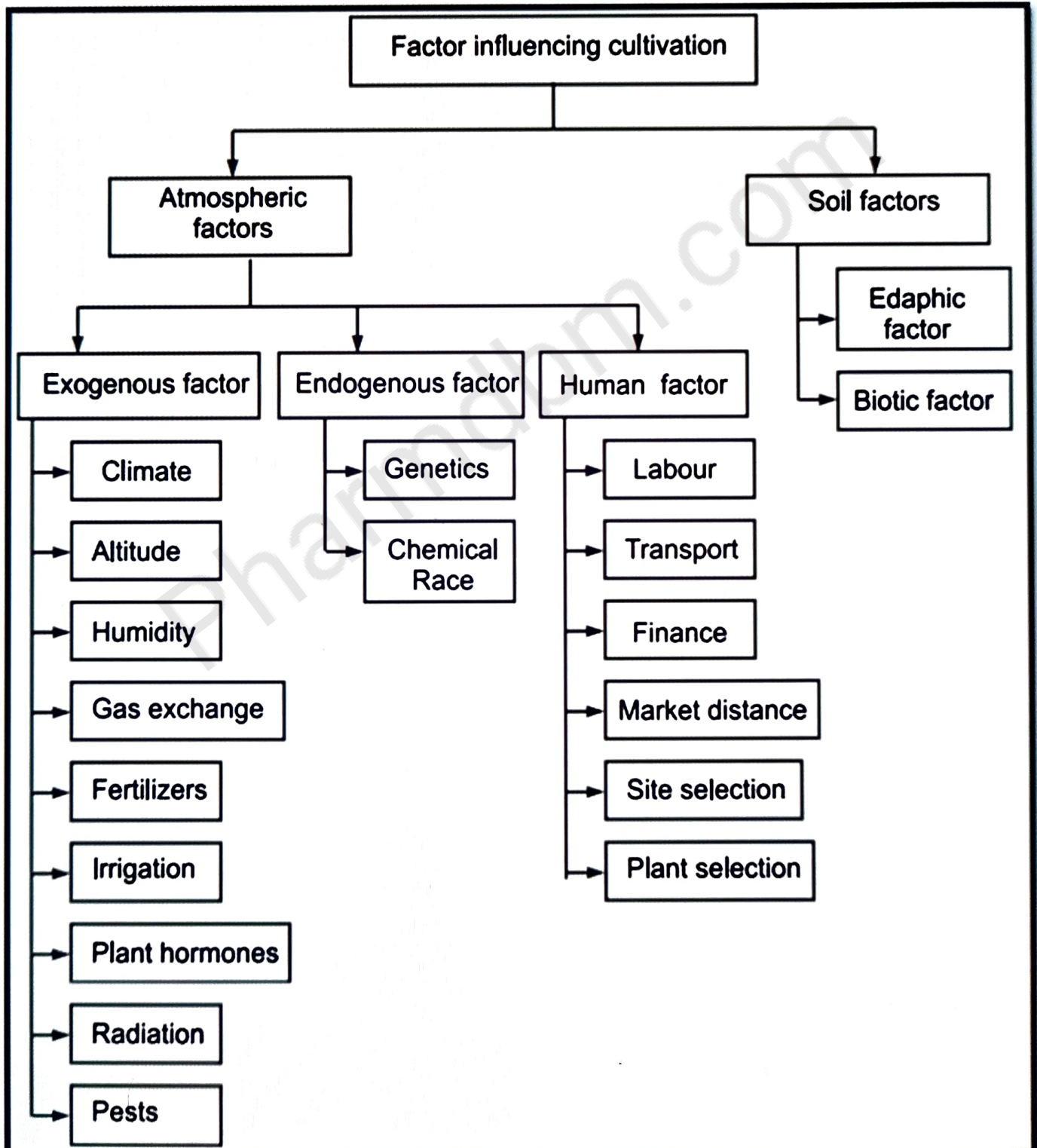
- After the sufficient growth of plant, the plant material should be collected at specific season & also at specific time period, to get best quality of product.
- After collection, the raw material is subjected to preliminary processing including -
 - ✓ **Washing**
 - ✓ **Removing of extraneous /undesirable materials**
 - ✓ **Cutting**
 - ✓ **Drying**
 - ✓ **Storing**
- The collected materials should be **protected** from insects, rodents, birds, pests etc.
- After collection to prevent it from **attacking of microbes**, the plant materials are properly dried & stored in well closed container.

