Cultivation,collection and processing of crude drugs

CULTIVATION

- Nuxvomica, acacia, myrobalan etc are cultivated from the wild source.
- Crude drugs like cardamom, clove, Indian hemp, poppy latex, tea, cinchona, ginger, linseed, isapghul, Ceylon cinnamon, saffron, peppermint , fennel etc are obtained from cultivated plants.
- The cultivation of vegetable drugs involves various agricultural and pharmaceutical factors such as **soil, climate, rainfall, irrigation, altitude, temperature, use of fertilizers, pesticides,** genetic manipulation and bio chemical aspects of natural drugs.

ADVANTAGES OF CULTIVATION

IT ENSURES QUALITY AND PURITY OF MEDICINAL PLANTS

- If uniformity is maintained in all operations during the process of cultivation, drugs of highest quality can be obtained.
- Systematic cultivation results in raising a crop with maximum control of volatile oil and other constituents.

  (for eg) Ginger, Turmeric and Liquorice
- If the cultivated plants are kept free of weeds the contamination of crude drugs can be conveniently avoided

COLLECTION OF CRUDE DRUGS FROM CULTIVATED PLANTS GIVES A BETTER YIELD AND THERAPEUTIC QUALITY

- it is a skilled operation and requires some professional excellence.
- (for eg) collection of latex from poppy capsules and oleo resins from *pinus* species. If done by experienced persons can result in better yield of crude drugs.

CULTIVATION ENSURES REGULAR SUPPLY OF A CRUDE DRUGS

- Cultivation is a method of crop planning.
- Planning a crop cultivation regularizes its supply and as a result industries
- Depending upon crude drugs do not face problem of shortage of raw material

THE CULTIVATION OF MEDICINAL AND AROMATIC PLANTS LEADS TO INDUSTRIALIZATION TO A GREATER EXTENT

- The cultivation of coffee and cocoa in kerala has given rise to several cottage and small scale industries.
- Cultivation permits application of modern technological aspects such as mutation, polyploidy and hybridization

DIS ADVANTAGES OF CULTIVATION

- The high cost of cultivated drugs compared to wild sources and the losses due to ecological imbalance such as storms, earth quakes, floods etc are major dis advantages.

ORGANIC FORMING

- It is a method of agricultural production which avoids the use of synthetic products like fertilizers, pesticides, growth regulators and additives.
- Organic matter and water holding capacity plays a very important role for the desired growth of medicinal plants.
- Organic matter is the food of earth worms and micro organisms of soil.
- Micro organisms with suitable PH (6.5-7.5)
- Temperature (23-27 ℃) and optimum moisture fix the atmospheric nitrogen in the soil and supply to the plants for their growth.

- The specific micro organisms which are responsible for nitrogen fixation are *rhizobium,azatobacta,azo spirillium, bijericia, azella* and *blue green algae* species.
- Micro organisms decompose organic matter and convert it to **HUMUS** is responsible for water holding capacity of soil more the organic matter more the water holding capacity.

METHODS OF PROPAGATION

Sexual method and A sexual method

SEXUAL METHOD (SEED PROPAGATION)

In sexual method the plants are raised from seeds and such plants are known as seedlings.

ADVANTAGES

- Seedlings are long lived (in case of perennial drugs) it bears heavy fruits.
- Seedlings are comparatively cheaper and easy to rise.
- In case of plants where other vegetable methods can not be utilized propagation from seeds is the only method of choice.
- Propagation from seed are responsible for the production of orange papaya etc.,

DIS ADVANTAGES

- Generally seedling trees are not uniform in their growth and yielding capacity as compared to grafted trees.
- They require more time to bear as compared to grafted trees.
- The cost of harvesting , spraying of pesticides etc is more then the grafted plants.
- It is not possible to avail a modifying influence of root stocks of scion as in case of vegetatively propagated trees.

- For propagation purpose the seeds must be of good quality.
- They should be capable of high germination rate , free from diseases and insects and also free from other seeds.
- The germination capacity of the seeds are tested by the rolled towel test , excised embryo test etc.
- Seeds should be stored in a cool and dry place to maintain their germinating power. long storage of the seeds should be avoided.

- Before germination sometimes a chemical treatment is given with suitable stimulants like cytokinins, ethylene, thio urea, potassium nitrate or sodium hypo chloride.
- Gibbrelic acid (GBA) Promotes germination and stimulates the seedling growth.
- To enhance germination special treatments are given such as soaking the seeds in water for a day (for eg) castor seeds. Thio urea is used for the seeds which do not germinate in dark or at high temperature.

A SEXUAL METHOD (VEGETATIVE PROPAGATION)

The vegetative part of a plant such as stem or root is placed in such an environment that it develops in to a new plant.

