Natural Science

Crops:

Crops are plants that are cultivated and harvested for commercial purposes and use by humans. They can be grown for food, medicine, fuel, fibre, raw materials or for their chemical properties.

Importance of classifying the Crop Plants:

- To get acquainted with crops.
- To understand the requirement of soil & water of different crops
- To know adaptability of crops.
- To know the growing habit of crops.
- To understand climatic requirement of different crops
- To know the economic produce of the crop plant & its use
- To know the growing season of the crop
- Overall to know the actual condition required for the cultivation of plants.

Classification based on climate:

1. Tropical: Crops grow well in warm & hot climate. E.g. Rice, sugarcane, jowar etc
2. Temperate: Crops grow well in cool climate. E.g. Wheat, Oats, Gram, Potato etc.

Classification Based on growing season:

1. **Kharif/Rainy/Monsoon crops:** The crops grown in monsoon months from June to Oct-Nov, Require warm, wet weather at major period of crop growth, also required short day length for flowering. E.g. Cotton, Rice, Jowar, bajara.
2. **Rabi/winter/cold seasons crops:** These require winter season to grow well from Oct to March month. Crops grow well in cold and dry weather. Require longer day length for flowering. E.g. Wheat, gram, sunflower etc.
3. **Summer/Zaid crops:** crops grown in summer month from March to June. Require warm day weather for major growth period and longer day length for flowering. E.g. Groundnuts, Watermelon, Pumpkins, Gourds.

Use/Agronomic classification:

1. **Grain crops:** May be cereals such as millets cereals are the cultivated grasses grown for their edible starchy grains. The larger grain used as staple food is cereals, E.g. rice, Jowar, wheat, maize, barley. Millets are the small grained cereals which are of minor importance as food. E.g. Bajara.

2. **Pulse/legume crops:** Seeds of leguminous crops plant used as food. On splitting they produced dal which is rich in protein. E.g. green gram, biack gram, soybean, pea, cowpea etc.

3. **Oil seeds crops:** crop seeds are rich in fatty acids, are used to extract vegetable oil to meet various requirements. E.g. Groundnut, Mustard, Sunflower, Sesamum, linseed etc.

4. **Forage Crop:** It refers to vegetative matter fresh as preserved utilized as food for animals. Crop cultivated & used for tickler, hay, silage. Ex: Sorghum, Elephant grass, Guinea grass, Berseem & other pulse bajara etc.

5. **Fiber crops:** Crops grown for fiber yield. Fiber may be obtained from seed. E.g. Cotton,

steam, jute, Mesta, sun hemp, flax.

6. **Roots crop:** Roots are the economic produce in root crop. E.g. sweet, potato, sugar beet, carrot, turnip etc.

7. **Tuber crop**: Crop whose edible portion is not a root but a short thickened underground stem. E.g: Potato, yam

8. **Sugar crops:**The two important crops are sugarcane and sugar beet cultivated for production for sugar.

9. **Starch crops**: Crops grown for the production of starch. E.g,. tapioca, potato, sweet potato.
10. **Dreg crop**: used for preparation for medicines.,E.g. tobacco, mint, pyrethrum.
11. **Spices & condiments/spices crops**: Crop plants whose products are used to flavor taste and sometime color the fresh preserved food. E.g. ginger, garlic, chili, cumin onion, coriander, cardamom, pepper, turmeric etc.
12. **Vegetables crops:** may be leafy or fruity vegetables. E.g. Palak, mentha, Brinjai, tomato.
13. **Green manure crop**: Grown and incorporated into soil to increase fertility of soil. E.g. sun hemp.
14. **Medicinal &'aromatic crops:** Medicinal plants includes cinchona, isabgoli, opium poppy, senna, belladonna, rauwolfra, iycorice and aromatic plants such as lemon grass, citronella grass, palmorsa, Japanese mint, peppermint, rose geranicern; jasmine, henna' etc.

Classification based on **life** of crops/duration of **crops:**

1. **Seasonal crops:** A crop which completes its life cycle in one season-Karin, Rabi, summer. E.g. rice, Jowar, wheat etc,

2. **Two seasonal crops**: crops complete its life in two seasons. E.g. Cotton, turmeric, ginger.