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

- ✓ **Sunlight**
- ✓ **Drying in oven**
- ✓ **Vaccum drying**
- ✓ **In spray dryer**

❑ FACTORS INFLUENCING CULTIVATION OF MEDICINAL PLANTS

- The most important parameter is factors on which the **growth, variation of plant species depends.**
- It also affects the quantity of the medicinally active compounds present in the plants and this greatly **depends on the plant size.**
- An **auxanometer** is an apparatus for measuring **increase or rate of growth in plants.**



❖ Atmospheric Factors

➤ Exogenous Factors:

✓ Climate and Light:

- Plant should be cultivated in conditions which are similar to the **plant's natural habitat**.
- Hence climate that is **temperature, rainfall and length of day**, plays an important role in the growth of plants.
- Different crops require **different climatic patterns**.
- Most of the plants can grow well in **sunny, dry conditions**.

Examples:

- In cloudy weather the amount of carbohydrates in leaves is decreased, since **photosynthesis is light-dependent**.

✓ Altitude:

- Is a very important factor in cultivation of medicinal plants.
- **Tea, cinchona and eucalyptus** are cultivated favourably at an altitude of 1000-2000 metres.
- **Cinnamon and cardamom** are grown height of 500-1000 metres, while senna can be cultivated at sea level.

✓ Humidity:

- Humidity refers to the **amount of vapour that the air holds** at a given time.
- It is usually expressed as a percentage in relation to the maximum amount of water vapour that the air will hold at current temperatures.
- There are three main measurements of humidity: **absolute, relative and specific**.

Examples:- Optimum Humidity for plant growth is 50-80%; high humidity encourages the spread of fungal diseases, whereas low humidity increases.

✓ Fertilizers :

- The fertilizers are added to the soil, to supply nutrients for the growth of plant.
- **Types of fertilizers**
 1. **Chemical fertilizer**- e.g. Urea, ammonium sulphate, ammonium chloride, etc.
 2. **Biofertilizers** - e.g. Rhizobium, Azotobacter, "Blue green algae, etc.

✓ Pests:

- Reduction in the quantity of the crude drugs also depends on the **pests and their attack**.
- The huge losses due to pest infestation tune to lakhs of rupees every year due to less medicinal values.
- **Pests are detrimental** for the plants and thus controlling them during cultivation of medicinal plants is essential.
- These pests include **fungi, viruses, weeds, insects and rodents** (non insect pests).

➤ Endogenous Factors :

✓ Genetic factors:

- Genetic differences are responsible for **morphological variety and biochemical diversity**.
- Information on genetic divergence is essential for sustained genetic improvement of a crop.
- They represent genetic differences between individual organisms or species.
- **TYPES :**
 1. **Morphological markers**, which themselves are phenotypic traits or character
 2. **Biochemical markers**, which include allelic variants of enzymes called isozymes.
 3. **DNA markers**, which reveal sites of variation in DNA.

✓ Chemical races:

- It is also known as **chemodemes**.
- They are regarded as a group of plants of a species which have **identical morphological characters, but differ in their chemical nature**.

➤ Human Factors :

✓ Transport:

- Is an economic factor of **production of goods and services**, implying that relatively small changes can have substantial impacts in on costs, locations and performance.
- It provides **market accessibility** by linking producers and consumers.

✓ Finance:

- Profits are used to pay the wages and to re-invest in the farm e.g., buying seeds, fertilizer, machinery and animals.
- This is known as **feedback within the farming system**.

✓ Selection of plants:

- The **species or botanical variety selected for cultivation** should be the same as that specified in the national pharmacopoeia or recommended by other authoritative national documents.