ADVANTAGES

- There is no variation between the plant grown and plant from which it is grown. The plants are uniform in growth and their yielding capacity in case of fruits are more.
- Seedless varieties of fruits can be propagated vegetatively (for eg) grapes, pomegranates and lemon.
- Plants start bearing earlier as compared to seedling trees.
- Budding or grafting encourages disease resistant varieties of plants.
- Modifying influence of root stocks on scion can be availed.
- Inferior or un suitable varieties can be overlooked.

DIS ADVANTAGES

- Compared to seedling trees these are not vigorous in growth
- And are not long lived. No new varieties can be produced by this method.
- Vegetative propagation is sowing various parts of the plants in well prepared soil.

(for eg) **Bulbs** – Squill,garlic

corms – Colchicum,saffron

Tubers -- Jalap,aconite,potato

Rhizomes- Ginger,turmeric

Runners – Peppermint

Suckers- Mint,pine apple, banana, chrysanthemum

Off sets- Aloe,valerian

Stolons- Arrow root,Liquorice

ASEPTIC METHODS OF MICRO PROPAGATION

It is a novel method for propagation of medicinal plants in micropropagation the plants are developed in an artificial medium under aseptic conditions from fine pieces of plants like single cells, callus, seeds, embryos,root tips, shoot tips pollen grains etc. They are provided with nutritional and hormonal requirements.

FACTORS AFFECTING CULTIVATION

- Altitude , temperature and humidity
- Rain fall and irrigation
- Soil and soil fertilizers
- Fertilizers
- Pest and pest control

ALTITUDE, TEMPERATURE AND HUMIDITY

Altitude is a very important factor in cultivation of medicinal plants

- Tea – 1000-1500 m
- Cinchona – 1000-2000 m
- Camphor - 1500 – 2000 m
- Cinnaman – 250 – 1000 m
- Coffee – 1000 – 2000 m
- Clove – up to 900 m
- Saffron – up to 1250 m
- Cardamom – 600 – 1600 m

TEMPERATURE

- Temperature is another factor affecting the growth of a plant.
- Excessive temperature as well as frost also affect the quality of medicinal plants adversely.

(for eg) Cinchona – 60 – 75℃

Tea – 70 – 90℃

Coffee – 55 – 70 ℃

Cardamom – 50 – 100 ℃

- Camphor and coffee can not withstand frost where as saffron needs only cold climate and pyrethrum requires dry weather for cultivation.

RAIN FALL AND IRRIGATION

- Except the xerophytic plants like aloe , acacia and few others, most of the plants need either proper arrangement for irrigation or sufficient rain fall for their favorable development .
- In a few cases well distributed rainfall through out the year is desired.

SOILS AND SOIL FERTILITY

- Soil is the most important natural resource as it supports growth of all plants.
- Soil provides mechanical support as well as water and essential plant food elements for plant growth.
- The capacity of soil to supply plant nutrients in quantities and proportions required and to provide a suitable medium for plant growth is known as soil fertility.

- Soil makes chemical make up and nutrients available to plants.
- Plant growth depends upon physical arrangement and nature of soil particles organic matter content of soil and its living organisms.
- Soil consists of mineral matter , air , water and organic matter.
- It is the mineral matter which makes a lot of difference in various forms of soil.

- Mineral matter may be coarse gravel , coarse sand or in the form of finest particles of clay and slit.
- Clay is one of the highly weathered portions of the soil consisting of finest particles.
- This provides the soil adhesive and cohesive properties and also holds plant nutrients with the result that nutrients are not lost through leaching.

TYPES OF SOILS
(PARTICLE SIZE IN DIAMETERS)

- Fine clay – Less than 0.002 mm
- Coarse clay or slit – 0. 002 – 0.02 mm
- Fine sand – 0. 02 – 0.2 mm
- Coarse sand – 0.2 – 2.00 mm

CLASSIFICATION OF SOILS

- Clay soil – More than 50% of clay
- Loamy soil – 30 – 50 % of clay
- Slit loam soil – 20 – 30 % of clay
- Sandy loam soil – 10 – 20 % of clay
- Sandy soil – More than 70 %
- Calcarious soil – More than 20 % of lime

- Any type of soil containing less than 0.5% organic matter is considered as poor.
- If more than 1.5% - 5% of organic matter is present it is described as a rich soil.
- The soil with 0.5% - 1.5% humus is termed as intermediate soil.
- A soil with half of the pore spaces filled with water and rest with air is considered as good soil. Since good aeration is essential for root development.

