



Economically Useful Plants and Entrepreneurial Botany



Learning Objectives

The learner will be able to

- ❖ Acquire knowledge about origin, area of cultivation and uses of various food yielding plants.
- ❖ Describe the different spices and condiments and their uses.
- ❖ Elicit the uses of fibre, timbers, paper and dye yielding plants.
- ❖ Acquire knowledge about the active principles, chemical composition and medicinal uses of plants.
- ❖ Develop skill of mushroom cultivation, knowledge of SCP production and sea weed liquid fertilizers
- ❖ Gains knowledge of organic farming- bio fertilisers and bio pest repellants.
- ❖ Learn to make terrarium and bonsai
- ❖ Acquires knowledge of cultivation of medicinal plants.



Chapter outline

- 10.1 Food Plants
- 10.2 Spices and Condiments
- 10.3 Fibre
- 10.4 Timber
- 10.5 Latex
- 10.6 Pulp wood
- 10.7 Dye
- 10.8 Cosmetics
- 10.9 Traditional system of medicines
- 10.10 Medicinal plants
- 10.11 Entrepreneurial Botany



The land and water of the earth sustain a vast assemblage of plants upon which all other living forms are directly or indirectly dependent. Pre-historic humans lived on berries, tubers, herbage, and the wild game which they collected and hunted that occupied whole of their time. Domestication of plants and animals has led to the production of surplus food which formed the basis for civilizations. Early civilization in different parts of the world has domesticated different species of plants for various purposes. Based on their utility, the economically useful plants are classified into food plants, fodder plants, fibre plants, timber plants, medicinal plants, and plants used in paper industries, dyes and cosmetics. Selected examples of economically important plants for each category are discussed in this chapter.

10.1 Food plants

Currently about 10,000 food plants are being used of which only around 1,500 species were brought under cultivation. However, food base of majority of the population depends only on three grass species namely rice, wheat and maize.

10.1.1 Cereals

The word cereal is derived from Ceres, which according to the Roman mythology denotes “Goddess of agriculture”. All cereals are members of grass family (Poaceae) that are grown for their edible starchy seeds. The prominence of cereals as food plants is due to the following attributes:

- i. Greater adaptability and successful colonisation on every type of habitat.
- ii. The relative ease of cultivation
- iii. Tillering property that produce more branches which results in higher yield per unit area.
- iv. Compact and dry grains that they can be easily handled, transported and stored without undergoing spoilage.
- v. High caloric value that provides energy.

The nutrients provided by cereals include carbohydrates, proteins, fibres and a wide range of vitamins and minerals. Cereals can be classified into two different types based on their size namely Major Cereals and Minor Cereals.

Major Cereals

Rice / Paddy

Botanical name : *Oryza sativa*

Paddy is a semi-aquatic crop and is grown in standing water. It is an important food crop of the world, occupying the second position in terms of area under cultivation and production, next to wheat. Rice is the chief source of carbohydrate.

Origin and Area of cultivation

South East Asia is considered as the center of origin of rice. Earliest evidences of rice cultivation have been found in China, India and Thailand. It is mainly cultivated in Delta and irrigated regions of Tamil Nadu.

Uses

Rice is the easily digestible calorie rich cereal food which is used as a staple food in Southern and North East India. Various

rice products such as **Flaked rice** (Aval), **Puffed rice** / **parched rice** (Pori) are used as breakfast cereal or as snack food in different parts of India.

Rice bran oil obtained from the rice bran is used in culinary and industrial purposes.

Husks are used as fuel, and in the manufacture of packing material and fertilizer.

International Rice Research Institute (IRRI)



International Rice Research Institute (IRRI) is located in Los Banos, Manila the capital city of Philippines. This is the only institute in the world which exclusively carries out research as on rice. IRRI aims to improve livelihoods and nutrition, abolishing poverty, hunger, and malnutrition. Whatever IR rice varieties available in the world are developed through rice breeding programme and released by IRRI. Till date IRRI has produced 843 rice varieties that have been released in 77 countries. IR8 is a high-yielding semi-dwarf rice variety developed by IRRI in the early 1960s and it is called as miracle rice, much celebrated for fighting famine. Another variety to mention is IR36 which is a semi-dwarf variety that proved highly resistant to a number of insect pests and diseases that raised farmers' rice yields and brought down the prices of the staple food in Asian families. The International Rice Gene bank of IRRI has a collection of more than 117 000 types of rice, comprising of modern and traditional varieties including wild relatives of Paddy.