❖ Soil Factors

✓ Edaphic Factors

- Soil texture
- Soil structure
- Soil aggregates
- Soil types
- Soil aeration
- Soil water
- Soil Ph
- Soil fertility
- Soil temperature
- Nutrient cycle
- C/N ratio

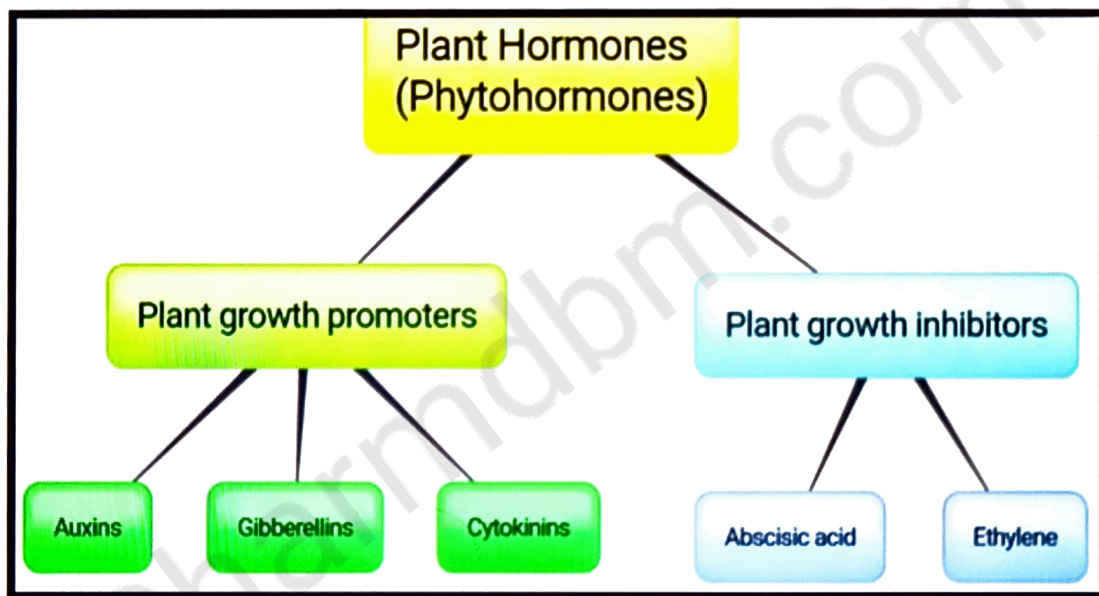
❖ Biotic Factors

- Beneficial soil microorganisms
- Beneficial organisms

❑ PLANT HORMONES

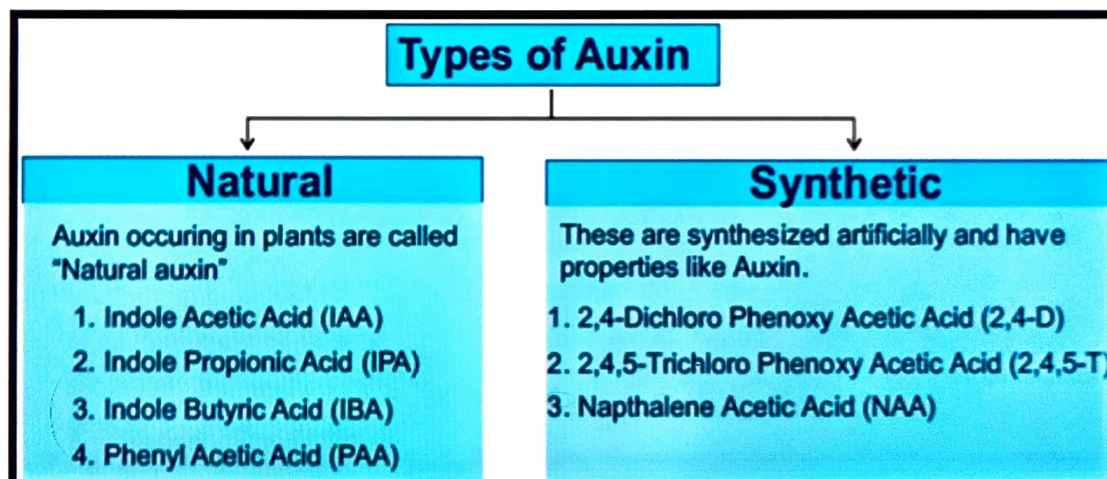
- They are the chemical substances which are responsible for the growth of plant & controlling its physiological processes.
- They are also called as " **Plant growth regulators**" or "**Phytohormones**"