- The maximum availability of the PH ranges from 6.5 – 7.5. For neutral acidic soils the PH can be limed or and by adding gypsum it can be made alkaline.
- Ground nut, sun flower seeds , cotton and rice grow better in alkaline soils.
- Tobacco, cinchona, tea and potato grow well in acidic soil.
- In alkaline soils phosphorous is converted to insoluble forms of calcium phosphate.

SOIL FERTILITY

- It is the capacity of soil to provide nutrients in adequate amounts and in balanced proportions to plants.
- If cropping is done with out fortification of soil with plant nutrients soil fertility gets lost.
- Soil fertility can be maintained by addition of animal manures, nitrogen fixing bacteria or by application of chemical fertilizers.

FERTILIZERS AND MANURES

- Plants also need food for their growth and development.
- Plants need basically for their growth are the carbon di oxide , sun rays , water and mineral matter from soil.
- With limited number of chemical elements plants build up fruits, grains, fibers etc and synthesize fixed oils and volatile oils , glycosides, alkaloids, sugars and many more chemicals.

CHEMICAL FERTILIZERS

- Plants need primary nutrients like nitrogen, phosphorous, potassium.
- Magnesium, calcium and sulphur in small quantities known as secondary nutrients.
- Trace elements like copper, manganese, iron, boron, molybdium, silica, zinc are also needed for healthy plant growth.
- Carbon, oxygen, hydrogen and chlorine are provided from water and air naturally.

MANURES

- Farm yard manure , castor seed cakes, poultry manures, neem and karanj seed cakes etc are manures normally consist of 3 – 6 % of nitrogen , 2%phosphate and potash 1 – 1.5 %. They are made easily available to plants.
- Bone meal , fish meal , bio gas slurry , blood meal and press mud are the other forms of organic fertilizers.

BIO FERTILIZERS

- This consist of different types of micro organisms or lower organisms which fix the atmospheric nitrogen in soil and plants can use them for their day to day use.
- (for eg) *Rhizobium, Azotobactor, Azo sperillium , Bijericia, Blue green algae*, *Azolla* and phosphorus solubilizing organisms.

PESTS AND PEST CONTROL

Pest is an undesired animal or plant species and pesticides are chemicals derived from synthetic and natural sources effective in small concentrations against pests.

DIFFERENT TYPES OF PESTS : Fungi and viruses, weeds, insects and non insect pests including rodents.

FUNGI AND VIRUSES

- ***Ascochyta atropae*** causes the formation of greyish white irregular spots which further cause necrosis of leaves.This disease is called as **leaf necrosis**.
- ***Cercospora atropae*** causes round to angular brown spots with chest nut coloured margins on both sides of leaves called as **leaf spot.**
- ***Phytophthora nicotianae*** causes dropping of young leaves and branches yellowing of older leaves and drying of whole plant this disease is called as ***phytophthora*** **root rot.**

- Many different viruses are responsible for some plant diseases. They are **mosaic** causing necrosis of leaves petioles and stem of different solanaceous plants.
- Tobacco mosaic virus, cucumber mosaic virus and tobacco ring spot virus are observed in ***Digitalis*** and a strain of cucumber mosaic virus is detected on ***Hyoscyamus.***
- The viruses show disease symptoms on Rauwolfia , tobacco, datura, vinca , and eucalyptus.
- other viruses reports on medicinal plants are yellow vein mosaic, graft transmissible virus.

INSECTS

- Through out the world about 1 million species of insects have been reported.
- Various insect pests which attack medicinal plants are **Agrotis** species **Heliothis armigera** and **Odontotermes obesus**, **Flea beetle**, **Empoasea pterides, Laphygma exigna , Odontotermes obesus** and **Phytomyza atriicornis** are the insect pests which affect the ***mentha*** species.
- The other insect pests known to cause damage are **caterpillars, lepidopterus larvae, cut worms, hessian fly, aphides, pyrilla, grasshoppers, spiders,mites** etc,
- All the insect pests belong to phylum **Anthropoda** of animal kingdom and they are further placed under 2 morphological groups namely **Biting and chewing**, **Piercing and sucking insects**.

WEEDS

- A weed is an un desired plant or waste plant.
- Weeds are considered as dreadful pests because losses due to them are estimated to be more then those occurring due to other pests and diseases combined together.
- Some weeds causes allergies (for eg) **Hay fever** caused by poison ivy , western poison oak , varnish tree, poison sumae etc.
- some plants growing as weeds may be poisonous like datura and menispermus species etc

NON INSECT PESTS

They are grouped in to 2 categories

- Vertebrates like rats , monkeys , birds , rabbits , squirrels , deer, pigs etc,
- In vertebrates like nematodes , crabs , snails , mites and symphylids.
- The rodents have sharp teeth causing considerable spoilage of crude drugs and the fecal matter cause contamination of crude drugs.