3. **Annual crops:** Crops require one full year to complete its life in cycle, E.g. sugarcane.

4. **Biennial crops:** which grows in one year and flowers, fructifies & perishes the next year? E.g: Banana, Papaya,

5. **Perennial crops:** crops live for several years. E.g. Fruit crops, mango, guava etc.

Classification based on cultural method / water:

1. Rain fed: Crops grow only on rain water. E.g. Jowar, Bajara, Mung etc.

2. Irrigated crops: Crops grows with the help of irrigation water. E.g. Chili, sugarcane, Banana, papaya etc.

Classification based on root system;

1. **Tap root system:** The main root goes deep into the soil. E.g. Tur, Grape, Cotton etc:

2. **Adventitious/Fiber rooted:** The crops whose roots are fibrous shallow & spreading into the soil. E.g. Cereal crops, wheat, rice etc.

Classification based on economic Importance:

1. **Cash crop**: Grown for earning money. E.g. Sugarcane, cotton.

2. **Food crops**: Grown for raising food grain for the population and & fodder for cattle. E.g. Jowar, wheat, rice etc.

Classification based on number of cotyledons:

1. Monocots or monocotyledons: Having one cotyledon in the seed. E.g. all cereals & Millets.
2. Dicots or dicotyledonous: Crops having two cotyledons in the seed. E.g: all legumes and pulses

Classification based on photosynthesis(Reduction of Co2/oark reaction):

- **C3 Plants:** Photo respiration is high in these plants C3 Plants have lower water use efficiency. The initial product of C assimilation in the three 'C' compounds. The enzyme involved in the primary carboxylation is ribulose-1,-Biophospate carboxylose. E.g. Rice, soybeans, wheat, barley cottons, potato.
- **C4 plants:** The primary product of C fixation is four carbon compounds which may be malic acid or acerbic acid. The enzymes responsible for carboxylation are phosphoenol pyruvic acid carboxylose which has high affinity for Co2 and capable of assimilation Co2 event at lower concentration, photorespiration is negligible. Photosynthetic rates are higher in C4 than C3 plants for the same amount of stomatal opening. These are said to be drought resistant & they are able to grow better even under moisture stress. C4 plants translate photosynthates rapidly. E.g. Sorghum, Maize, napter grass, sesame etc.
- **Cam plants:** (Crassulacean acid metabolism plants) the stomata open at night and large amount of Co2 is fixed as a malice acid which is stored in vacuoles. During day stomata are closed. There is no possibility of Co2 entry. Co2 which is stored as malice acid is broken down & released as Co2. In these plants there is negligible transpiration. C4 & cam plant have high water use efficiency. These are highly drought resistant. E.g. Pineapple, sisal & agave.

Classification based on length of photoperiod required for floral initiation:

Most plants are influenced by relative length of the day & night, especially for floral initiation, the effect on plant is known as photoperiodism. The rate of the flowering initiation depends on how short or long is photoperiod. Shorter the days, more rapid initiation of flowering in short days plants. Longer the days more rapid are the initiation of flowering in long days plants.

Depending on the length of photoperiod required for floral ignition, plants are classified as:

- **Short-day plants:** Flower initiation takes place when days are short less than ten hours. E.g. rice, Jowar, green gram, black gram etc.

- **Long-day plants:** require long days are more than ten hours for floral ignition. E.g. Wheat, Barley,
- **Day neutral plants**: Photoperiod does not have much influence for phase change for these plants. E.g. Cotton, sunflower.

FOREST

A forest is a large area of land covered with trees or other woody vegetation. Forests covered an area of four billion hectares (15 million square miles) or approximately 30 percent of the world's land area in 2006.

Forests are the dominant terrestrial ecosystem of Earth, and are distributed across the globe. Forests account for 75% of the gross primary productivity of the Earth's biosphere, and contain 80% of the Earth's plant biomass.