❖ Types :-



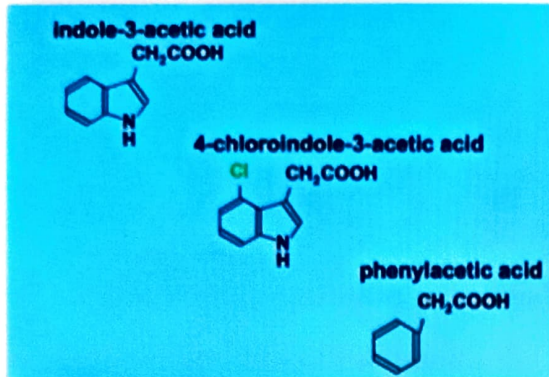
➤ Auxins -

- The term "auxin" is derived from the Greek word "auxein" which means to grow.
- It was discovered by "**Charles Darwin**"

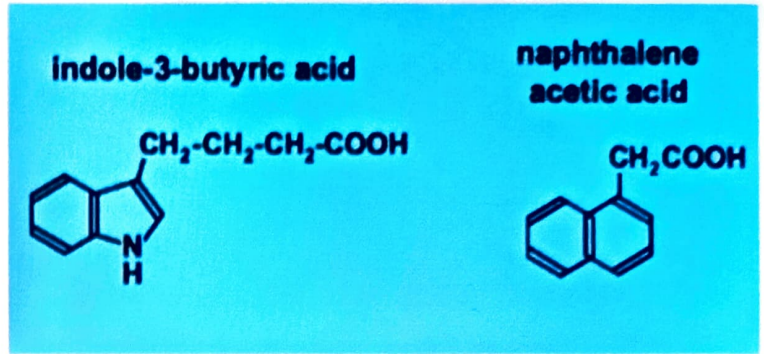


EXAMPLE :-

(a) Natural auxin



(b) Synthetic auxins



✓ Functions

- Promoter cell elongation.
- It stimulates differentiation in phloem & xylem.
- It involves in different growth processes like :-
 1. leaf growth
 2. fruit growth
 3. Initiation of vascular tissue etc .
- It promote cell division at root & shoot apex.

➤ Gibberellins-

- They are **acidic in nature**.
- They are a class of endogenous plant growth regulator.
- There are currently **136 GAs** identified from **plants, fungi & bacteria**.
- The gibberellins are named $\text{GA}_1, \dots, \text{GA}_n$ in order of discovery.
- They are present in different organs & tissues like - **root, shoot, buds, leaves, fruits, etc.**
- Named as $\text{GA}, \text{GA}_2, \text{GA}_3, \dots, \text{GA}_n$
- 1st discovered from fungus "Gibberella fujikuroi"
- GA_3 is called as **Gibberellic acid**.

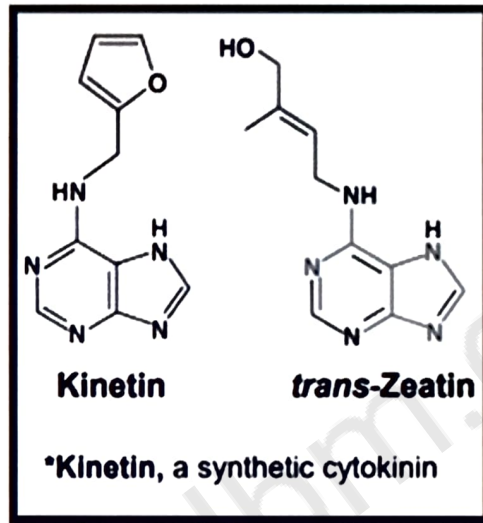
✓ Functions -

- They are able to produce morphological changes in plants.
- They promote stem elongation.
- They can cause parthenocarpic (seedless) fruit development.