METHODS OF PEST CONTROL

- **MECHANICAL METHOD**
- **AGRICULTURAL METHOD**
- **BIOLOGICAL CONTROL**
- **CHEMICAL CONTROL**

MECHANICAL METHOD

- It employs manual labour along with different devices for collection and destruction of pest.
- The simple technique used are **hand picking**, **pruning, burning** and **trapping of pests**.
- A proper approach is made for collection and destruction of eggs, larvae, pupae and adults of insects. The better way for the protection from rodents like rats are construction of concrete ware houses.
- This method is adopted for trapping flying insects is to emplace funnel shaped containers containing flavored attractants comprising rose oil, anise oil mixed with saw dust.
- The insects can easily get an entry in the trap but not an easy exit.

AGRICULTURAL METHOD

- It covers advanced plant breeding techniques capable of inducing genetic manipulation resulting in production of pest resistant species,
- It produces hybrid varieties which are resistant to fungal and bacterial attack , as compared to limited success with insects.
- Another aspect in agricultural control is deep plough to eradicate weeds.

BIOLOGICAL CONTROL

In this method the insects are controlled. This method is the effective safe and economic method of pest control.

CHEMICAL CONTROL

- The control of pests is with the use of chemical pesticides which include insecticides, fungicides, herbicides and rodenticides.
- The chemical pesticides are further classified as rodenticides, insecticides,

  Acaricides, fungicides, herbicides, ovicides, bactericides, arboricides etc.

RODENTICIDES : warfarin, strychnine, arsenic tri oxide , red squill etc

INSECTICIDES : Gammaxine,methoxy chlor, parathion, malathion, sodium arsenate , pyrethroids, rotenoids, carbamates etc

ACARICIDES (MITICIDES): Tetradion,chloro benzolate

FUNGICIDES : Chloro phenols,anti biotics , quartenary ammonium compounds

HERBICIDES : 2,4 Di chloro phenoxy acetic acid , calcium arsenate, sulphuric acid.

- An ideal insecticide should be non toxic and non injurious to medicinal plants and human beings.
- It should be selective in action and highly toxic to insects in small concentrations.
- The pesticides should be stable under ordinary conditions of storage non inflammable , non corrosive and free from odour.
- It should be non cumulative in soil and possess stability on treated surface.

- Some synthetic pesticides are Methoxy chlor , Aldrin,DDE,DDT,Carbaryl, Baygon,parathion, Malathion.

BIO PESTICIDES FOR CROP PROTECTION

Bio pesticides (biological pesticides)

- Derived from natural materials such as animals, plants, bacteria and certain minerals.
- Chemical pesticides are hazardous and cause damage to health eco system and water.

DIFFERENCES BETWEEN BIO PESTICIDES AND CHEMICAL PESTICIDES

1. Bio pesticides are completely non toxic to the plants hence increase chlorophyll and proteins in the plants.

Chemical pesticides are poisonous hence destroy chlorophyll and proteins in the plants.

2.BP-These are eco friendly and do not cause any physiological damage to the organism.

CP-Excess use of these chemicals cause environmental pollution there by causing physiological damage and ecological imbalance.

3.BP-These are used in very small quantity (4 to 5 sprays). These prevent multiplication of insects.

CP-These are used in large quantity (10 to 20 sprays) and cause mutation in the insects hence new species of insects may appear.

4. Bio pesticides are bio degradable and do not retain any residue or toxins.

Chemical pesticides retain toxic residue on the plants and are toxic to human beings.

5.BP- No harmful effect on useful micro organisms or pollinating insects or earth worms.

CP - cause harmful effect on useful micro organisms or pollinating insects.

6. BP -are safe to handle, store, transport and spray.

CP- need care full handling their transport and spraying should be done with caution.

7. BP- Do not affect soil fertility.

CP- Adversely affect soil fertility.-

8.BP- Do not cause any chemical reaction and can be produced in large quantity and stored safely.

CP- Sometimes cause toxic and harmful chemical reactions which are un controllable.

9.BP -are not toxic to human beings hence can be sprayed in habited areas.

CP -Produce hazardous effects on human beings if sprayed in habited areas.

10. BP -Act as insecticides, fungicides, viricides, insect repellents and some time act as growth nutrients.

CP- Different products are necessary as insecticides , fungicides, viricides and insect repellents and hence they are not economical.