Forests at different latitudes form distinctly different ecozones: boreal forests near the poles tend to consist of evergreens, while tropical forests near the equator tend to be distinct from the temperate forests at mid-latitude.

The amount of precipitation and the elevation of the forest also affect forest composition.

Human society and forests influence each other. Uses of Forests:

- They provide ecosystem services to humans and serve as tourist attractions center.
- Provides oxygen to air and maintain biodiversity
- Source of food, fodder and fibre
- Source for many forest based industry such as lac, match box, oil,timber and furniture, paper making etc
- Medicinal value
- Biodiesel as an alternative fuel
- Ornamental purpose
- Biodiesel as an alternative fuel
- Ornamental purpose
- Ggenerates employment
- Act as carbon sink

The latitudes 10° north and south of the equator are mostly covered in tropical rainforest, and the latitudes between 53°Nand 67°N have boreal forest. As a general rule, forests dominated by angiosperms *(broadleaf forests)* are more species-rich than those dominated by gymnosperms (*conifer, montane,* or *needleleaf forests).*.

Forest Trees:

1. Timber spp: Used for timber, furnitures. E.g: Sal, Mahogany, Ebony, Teak etc
2. Fodder and Manure trees: E.g: Subabul
3. Medicinal Forest spp: Eg. Hirda (*Terminalia chibula*)
4. Ornamental spp: Eg. Raintree, Cork tree
5. Food purpose: Eg: Cashew, mango, jackfruit, walnut etc
6. Resin, gum, oil: Eg: Rubber tree – rubber; pine tree – gum, resin ; Sandalwood – oil
7. Industrial purpose: Bamboo – paper industry; Tendu (Diaspyros) – Beedi leaves; Indian oak – Sericulture, *Butea monosperma* – cottage industries; Agave – ropemaking

MEDICINAL AND AROMATIC PLANTS:

Introduction

Medicinal and aromatic plants play a significant role in the life of people and are present in innumerable forms. In Indian traditions, all the plants in this earth are considered as medicinal *[Jivak* in *Astcmga Hriday* (Sutra:9-10)]. However, a simplest definition of the medicinal plant would be "*Medicinal plants are those plants which are used in official and various traditional systems of medicines throughout the world".* Other definition could be *"Medicinal plants are that provide people with medicines – to prevent disease, maintain health or cure ailments".* In one form or another, they benefit virtually everyone on earth. No exact definition for Medicinal Plant is possible. There are related issues, such as for nutrition, toiletry, body care, incense and ritual healing. Aromatic plants are a special class of plants used for their aroma and flavour. Many of them are exclusively used also for medicinal purposes in aromatherapy as well as in various systems of medicine. Similarly a number of medicinal plants also produce essential oils as well as being used for perfumery e.g. *Vetroselinum sauvwn\ Daucus carota, Anethum graveolens* and *Pimpinella anisum,* etc.

India has been considered as treasure house of a large number of valuable medicinal and aromatic plant species. Ministry of Environment and Forests has identified and documented over 9500 plant species considering their importance in the pharmaceutical industry. MAP species are still by and large gathered and collected from the wild and relatively a few are cultivated in farmland. The exploitation from the nature coupled with increasing urbanization has led to steady erosion and loss of MAPs biodiversity from the natural habitat. It is, therefore, relevant that these valuable plant species are not only preserved but also their cultivation practices are developed in order to meet the entire demands of the domestic industries as also to harness the bright prospect for current export. Shift from collection to cultivation of MAP will also ensure purity, authenticity and sustainable supply of raw drugs. Foreign exchange earning potential y from these groups of plants in India is estimated to be over US$ 3000 million per annum.

Distribution of Medicinal and Aromatic Plants (MAP)

An analysis of distribution of MAP in natural habitat showed that about 70% of India's MAPs are found in tropical forests of Western and Eastern ghats, the Vindhyas, Chotta Nagpur plateau, Aravalis and the Himalayas. Studies also showed that a large percentage of known MAPs occur in the dry and moist deciduous vegetation area compared to evergreen and temperate regions. Habit-wise classification showed that about 33% are trees, 32% herbs, 20% shrubs, 12 % creepers and 3% others.