➤ Cytokinin :-

- They are a class of **purine type phytohormones**.
- They contains purine ring in its structure.
- Cytokinin breaks into –
 - **Cyto (Cell) + kinin (Division) means cytokinin promotes cell division.**

✓ Type of cytokinin :-

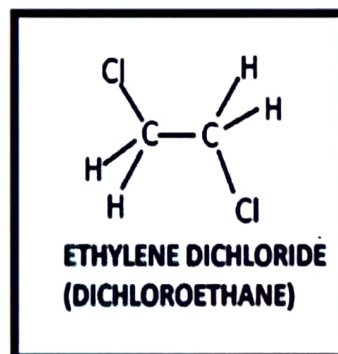


✓ Functions –

- They stimulates **cell division**.
- Stimulates **morphogenesis (shoot initiation / bud formation)**
- Allows **talling of plants & trees**.
- **Stomatal opening**.

➤ 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-



- In 1934, **Gane** reported that plants synthesize ethylene.
- In 1935, **Crocker** proposed that ethylene is responsible for fruit ripening.

✓ **Functions :-**

- **Fruit ripening and Growth inhibition.**
- **Induction of flowering.**

➤ **Abscisic acid :**

- It is a **natural plant growth inhibitor.**
- Also called as ABA.
- It is a **naturally occurring sesquiterpenoid (15-carbon) compound in plants, produced via mevalonic pathway.**
- **T1 is called as "stress hormone".** It increases the tolerance of plants toward various stresses. It induces the closure of stomata during water stress.

✓ **Functions-**

- It stimulates the **closure of stomata** (water stress brings about an increase in ABA synthesis).
- It promotes falling of leaves and Inhibits shoot growth.

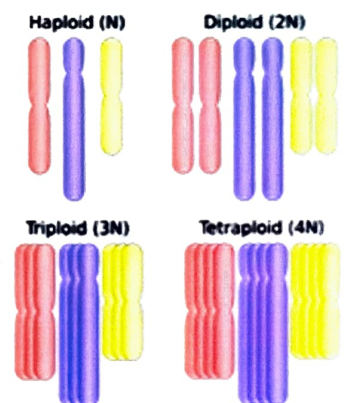
□ **Polyploidy**

- The state of a cell or organism having more than **2 sets of homologous chromosomes** known as Polyploidy.

Poly + ploidy

(Many) (Pair of chromosomes)

- Means Polyploids are organisms 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.
- It may occur due to **abnormal cell division.**



❖ Applications:

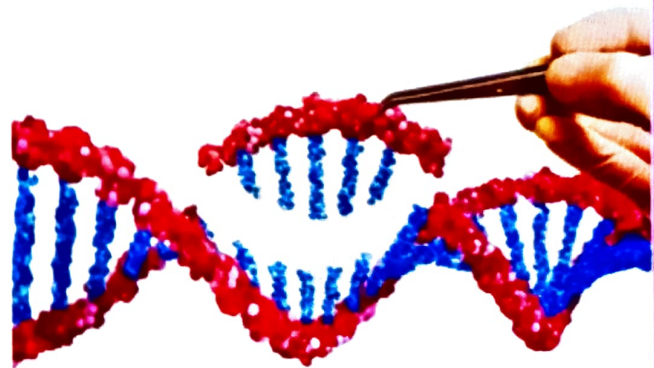
- It provides significant information on the **evolutionary history of plants** which helps in better conservation of plant species.
- Increase **fruits size** than normal one.
- It helps in **crop domestication** as it found high in vegetative content.
- Flowers become larger with thicker petals resulting in longer lasting flowers.

❑ MUTATION

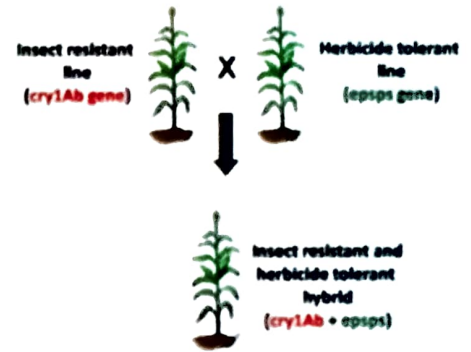
- It can be caused by copying errors in the genetic material during cell division and **by exposure to radiation, chemicals or during meiosis.**
- Mutation can result in the morphological, anatomical and chemical changes in the plants with significant increase in the active constituents.
- The three types of changes in nucleotides and as per that it is classified as **point mutation, insertion and deletion.**
- Mutagens are the agents that bring about a permanent alteration to physical composition of a DNA gene

❖ Applications:

- This method is **rapid method and cheap** for development of new varieties.
- Induced mutagens are used for the induction of CMS (Congenital Myasthenic Syndrome), **example:** Ethidium bromide is used for induction of CMS in barley.
- It is used to improve the **specific characters** of well adapted high yielding varieties.
- It improves the **disease resistance in crop plants.**
- This method is **quick, simple and best way** when a new character is to be induced.