PLANT GROWTH REGULATORS

- Plant growth regulators are the compounds other than nutrients which affect the morphological structure and physiological processes of plants in low concentrations.
- Major growth hormones are auxins, gibberellins, cytokinins, abcisic acid and ethylene.
- These substances regulate cell enlargement, cell division, cell differentiation, organogenesis, senescence and dormancy.
- They are employed in seed treatment to achieve earlier growth and root development, quality improvement like protein level and amino acid balance etc.

AUXINS

- They promote elongation of coleoptiles tissues.
- Indole acetic acid (IAA) is an auxin that occurs naturally In plants.
- They are either natural auxins which are produced by plants themselves or synthetic auxins which have same action as natural auxins.
- IAA is the principal auxin and other natural auxins which have the same action as natural auxins are indole – 3- acetonitrile (IAN) 4- Chloro indole 3 acetic acid and phenyl acetic acid.
- The synthetic auxins are indole 3 butyric acid (IBA), 2 Napthy oxy acetic acid (NOA),Napthyl acetic acid (NAA), 1-Napthyl acetamide

(NAD) , 2,4 – Di chloro phenoxy acetic acid , (2,4-D) 2, 4, 5 Tri chloro phenoxy acetic acid and 5- carboxy methyl N, N- Di methyl di thio carbamate.

GIBBERELLINS

- About 50 gibberellins are known, about 40 of these occur in green plants while others are present in some fungi.
- They are present in different organs and tissues like roots, shoots , buds, leaves,Root nodules, fruits and callus tissues.
- The commercial formulation of gibberellins are used currently for promoting vegetative and fruit growth, breaking dormancy, flower initiation etc.
- The effect of gibberellins in cell division is an increase in cell size similar to the effect of auxins.
- The use of gibberellins in lower dose has shown increased yield of digitalis glycosides per shoot.The hormone tried with leaf and root culture of digitalis showed higher production of digoxin.

CYTOKININS

- These are either natural (zeatin) or synthetic (kinetin) compounds with significant growth regulating activity.
- Zeatin has effect on cell division and leaf senescence and synthetic cytokinins are useful in promoting lateral bud development and inhibition of senescence.
- Cytokinins plays a important role in the promotion of cell division.
- The naturally occurring cytokinins are zeatin.
- Cytokinins are reported to increase marginally sennoside content in Tinnevelly senna leaves and also enhance the dry weight of shoots.

ETHYLENE

- It Is a simple organic molecule present in the form of volatile gas.
- It is present in ripening fruits , flowers, stems, roots, tubers and seeds.
- It is present in very small quantity in plant 0.1 ppm (part per million).
- Its quantity increases in local areas during the time of growth and development.
- Ethylene is produced by incomplete burning of carbon rich substances like a natural gas, coal and petroleum.
- Ethylene shows growth response in plants which include fruit ripening, leaf abscission, stem swelling, leaf bending, flower petal dis coloration and inhibition of stem and root growth.

ABSCISIC ACID(ABA)

The physiological activities in plants like retaining or shedding of different organs such as leaves, stems, flowers and fruits have led to finding of natural growth inhibitor.

COLLECTION AND PROCESSING OF CRUDE DRUGS

- The drugs are collected suitably when they contain maximum concentration of active ingredients.
- While collecting the crude drugs diseased plants or plants treated with pesticides are to be avoided for medicinal use and should be rejected during collection.
- The season of collection of medicinal plants is also very specific.

(for eg) Rhubarb rhizome and aconite roots contain maximum active constituents on warm season.

- The drugs which constitute leaf and the flowering tops of plants are collected just before they reach their flowering stage (maturity).

  (for eg) senna, digitalis, vinca, belladonna etc
- The leaves of aloe are collected when they are sufficiently thick.
- Flowers should be collected just before pollination or many time before their full expansion.

  (for eg) saffron, clove buds, chamomile, arnica etc.
- Barks are collected in early summer when cambium is active as it is easy to detach them from the stem.

- 3 different methods of collecting bark drugs are felling, up rooting and coppicing.
- In **felling** method the tree is cut at base and bark is peeled off.
- In **up rooting** technique the roots are dug out and barks are stripped off from the roots and branches
- In **coppicing** method the plant is allowed to grow for a definite period and then it is cut off at specific distance from soil.

- The fruits are collected depending upon the part of fruits used.They are collected either ripe or half ripe but full grown.
- The un organised drugs such as resins, gums, latex are collected as soon as they ooze out of the plant.
- Acacia gum is collected 2-3 weeks after making incisions on the bark of the tree and when it is sufficiently hard.
- Opium and papaya latices are collected after coagulation of latex.
- Turpentine oleo resin and balsam of peru are collected when the plant is about 8-10 years old.

HARVESTING

- Harvesting can be done efficiently in every respect by the skilled workers.
- Selectivity is of advantage in that the drugs other than genuine but similar in appearance can be rejected at the site of collection.
- The under ground drugs like roots, rhizomes, tubers etc are harvested by mechanical device such as diggers or lifters.