Rice



Wheat



Maize

Figure 10.1: Major Cereals

Wheat

Botanical name : *Triticum aestivum*

Origin and Area of cultivation

Earliest evidence for wheat cultivation comes from Fertile Crescent region. The common cultivated wheat, *Triticum aestivum* is cultivated for about 7,500 years. Wheat is mostly cultivated in the North Indian states such as Uttar Pradesh, Punjab, Haryana, Rajasthan, Madhya Pradesh and Bihar.

Uses

Wheat is the staple food in Northern India. Wheat flour is suitable to make bread and other bakery products. Processed wheat flour, that has little fibre, is called Maida which is used extensively in making parota, naan and bakery products. Malted wheat is a major raw material for producing alcoholic beverages and nutritive drinks.

Maize / Corn

Botanical name : *Zea mays*

Origin and Area of Cultivation

Maize is the only cereal that has originated and domesticated from the New World. Madhya Pradesh, Himachal Pradesh and Punjab are the major maize producing states of India.

Why do popcorn pops?



Endosperm in corn consists of two type namely soft and hard. In popcorn soft endosperm constitutes most part of the grain surrounded by thin layer of hard endosperm. When heated, the internal starch and protein are converted into gelatinous substances and when pressure mount further, the soft endosperm expands and explodes reversing the grain and the gelatinous starch are converted into foam, which readily solidifies outside and convert into crispy, tasty popcorn.

Whereas Perambalur, Ariyalur, Cuddalore, Dindigul and Tirupur are the major maize growing belts in Tamil Nadu.



PSEUDO-CEREAL

The term pseudo-cereal is used to describe foods that are prepared and eaten



Pseudo cereal -
Chenopodium quinoa

as a whole grain, but are botanical outliers from grasses. Example: **quinoa**. It is actually a seed from the *Chenopodium quinoa* plant

belongs to the family Amaranthaceae. It is a gluten-free, whole-grain carbohydrate, as well as a whole protein (meaning it contains all nine essential amino acids) and have been eaten for 6,000 years in Andes hill region.

Uses

Most of the corn produced is used as fodder than food. Corn syrup is used in the manufacture of infant foods. Corn is a raw material in the industrial production of alcohol and alcoholic beverages.

10.1.2 Millets (Siru Thaniyangal)

The term millet is applied to a variety of very small seeds originally cultivated by ancient people in Africa and Asia. They are gluten free and have less glycemic index.

Pearl Millet

Botanical name: *Pennisetum americanum*

It is one of the millets introduced in India and Africa. Pearl Millet is rich in fibre, iron and minerals, stable food grain in many parts of India, especially in Gujarat and Rajasthan.

Uses

It is commonly used to make flat bread, gluten free cereal based products, porridge (Kambang koozh), biscuits, pasta and non-dairy probiotic beverages.



Pearl Millet



Finger Millet



Sorghum

Figure 10.2: Millets

Finger Millet – Ragi

Botanical name : *Eleusine coracana*

Finger millet is the crop of early introduction from East Africa into India. Ragi is rich in calcium.

Uses

It is used as a staple food in many southern hilly regions of India. Ragi grains are made into porridge and gruel. Ragi malt is the popular nutrient drink. It is used as a source of fermented beverages.

Sorghum

Botanical name : *Sorghum vulgare*

Sorghum is native to Africa. It is one of the major millets in the world and is rich in calcium and iron.

Uses

It is fed to poultry, birds, pigs and cattle and a source of fermented alcoholic beverage

10.1.3 Minor Millets

Little Millet

Botanical name- *Panicum sumatrense*

This is one of the oldest millets and is native to India. The species name is based on a specimen collected from Sumatra. It is rich in iron and fibre than rice that makes it best for diabetes.

Uses

It is cooked like rice and also milled and baked. It cures anaemic condition, constipation and other gastrological problems.