❑ HYBRIDIZATION



- The natural or artificial process that results in the **formation of hybrid** is known as hybridization.
- The **cross between two genetically different parents** is known as hybrid.
- This method is used to create a **variable population** for the selection of types with **desired combination of characters** and to exploit and utilize the hybrid varieties.
- It results in **progeny** that differ **qualitatively and quantitatively** from the parents in the expression of secondary chemicals and morphological characters

❖ Procedure:

It involves the following steps:

- (i) Selection of parents
- (ii) Selfing of parents or artificial self-pollination
- (iii) Emasculation
- (iv) Bagging
- (v) Tagging
- (vi) Crossing
- (vii) Harvesting and storing the F₁ seeds
- (viii) Raising the F₁ generation:

❖ Applications:

- This method improves **yield and quality of crops** and **hardiness of plants and seedless varieties of crops**.
- This method provides **better resistance to diseases and insects**
- It improves **fruit sizes and quality**.
- It improves storage **capabilities of crops**.
- It improves **fall colours**.

❑ CONSERVATION OF MEDICINAL PLANTS

❖ Introduction

- Medicinal plant conservation strategies are based on an understanding of indigenous **knowledge** and **practices**

As per the world conservation strategy (1980), the conservation is defined as **“The management of human use of the biodiversity so that it may yield the greatest sustainable benefit to present generation while maintaining its definitions invokes two complementary components conservation and sustainability.**

- Many drugs contain **herbal ingredients** and it has been said that 80-90% of the world’s population relies on some form of non-conventional medicine, but the market demand has led to an increased pressure on the **natural resources** that lend to the production of some of these plants.
- The most serious proximate threats when extracting medicinal plants generally are **habitat loss, habitat degradation, global climate change and over harvesting**
- Various national and international agencies have formulated various **policies** and **strategies** for the conservation of the medicinal plants. According to these strategies, the **primary goals are:**

a)	Maintenance of essential ecological processes and life support systems for human survival.
b)	Preservation of species and genetic diversity.
c)	Sustainable use of species and ecosystems which supports rural communities and also the industries.
d)	Maintenance and assessment of germplasm for future use.



SOME AGENCIES ARE

✓ IUCN (The International Union for Conservation of Nature and Natural Resources)	Founded in 1948.
✓ WWF (World Wide Fund for Nature)	It is established in 1961.
✓ UNDP (United Nations Development Programme)	It is established in 1965.
✓ UNEP (United Nations Environment Programme)	It is established in 1972.
✓ WRI (World Resources Institute)	It is founded in 1982.
✓ FRLHT (Foundation for Revitalization of Local Health Traditions)	It is established in 1993.

❖ NMPB (National Medicinal Plants Board)

- It is established in **2000** by the Government of India has the primary mandate of coordinating all matters relating to **medicinal plants and support policies and programmes for growth of trade, export, conservation and cultivation.**
- The Board is located in the Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha & Homeopathy (AYUSH) of the Ministry of Health & Family Welfare.
- The mission for the conservation of plants and **Their habitats are:**



a)	To preserve wild populations of different plants species with their inherent intraspecific diversity for further evolution.
b)	Revitalization of social processes for transmission of traditional knowledge of healthcare for its wider use and applications.

- **The objectives are to:**

a)	Establish a system of protected areas where special measures needs to be taken to conserve biological diversity;
b)	Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings
c)	Develop necessary regulatory provisions for the protection of threatened species and populations.

- The states like **Karnataka, Tamil Nadu, Kerala and UP** are involved in the conservation of medicinal plants.
- The most widely accepted scientific technologies of biodiversity conservation are the **in-situ and ex-situ methods**.