- **Flowers, seeds** and **small fruits** are collected by a device known as **seed stripper**.
- The technique of beating plant with bamboos is used in case of cloves.
- The cochineal insects are collected from branches of cacti by brushing.
- Fennel, coriander and caraway plants are up rooted and dried.

DRYING

- Drying consist of removal of sufficient moisture content of crude drugs to improve its quality and make it resistant to the growth of micro organisms.
- Drying inhibits partially enzymatic reactions.
- The slicing and cutting in to smaller pieces is done to enhance drying as in case of glycyrrhiza, squill and calumba.
- The flowers are dried in shade to retain its color and volatile oil content.
- Depending upon the type of chemical constituent a method of drying can be used for a crude drug. Drying of flowers can be achieved by sun drying and Artificial drying.

NATURAL DRYING (SUN DRYING)

- It may be direct sun drying or in the shed.
- If the natural color of the drug (digitalis, clove, senna) and the volatile principles of the drug

(peppermint) are to be retained. Drying in shed is preferred.

- If the contents of the drugs are quite stable to the temperature and sunlight the drugs can be dried directly in sun shine (gum acacia, seeds and fruits)

ARTIFICIAL DRYING

Drying by artificial means includes drying the drugs in an oven

TRAY DRYERS , **VACCUM** DRYERS, **SPRAY** DRYERS **(TVS)**

TRAY DRYERS

- The drugs which do not contain volatile oils and the quite stable to heat or which need deactivation of enzymes are dried in tray dryers.
- In this process hot air of the desired temperature is circulated through the dryers and this facilitates the removal of water content of the drugs
- (for eg) belladonna roots, cinchona bark , tea and rasp berry leaves and gums are dried by this method.

VACCUM DRYERS

- The drugs which are sensitive to higher temperature are dried by this process

  (for eg) Tannic acid and digitalis leaves

SPRAY DRYERS

- Drugs which are highly sensitive to atmospheric conditions and also to temperature of vaccum drying are dried by spray drying method.
- This technique is followed for quick drying of economically important plant or animal constituents rather than the crude drugs.

  (for eg) papaya latex, pectin,tannins etc.,

GARBLING(DRESSING)

- This process is desired when sand, dirt and foreign parts of the same plant not constituting drug are required to be removed.
- If the extraneous matter is permitted in crude drugs the quality of drug suffers and all times it does not pass pharmacopeial limits.
- Excessive stems in case of lobelia and stramonium are removed.
- Stalks of cloves are to be deleted.

- Drugs constituting rhizomes need to be removed from the roots and rootlets and also stem bases.

- Pieces of iron must be removed with the magnet in case of castor seeds before crushing and by shifting in case of vinca and senna leaves.

- The pieces of bark should be removed by peeling as in acacia.

PACKING

- The morphological and chemical nature of drug its ultimate use and effects of climatic conditions during transportation and storage should be taken in to consideration while packing the drugs.
- Aloe is packed in goat skin. Colophony and balsam of tolu are packed in kerosene tins.
- Asafoetida is stored in well closed containers to prevent loss of volatile oils.
- Cod liver oil is sensitive to sunlight should be stored in such containers which will not have effect of sunlight.

- Leaf drugs like senna, vinca and others are pressed and baled.
- The chemicals which absorb excessive moisture from the drug are incorporated in the containers.

  (for eg) Digitalis,Ergot and Squill
- Roots and seeds are packed in gunny bags.

STORAGE AND PRESERVATION OF CRUDE DRUGS

- Preservation of the crude drugs needs sound knowledge of their physical and chemical properties.
- Good quality of the drugs can be maintained if they are preserved well.
- All the drugs should be preserved in well closed and in the filled containers.

- They should be stored in water proof, fire proof and rodent proof containers.

- A number of drugs absorb moisture during their storage become susceptible to the microbial growth.

- Some drugs absorb moisture to the extent of 25% of their weight.

- The excessive moisture present leads to enzymatic reactions resulting in decomposition of active constituents.

  (for eg) Digitalis wild cherry bark, Gentian and Ergot.

- The moisture not only increases the bulk of the drug but also impairs the quality of the drug.

- Preservation against insect or mould attacks is also essential.

- Different types of insects nematode, worms, moulds and mites infest the crude drugs during storage.

- Some of the more main pests found in drugs are ***coleoptera,Lepidophera*** and ***Arachnida*** or ***mites.***

- Few drops of chloroform and carbon tetra chloride are very useful for preventing insect attack.