Conservation

Conservation of MAPs is necessary for the posterity of the future generation. Several issues have consistently been raised in the various sets of recommendations compiled to promote the conservation of MAPs. These include:

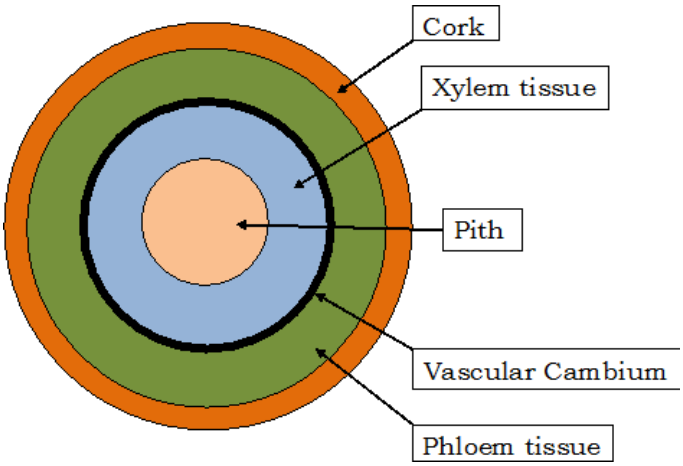
- The need for a coordinated, conservation action based on both "in situ" and "ex situ" strategies.
- The inclusion of community and gender perspectives in the development of policies and programmes.
- The development of sustainable harvesting practices.
- The need for more information on the medicinal plant trade - establishing systems for inventorying and monitoring the status of stocks of medicinal plants.
- Encouraging micro-enterprise development based on sustainable resource use by indigenous and rural communities.
- Protection of traditional resources and the intellectual property rights.

Medicinal Plant Board

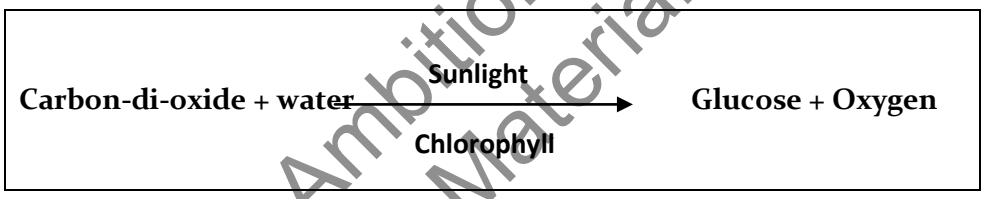
A Medicinal Plants Board has been created in 2000 in the Department of Indian Systems of Medicines & Homeopathy to address all the issues related to MAP sectors.

PHOTOSYNTHESIS:

- All organisms require energy for their survival. The source of all energy is solar energy and green plants are capable of harvesting this solar energy and converting it into a usable form by the process of **photosynthesis**.
- Green plants are **autotrophic organisms**(*auto* – self; *troph* - nutrition); they are **capable of synthesizing their own food** by using easily available raw materials such as carbon-di-oxide, sunlight and water. All other organisms mainly depend upon the green plants for their food. Photosynthesis has been **responsible for the sustenance and evolution of life on earth.**
- The **ability to trap solar energy** comes from the presence of the **photosynthetic pigment Chlorophyll**. This molecule is vital to the process since it **absorbs solar light and initiates the process of conversion of this light energy into a usable chemical form** (glucose).
- **Water**, which is a requirement for photosynthesis is absorbed by the roots of the plant and **transported** upwards to the leaves and other plants of the plant body **through the conducting tissue Xylem**. This upward movement of water in Xylem against the action of gravity is called **Ascent of sap**.
- **Glucose** that is produced as a result of photosynthesis has to be **transported from the leaves** (where it is synthesized) **to the non-green parts** of the plants such as **roots**. This **conduction of food** happens through the **tissue phloem**.
- In higher plants, **Xylem tissue** is **arranged** towards the **centre of the stem/trunk** while **phloem** is **arranged around the periphery**. If the **outer portion of the stem is removed**, the **tree may die** because the food synthesized in the leaves does not reach the roots.
- **Glucose** is also **polymerized to form starch** which serves as an energy source for both the plants and the animals that consume these plants.