Little Millet



Foxtail Millet



Kodo Millet

Figure 10.3: Minor Millets

Foxtail Millet

Botanical name : *Setaria italica*

This is one of the oldest millet used traditionally in India. Which is domesticated first in China about 6000 years. Rich in protein, carbohydrate, vitamin B and C, Potassium and Calcium.

Uses

It supports in strengthening of heart and improves eye sight. Thinai porridge is given to lactating mother.

Kodo Millet

Botanical name : *Paspalum scrobiculatum*

Kodo millet is originated from West Africa, which is rich in fibre, protein and minerals.

Uses

Kodo millet is ground into flour and used to make pudding. Good diuretic and cures constipation. Helps to reduce obesity, blood sugar and blood pressure.

10.1.4 Pulses

The word Pulse is derived from the Latin words 'puls' or 'pultis' meaning "thick soup". Pulses are the edible seeds that are harvested from the fruits of Fabaceae. They provide vital source of plant-based protein, vitamins and minerals for people around the globe.





Figure 10.4: Pulses

Black gram

Botanical name : *Vigna mungo*

Origin and Area of cultivation

Black gram is native to India. Earliest archeobotanical evidences record the presence of black gram about 3,500 years ago. It is cultivated as a rain fed crop in drier parts of India. India contributes to 80% of the global production of black gram. Important states growing black gram in India are Uttar Pradesh, Chattisgarh and Karnataka.

Uses

Black gram is eaten whole or split, boiled or roasted or ground into flour. Black gram batter is a major ingredients for the preparation of popular Southern Indian breakfast dishes. Split pulse is used in seasoning Indian curries.

Red gram / Pigeon pea

Botanical name : *Cajanus cajan*

Origin and Area of cultivation: It is the only pulse native to Southern India. It is mainly grown in the states of Maharashtra, Andhra Pradesh, Madhya Pradesh, Karnataka and Gujarat.

Uses

Red gram is a major ingredient of sambar, a characteristic dish of Southern India. Roasted seeds are consumed either salted or unsalted as a popular snack. Young pods are cooked and consumed.

Green gram

Botanical name : *Vigna radiata*

Origin and Area of cultivation

Green gram is a native of India and the earliest archaeological evidences are found in the state of Maharashtra. It is cultivated in the states of Madhya Pradesh, Karnataka and Tamil Nadu.

Uses

It can be used as roasted cooked and sprouted pulse. Green gram is one of the ingredients of pongal, a popular breakfast dish in Tamil Nadu. Fried dehulled and broken or whole green gram is used as popular snack. The flour is traditionally used as a cosmetic, especially for the skin.

Chick pea / Bengal gram

Botanical name : *Cicer arietinum*

Origin and Area of cultivation: It has originated in West Asia and was known in cultivation for more than 4,000 years in India. It is mainly grown in the states of Madhya Pradesh, Uttar Pradesh and Rajasthan.

Uses

Chick pea protein is rated high in terms of amino acid content and digestibility. Infant food formulae uses malted chick pea as an ingredient. Chick pea seed flour is a prime constituent of many forms of Indian confectionary. Roasted and salted, whole or split gram forms the popular snacks of middle class.

10.1.5 Vegetables

While walking through a market filled with fresh vegetables like stacks of lady's finger, mountains of potatoes, pyramids of brinjal, tomatoes, cucurbits, we learn to choose the vegetables that is fresh, tender, ripe and those suit the family taste through experience and cultural practices. Why do we need to eat vegetables and what do they provide us?

Vegetables are the important part of healthy eating and provide many nutrients, including potassium, fiber, folic acid and vitamins A, E and C. The nutrients in vegetables are vital for maintenance of our health.

Potato

Botanical name : *Solanum tuberosum*
Family: Solanaceae

Origin and Area of cultivation

Potato has originated from the highlands of Peru and Bolivia. It is cultivated in Uttar Pradesh, West Bengal and Bihar are the major potato cultivating states of India. Nilgiri and Palani hills also contribute to the potato cultivation in Southern Indian hills.