❖ **In-situ Conservation**

- This process is also known as on **site conservation**
- It is the process of protecting the existing **biological and genetic diversity** at best and cost effective way.
- In this technique, wild species or stock of a **biological community** or endangered plant is preserved in its natural habitat either by protecting or **cleaning up the habitat**.

a	Medicinal plant conservation areas	During 1997 FRLHT (Foundation for Revitalization of Local Health traditions) Bangaluru, Karnataka, in collaboration with State Forest Departments established a coordinated network of in-situ medicinal plants conservation areas (around 30 Nos.) located within the protected areas of Kerala, Tamil Nadu and Karnataka.
b	Sacred Groves	These are the combinations of forest whose entire biodiversity along with other natural resources is conserved by the forest village communities. This method provides the conservation of forest biodiversity, conservation of threatened taxa etc.
c	Conservation of Ethnomedicinal plants	There are more than 6000 plant species are exist with their medicinal values but not have scientific evidences, is traditionally passed on orally through generations. Those plants are requires to conserve for future uses and to know their therapeutic activities through scientific research.

❖ Ex-situ Conservation

- It is a process of **protecting endangered plants from threatened habitat** and placing in a new location which are in wild area or within them of humans i.e., by cultivating and maintaining plants in biotic gardens, parks, other suitable sites.

a	Ethno-medical plant gardens	<ul style="list-style-type: none">• It is an important process for creating a network of regional and sub-regional ethno-medical plant gardens which contain all the ethnic communities medicinal plants from the different regions of India.• These gardens provide ethno-medical history and their detailed knowledge and also act as regional repositories of our culture.
b	Gene banks	<ul style="list-style-type: none">• Gene banks are a type of bio-repository which preserves genetic material.• In plants, this is by freezing cuts from the plant, or stocking the seeds and it is possible to unfreeze the material and propagate it.• Gene banks are used to store and conserve the plant genetic resources of major crop plants and their crop wild relatives that results in conservation of agricultural biodiversity.• Various types of gene banks include seed bank, tissue bank, Cryo bank, pollen bank, field gene bank etc.
c	Nursery or demonstration plots	<ul style="list-style-type: none">• This is one of the important methods for conservation of traditional medicinal plants and to get the proper idea about the history of the medicinal plants• These nurseries are the primary sources of supply of the plants, seed materials etc.

❖ **There some legal protection and conservation rules for medicinal plants by which farmers are benefited in India such as:**

➤ **Plant Variety Protection Act 1970 (PVPA):**

- It is an intellectual property statute in the USA.
- The PVPA gives breeders up to 25 years of exclusive control over **new, distinct, uniform and stable sexually reproduced or tuber propagated plant varieties.**
- It is a right for limited period of legal control to breeders of sexually reproduced or tuber propagated plant varieties.



➤ **Farmer's Right Act 2001:**

- The Protection of Plant Variety and Farmers Right Act, 2001 (PPVFR Act) is an Act of the **Parliament of India.**
- This act enacted to provide for the **establishment of an effective system for protection of various plant varieties**, the rights of farmers and plant breeders and to encourage the development and cultivation of new varieties of plants.
- Farmers are entitled to **save, use, sow, re-sow, exchange or sell** their farm produce including seed of a registered variety in an unbranded manner.
- Farmers are totally **exempted from payment** of any fee in any proceedings under this Act.
- **Annual fee** is required to pay every year for maintaining the registration and renewal fee is also to pay for the extended period of registration.

DURATION OF REGISTRATION

1.	For trees and vines	18 years from the date of registration of the variety.
2.	For other crops	15 years from the date of registration of the variety
3.	For extant varieties	15 years from the date of notification of that variety by the Central Government under section 5 of the Seeds Act, 1966.

EXEMPTIONS PROVIDED BY THE ACT

1.	Farmers' Exemption	Farmer shall be entitled to produce, save, use, sow, re-sow, exchange, share or sell his farm produce including seed of a variety protected under this Act.
2.	Researcher's Exemption	<ol style="list-style-type: none">i. The use of registered variety for conducting experiment.ii. The use of variety as an initial source of variety for the purpose of creating other varieties.
3.	For extant varieties	15 years from the date of notification of that variety by the Central Government under section 5 of the Seeds Act, 1966.