- Digitalis and ergot need low moisture content so it should be kept with calcium oxide which are non liquifying , inert and dehydrating substance.
- The drugs containing volatile oil should be stored in well closed , air tight, dark colored containers in a cool and dark place.
- All the biological products should be stored at temperature between 2-8℃

MEDICINAL PLANT BIO TECHNOLOGY

MUTATION

- Mutation means variation in characters of the species, it is caused either due to environmental changes or changes in hereditary constitution.
- **Variations** caused **due to environmental changes** are called as **modifications.**
- When a **change** occurs **due to genome** of an individual which is not caused due to environment , a sudden change in the geno type is called **mutation**.
- 2 types of mutation are **chromosomal mutations** and **point mutation**

- Mutation which occurs due to some un known reason from nature is called as **spontaneous mutation**.This has been observed in some plants, bacteria, viruses etc.
- Mutation induced by artificial with some reagents are called **mutagens** and called as **induced mutations**.
- The changes caused due to mutations include morphological and anatomical changes and also changes in the chemical composition of the plants.

POLYPLOIDY

This method produced useful effects on medicinal plants like digitalis, mentha, poppy, lobelia and tropane alkaloid containing plants.

- The specific number of chromosomes is a character of each species and is called genome which is present in all types of organisms.
- The term **EU PLOIDY** is a type of PLOIDY in which genome contains whole set of chromosomes and eu ploidy includes **mono ploidy, di ploidy** and **poly ploidy.**
- When the organism contains **more then 2 genome** it is called **poly ploidy**.
- The polyploidy occurs in a multiple series of 3,4,5,6,7,8,etc of the basic chromosome or genome number it is called as tri ploidy, tetra ploidy, penta ploidy, hexa ploidy, hepta ploidy and octa ploidy respectively.
- Poly ploidy caused through cell generation, physical agents like x rays, centrifugation, temperature chocks and chemical agents mainly colchicine, veratrine, sulphanilamide, hexa chloro cyclo hexane and mercuric chloride.

CHEMODEMES (CHEMICAL RACES)

- Group of plant species which have identical morphological characters, but differ in their chemical nature.
- chemodemes can be confirmed by growing different plants of a species in identical conditions preferably from seeds for many generations.
- It shows variations in their chemical constituents.

ARTIFECIAL MUTATION

- They are induced artificially in the living organisms exposing them to abnormal environment such as radiations, temperature and chemicals which are called as **mutagens** or **mutagenic agents**.

RADIATION MUTATION

- The electro magnetic waves of short wave length (ultra violet light, x rays , gamma rays, alpha and beta rays) are radiation mutagens.
- The x rays and gamma rays are called ionizing radiations and also include alpha particles, beta rays, thermal and fast neutrons.

CHEMICAL MUTATION

- Some chemical mutations or mutagens like nitrogen mustard, formaldehydes, nitrous acid and ethyl ethane sulphonate alter chemical constitution of DNA bases and cause transitional substitution in DNA.
- Chemical mutagens has cellular effects like production of abnormal DNA (nitrogen mustard) inhibition of cyto chrome oxidase with resultant peroxide formation (in organic cyanides).

HYBRIDIZATION

- The process through which hybrids are produced is called hybridization
- A hybrid is an organism formed by crossing of 2 different varieties.
- The resultant hybrids are mono hybrid (one pair of different characters)
- Di hybrids (2 pairs of different characters) or poly hybrid (more than 2 pairs of different characters)
- Hybridization helps for the production of new variety which are not present in both the parents.
- (for eg) *withania somnifera* chemo type has led to the formation of a new hybrid which contains 3 withanolides.
- A recent development in hybridization is tissue culture (eg) proto plast culture (protoplast fusion or asexual hybridization) The fusion of cells of same origin or different species.

CONSERVATION OF MEDICINAL PLANTS

- Bio diversity in the form of plants (more than 8000 species) and animals form the resource base of Indian health traditions like folk Ayurveda , unani , siddha and Homeopathy medicines.
- The applications of these resources cover prevention of diseases, cure and promotion of health.
- Health for all by 2000 AD is the National goal set for the country in order to achieve this goal the alternative systems of medicines like Ayurveda , siddha, unani and Naturopathy have to be promoted.
- All the systems of medicine including Allopathy depends to a greater extent on plant based products.