- **Photosynthetic pigments:**
  - In different organisms, different forms of chlorophyll are present, eg: **chlorophyll a, b, c, d and e**. Also, some other pigments such as **carotenes** and **xanthophylls** are also present.
  - Of all the pigments, **chlorophyll a** is the **primary pigment** since all other pigments absorb energy from this pigment. The **other pigments** are called as **accessory pigments**.



Transpiration:

- Transpiration is the process of water movement through a plants and its evaporation from aerial parts such as leaves, but also from the stems and flowers.
- Water is necessary for plants but only a small amount of water taken up by the roots is used for growth and metabolism. The remaining 99-99.5% is lost by transpiration.
- Leaf surfaces are dotted with pores called as stomata and in most plants they are numerous on the underside of the foliage. The stomata are bordered by guard cells and their stomatal accessory cells that open and close the pore.
- Transpiration is considered as necessarily evil, and also as a "cost associated" with the opening of the stomata to allow the diffusion of carbon dioxide gas from the air for photosynthesis. Transpiration also cools plants, changes osmotic pressure of cells, and enables mass flow of mineral nutrients and water from roots to shoots.
- Mass flow of liquid water from the roots to the leaves is driven in part by capillary action but primarily by the water potential. This water is replaced by additional absorption soil leading to a continuous column of water in the plant's xylem.

- The process of transpiration provides the plant with evaporative cooling, nutrients, carbon dioxide entry and water to provide plant structure.
- Rates of transpiration depend on the water potential gradient from the soil to the atmosphere and the resistances to its movement through the plant. If water loss is greater than water uptake, air bubbles can form in the xylem.
- Plants reduce water loss by closing their stomata, developing thick cuticles, or by possessing leaf hairs to increase the boundary layer. Stomata are quick to respond to environmental cues to protect the plant from losing too much water, but still allowing in enough carbon dioxide to drive photosynthesis.
- **Factors affecting transpiration:**
    - Number of leaves
    - Number of stomata
    - Size of the leaf – larger surface area, higher rate of transpiration
    - Presence of plant cuticle – cuticle being impermeable to water and water vapour reduces transpiration except via the stomata. Hair like structures called trichomes present on the surface of the leaf or stem can also inhibit water loss.
    - Light supply
    - Temperature
    - Relative humidity
    - Wind
    - Water supply

Poisonous/ Harmful plants:

Countless other plants not commonly used as food are als poisonous, and care should be taken to avoid accidentally contacting or ingesting them.

As weeds	Lantana camera Eucalyptus sp
Irritant plants	Beggar tricks, Prickly Pear, Squirrel Tail Barley, Tearthumb
Poisonous	Black Nightshade, Climbing Nightshade, Ground Cherry, Horsenettle, Jerusalem Cherry, Jimsonweed, Potato Fruit, Wolfsbane
	Autumn Crocus, Black Locust, Castorbean, Lily of the Valley, Pooinsettia, Rhubarb, Water Hemlock, Yew

Miscellaneous	Giant Ragweed, Jack-in-the-Pulpit, Posion Ivy, Poison Sumac, Pokeweed, Ragweed, Stinging Nettle,

- *Abrus precatorius* (crab's eye, rosary pea, Indian licorice, akar saga etc): Bright attractive seeds (the size of a ladybug, glossy red with one black dot), the ingestion of which may lead to death.
- *Aconitum genus (*wolfsbane, monksood): All parts are poisonous. Has been used as poison for bullets, as a bait and arrow poison and to poison water supplies. Quick acting poison and has been used for killing wolves in the past (hence the name).
- *Areca catechu (*betel nut palm and pinyang): The nut contains an alkaloid related to nictione which is addictive. It produces a mild high, some stimulaton and lots of red saliva which cannot be swallowed as it causes nausea. Withdrawal causes headache and sweats. Is correlated with mouth cancer, and to a lesser extent to asthma and hear diseases.
- Asparagus genus(Asparagus officinalis and Asparagus densiflorus) Though asparagus plants cultivated for food are typically harvested before they reach reproductive maturity, the berries of the mature plant are poisonous and can induce abdominal pain and vomiting.
- Atropa belladonna (deadly nightshade, devil's cherry and dwale): one of the most toxic plnts found in the Western Hemisphere.