Uses

Potato tubers are used in a variety of ways like boiled, steamed, fried, baked, roasted or as an ingredient in soup, stews, pies and other dishes. It is the major raw material for the chips industry, brewing industry and in the manufacture of products used for microbiological and clinical applications.

Lady's finger / Okra

Botanical name : *Abelmoschus esculentus*
Family: Malvaceae

Origin and Area of cultivation

Lady's finger is a native of the Tropical Africa. Assam, Maharashtra and Gujarat are the important states where Lady's finger is grown in abundance. Coimbatore, Dharmapuri and Vellore are the major cultivating regions of Tamil Nadu.

Uses

The fresh and green tender fruits are used as a vegetable. Often they are sliced and dehydrated to conserve them for later use. It has most important nutrients.

Cucumber

Botanical name : *Cucumis sativus*
Family: Cucurbitaceae

The cucurbits are the vining plants of the family Cucurbitaceae, which include cucumbers, squash, pumpkins, melons and gourds.

Origin and Area of Cultivation

The cucumber is an important summer vegetable in all parts of India. It is originated in India. It has been cultivated for at least

three thousand years. Cucumber is commonly cultivated throughout India.

Uses

Depending on the species immature or mature fruit are consumed as fresh or cooked vegetables. It is used in the preparation of salad and pickle. Oil obtained from cucumber seed is good for the brain and the body and the kernels are used in confectionaries.

10.1.6 Fruits

Edible fruits are fleshy structures with a pleasant aroma and flavours. Fruits are sources of many nutrients including potassium, dietary fiber, folic acid and vitamins. Depending on the climatic region in which fruit crops grow, they can be classified into temperate (apple, pear, plum) and tropical fruits (mango, jack, banana). In this chapter we will study some examples of tropical fruits.

Mango (National fruit of India)

Botanical name : *Mangifera indica*
Family: Anacardiaceae

Origin and Area of cultivation

The mango is the native to Southern Asia, especially Burma and Eastern India. It is the National fruit of India. Major mango producing States are Andhra Pradesh, Bihar, Gujarat and Karnataka.

Salem, Krishnagiri, Dharmapuri are the major mango producing districts of Tamil Nadu. Some of the major cultivars of mango in India are Alphonso, Banganapalli, neelam and malgoa.

Uses

Mango is the major table fruit of India, which is rich in beta carotenes. It is utilized in many ways, as dessert, canned, dried and preserves in Indian cuisine. Sour, unripe mangoes are used in chutneys, pickles, side dishes, or may be eaten raw with salt and chili. Mango pulp is



Figure 10.5: Mango

made into jelly. Aerated and non-aerated fruit juice is a popular soft drink.

Banana

Botanical name : *Musa x paradisiaca*

Family: Musaceae

Origin and Area of cultivation

Bananas were domesticated in South East Asia. Tamil Nadu is the world's No.1 banana producer. Theni, Trichy, Erode,



Figure 10.6: Banana

Thoothukudi, Coimbatore, Kanyakumari, Thanjavur and Dindigul are the prominent regions in Tamil Nadu where the crop is being cultivated. Major cultivars of banana are Chevazhai, Nentheran, Karpooravalli, Poovan and Peyan.

Uses

The banana fruit is loaded with potassium and essential vitamins, which can be eaten raw or cooked (deep fried, dehydrated, baked or steamed). The fruit can be processed into flour and can be fermented for the production of beverages such as banana juice, beer, vinegar and wine.

Jack fruit (State fruit of Tamil Nadu)

Botanical name : *Artocarpus heterophyllus*

Family: Moraceae

Origin and Area of cultivation

The jackfruit has originated in the Western Ghats of India and it is the state fruit of Tamil Nadu. The major Jack fruit cultivating

areas of Tamil Nadu are Cuddalore, Kanyakumari, Dindigul, Pudukottai, Namakkal, Tirunelveli and Nilgiris. Panruti and Coimbatore districts are the major marketing centres.



Figure 10.7: Jackfruit

Uses

The fruit can be eaten raw or cooked. Unripe flake slices are deep-fried to make crispy chips. The seeds are either boiled or roasted and eaten. Unripe fruits are used as vegetables.