- Hence conservation and development of medicinal plants assumes special significance in the Indian medicines.
- 30% of drugs used in Allopathy come from plants mostly wild medicinal plants.
- More research is being focused towards medicinal plants for possible cure of serious ailments like cancer.
- **Taxol** from ***Taxus baccata*** and anti tumour alkaloids like camptothecin, 9-methoxy camptothecin and 20-0-acetyl camptothecin from ***Mappia foetida*** a western ghats tree species
- **Old medicines in new bottle** : some of the modern medicines based on the indigenous knowledge of tribal and agricultural communities are as follows.,

- **Aspirin** - from ***Filipendula ulmaria*** reduces pain and inflammation.
- **Codeine** - from ***Papaver somniferum*** relieves pain, suppresses coughing.
- **Ipecac** - from ***Psychotria ipecacuanha*** induces vomiting.
- **Pilocarpine** – from ***Pilocarpus jaborandi*** reduces pressure in eye.
- **Pseudo ephedrine** - from ***Ephedra sinica*** reduces nasal congestion.
- **Quinine** – from ***cinchona*** species cures malaria.
- **Reserpine** – from ***Rauwolfia serpentina*** lowers blood pressure

- **Taxol –** from ***Taxus brevifolia*** cures ovarian cancer and breast cancer.
- **Theophylline** – from ***Camellia sinensis*** used in bronchial diseases.
- **Vinblastine –** from ***Catharanthus roseus*** cures hodgkins diseases.
- Extraction and screening of biological activity has become a integral part in large industries which market new natural products such as oils, drugs, perfumes, waxes, bio pesticides etc.,
- More than 70% of the Rural population still depends on a large number of medicinal plants for the primary health care needs in india.

- About 15,000 herbal formulations are known in the traditional health care system for dealing with a wide range of preventive, promotive and curative uses.
- Over 95% of the medicinal plants are collected from the wild.
- Less than 20 species of plants are under commercial cultivations, 400 species are used in production by industry.
- Over 70% of the plant collections involve destructive harvesting.The plant parts used in medicine include leaves, flowers,fruits,seeds,stem,bark,root,gum,latex,heart wood etc.,
- Indigenous knowledge system,local knowledge, traditional knowledge of the local people have tremendous relevance in conservation.

- Local people have enormous knowledge about the seasonality of various plants.
- The ethno botanical knowledge of the tribals has enormous relevance for conservation.
- One of the most important problems that is being faced today is the decline in medicinal plant resources due to over exploitation of medicinal plants from the wild.
- A programme of value addition of medicinal plants in the form of herbal medicines, food supplements and cosmetics can improve the rural income and employment especially for women and also increases the demand for natural products in local, regional, national and inter national level.

- Forest medicinal plants should be saved by the forest managers.our national forest policy of 1988 also leads to forest conservation programmes which can be succeeded with peoples support and co operation.

- Conservation measures should include medicinal plant development areas, medicinal plants conservation parks, medicinal forms in home, school, community herbal gardens. Commercial cultivation in private holdings.

- Medicinal plants gardens should be maintained by the research wing of the Tamilnadu forest department.

MEDICINAL PLANTS IN FOREST AREA

TREES

- Nelli - *Phyllanthus emblica*
- Kadukkai – *Terminalia chebula*
- Vilvam – *Aegle marmelos*
- Illupai – *Madhuca longifolia*
- Neem – *Azadirachta indica*
- Etti – *strychnos nux vomica*
- Maravattai – *Hydnocarpus laurifolia*
- Naaval – *Syzygium cumini*
- Athi – *Ficus glomerata* and *Ficus recemosa*

SHRUBS

- Adhatoda – *Justicia adhatoda*
- Nochi – *vitex negundo*
- Semparuthi – *Hibiscus rosa, Hibiscus sinensis*
- Maruthani – *Lawsonia inermis*
- Avaram – *Cassia auriculata*
- Kumari – *Aloe barbadensis*
- Karum thulasi – *ocimum basilicum*
- Thulasi – *ocimum tenuiflorum*
- Vasambu – *Acorus calamus*
- Sarpagandhi – *Rauwolfia serpentina*

HERBS

- Vallarai – *Centella asiatica*
- Brahmi – *Bacopa monnieri*
- Amukkara – *Withania somnifera*
- Thoothuvalai – *Solanum trilobatum*
- Keezha nelli – *Phyllanthus fraternus*
- Karisalankanni – *Eclipta prostrata*
- Ponnankanni – *Alternanthera sessilis*
- Senna,Nila avarai – *Cassia senna*
- Nithyakalyani – *Catharanthus roseus*
- Nila vembu – Andro graphis paniculata

CLIMBERS AND LIANES

- Siru kurinjan – Gymnema sylvestre
- Kalppai kizhangu – Gloriosa superba
- Seenthil kodi – Tinospora cordifolia
- Vellai kundumani – Abrus precatorius
- Mudakkathan – Cardiospermum halilcacabum
- Sikakaai – Acacia sinuta

GRASSES

- Vettiver – Vetriveria zizanioidas