Classification of animals:

Classification is the process that scientist use to arrange organisms into groups based on the shared observable characteristics. Taxonomy is the science of identifying and classifying organisms into groups. A taxonomist is a scientist who identifies and names organisms based on their similarities and differences. They use physical characteristics as well as DNA, genetic information, to classify organisms.

In order to study living things, scientists classify each organism according to its:

Kingdom, Phylum, Division, Class, Order, Family , Genus, Species

1. **Kingdom**- organisms are placed into kingdoms based on their ability to make food and the number of cells in their body. In all there are 5 kingdoms: **Monera, Protists, Mycota (Fungi), Plant and Animal kingdoms.**

2. **Phylum** (phyla is plural)- In the Plant Kingdom, phyla are sometimes called divisions. In the Animal Kingdom, there are 35 different phyla.

3. **Class, Order, Family**-these levels become even more specific. Each level has fewer organisms that have more in common with each other as you move down the levels.

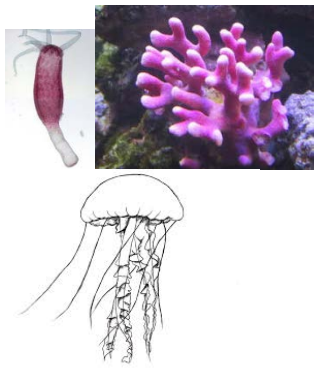
4. **Genus**- contains closely related organisms. The genus is the first word in an organism's scientific name.

5. **Species**- consists of all the organisms of the same type which are able to breed and produce young of the same kind. The species is the second word in an organism's scientific name.

Most scientists classify organisms into 5 kingdoms: Plants, Animals, Protists, Fungi, and Monera.

1) **Plants (Plantae)**- the plant kingdom is made up of plants. Plants are **autotrophs**, they make their own food. Plants are **eukaryotes**; they are made up of many cells. Plants are divided into 2 groups: vascular and nonvascular.
2) **Animals (Animalia)**- the animal kingdom is made up of animals. Animals are **heterotrophs**- they must obtain food by eating it. Animals are eukaryotes. The 35 phyla are divided into two groups: vertebrates and invertebrates.
3) **Fungi**- the fungi kingdom is made up of molds, yeasts, and mushrooms. Fungi are heterotrophs because they must absorb their food. Yeasts are one celled, while molds and yeasts are eukaryotes. Their cells have a nucleus, a cell wall, and no chlorophyll. Most fungi are **decomposers**, they break down dead organisms.
4) **Protists (Protista)**- the protists are made up of organisms that cannot easily fit into the plant, animal, or fungi kingdoms. They are one celled organisms with a nucleus or simple multicelled organisms. Some protists are autotrophs, some are heterotrophs.
5) **Monera**- the Monera kingdom is made up of bacteria. Their cells do not contain a nucleus. Some bacteria are autotrophs, some are heterotrophs.

Animal Kingdom:

Cnidarians ● invertebrates, no backbone ● radial symmetry ● have stinging cells ● have complex tissues, gut, nervous system ● examples: hydras, sea	

anemones, corals, jellyfish	
mollusks ● invertebrates ● bilateral symmetry ● has soft body, usually covered by a hard shell ● have circulatory system and gut ● examples: slugs, snails, clams, squids, octopuses	
annelids ● also called “segmented worms” ● invertebrates ● bilateral symmetry ● has gut, circulatory system, nervous system ● examples: earthworms, bristle worms, leeches	
arthropods ● invertebrates ● bilateral symmetry ● jointed limbs, segmented body (head, thorax, abdomen) ● exoskeleton - external skeleton made of protein &