10.1.7 Nuts

Nuts are simple dry fruits composed of a hard shell and an edible kernel. They are packed with a good source of healthy fats, fibre, protein, vitamins, minerals and antioxidants. Some of the important nuts are discussed below.

Cashew nut

Botanical name : *Anacardium occidentale*

Family: Anacardiaceae

Origin and Area of cultivation

Cashew has originated in Brazil and made its way to India in the 16th century through Portuguese sailors. Cashew is grown in Kerala, Karnataka, Goa, Maharashtra, Tamil Nadu, and Orissa.

Uses

Cashews are commonly used for garnishing sweets or curries, or ground into a paste that forms a base of sauces for curries or some sweets. Roasted and raw kernels are used as snacks.

Table 10.1 : Other common fruits

S.No	Common Name	Tamil Name	Botanical name	Family	Edible part
1	Guava	கொய்யா	<i>Psidium guajava</i>	Myrtaceae	Mesocarp and Endocarp
2	Papaya	பப்பாளி	<i>Carica papaya</i>	Caricaceae	Mesocarp
3	Pomegranate	மாதுளை	<i>Punica granatum</i>	Punicaceae	Aril
4	Fig	அத்தி	<i>Ficus carica</i>	Moraceae	Fleshy receptacle
5	Date Palm	பேரீச்சம்	<i>Phoenix dactylifera</i>	Arecaceae	Pericarp



Figure 10.8: Nuts

Almond

Botanical name : *Prunus dulcis*

Family: Rosaceae

Origin and Area of cultivation

Almond is a tree native to Mediterranean regions of the Middle East. Almond is cultivated in Kashmir, Himachal Pradesh and Uttar Pradesh.

Uses

Almonds are often eaten raw or roasted and are available as whole, sliced (flaked), and as flour. Almond oil is made into almond butter or almond milk, which are used in sweet and savoury dishes. Almond helps in promoting HDL (High Density Lipids)

10.1.8 Sugars

We experienced sweetness while eating the stems of sugarcane, roots of sugar beet, fruits of apple and while drinking palmyra sap. This is due to the different proportions of sugars found in it. Sugar is the generic name for sweet tasting soluble carbohydrate, which are used in foods and beverages. Sugars found in sugarcane and palmyra make them ideal for efficient extraction to make commercial sugar.

Sugarcane

Botanical name : *Saccharum officinarum*

Family : Poaceae

Origin and Area of cultivation

The cultivated *Saccharum officinarum* has evolved by repeated back crossing of *S.officinarum* of New Guinea with wild *S.spontaneum* of India to improve the quality. All districts except Kanyakumari and Nilgiris of Tamil Nadu cultivate Sugarcane.

Uses

Sugar cane is the raw material for extracting white sugar. Sugarcane supports large number of industries like sugar mills producing refined sugars, distilleries producing liquor grade ethanol and millions of jaggery manufacturing units. Fresh sugarcane juice is a refreshing drink. Molasses is the raw material for the production of ethyl alcohol.

Stevia /Sweet leaf

Botanical name : *Stevia rebaudiana*

Family: Asteraceae

Stevia is a sweetener and a sugar substitute, extracted from the leaves of *Stevia rebaudiana*. It has no calories and is 200 times sweeter than sugar. The Steviol glycoside is the chemical that is responsible for sweetness in Stevia.

Origin and Area of cultivation

Stevia is a native to Brazil and Paraguay. It is cultivated in the states of Himachal Pradesh, Gujarat and Tamil Nadu.

Uses

This is the most popular natural sweetener and is a substitute for white sugar, hence it is extensively used by diabetic patients and health conscious people.

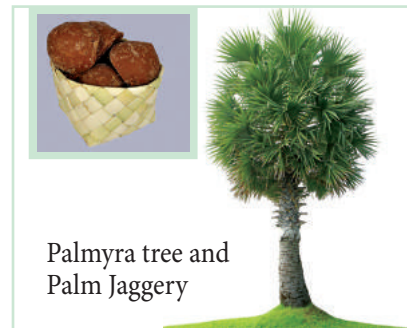


Figure 10.9: Sugars



Palmyra (State tree of Tamil Nadu)

Botanical name : *Borassus flabellifer*

Family: Arecaceae

Origin and Area of cultivation

Palmyra is native to tropical regions of Africa, Asia and New Guinea. Palmyra grows all over Tamil Nadu, especially in coastal districts.

Uses

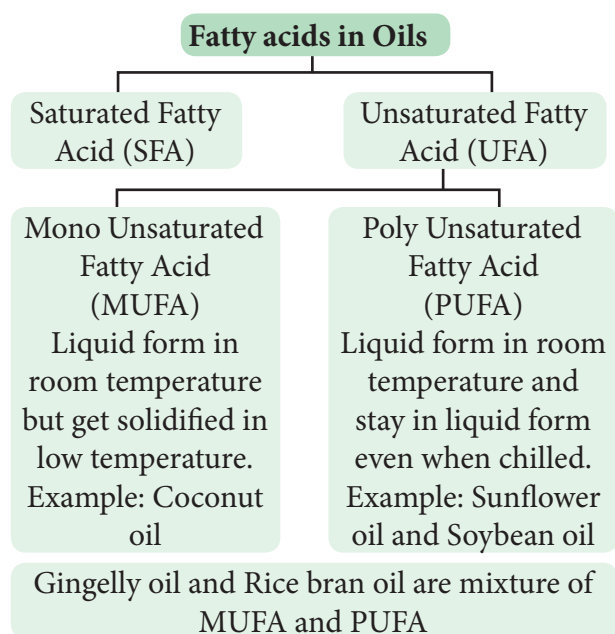
Exudate from inflorescence axis is collected for preparing palm sugar. Inflorescence is tapped for its sap which is used as health drink. Sap is processed to get palm jaggery or fermented to give **toddy**.

Endosperm is used as a refreshing summer food. Germinated seeds have an elongated embryo surrounded by fleshy scale leaf which is edible.

10.1.9 Oil Seeds

Why fried foods are tastier than boiled foods?

There are two kinds of oils namely, essential oils and vegetable oils or fatty oils. The essential oils or volatile oils which possess aroma evaporate or volatilize in contact with air. Any organ of a plant may be the source of essential oil. For example, flowers of Jasmine, fruits of orange and roots of ginger. The vegetable oils or non-volatile oils or fixed oils that do not evaporate. Whole seeds or endosperm form the sources of vegetable oils.



Let us know about few oil seeds

Groundnut / Peanut

Botanical name : *Arachis hypogaea*

Family : Fabaceae

Origin and Area of Cultivation:

Groundnut is native of Brazil. Portuguese introduced groundnut into Africa. The Spanish took it to the South East Asia and India via Philippines. In India Gujarat, Andhra Pradesh and Rajasthan are top producers.

Uses

Nuts contain about 45% oil. The kernels are also rich sources of phosphorous and vitamins, particularly thiamine, riboflavin and niacin. It is premium cooking oil because it does not smoke. Lower grade oil is used in manufacture of soaps and lubricants.

Sesame / Gingelly

Botanical name : *Sesamum indicum*

Family : Pedaliaceae

Origin and Area of cultivation: *Sesamum indicum* has originated from Africa.. Sesame is cultivated as a dry land crop. West Bengal and Madhya Pradesh are the top producers in India during 2017-18. It is considered as a healthy oil in Southern Indian culture.

Uses

Sesame oil is used for mostly culinary purposes in India. Lower grades are used in manufacture of soaps, in paint industries, as a lubricant and as an illuminant. In India, the oil is the basis of most of the scented oils used in perfumes. Sesame seed snacks are popular throughout India.

Coconut

Botanical name : *Cocos nucifera*

Family : Arecaceae



Origin and Area of cultivation: The origin of coconut is Pacific island region. Kerala and Tamil Nadu are the leading producers in India.



Groundnut



Sesame



Coconut

Figure 10.10: Oil Seeds

Uses

Coconut oil is classified as edible-industrial oil. Soaps obtained from coconut oil lathers well in soft and hard water. It is used in manufacture of rubber, synthetic resins, lubricants, brake fluids for aeroplanes and detergents. It is used as major hair oil and a base for applying medicinal powders.

10.1.10 Beverages

How about a cup of coffee or tea? We always entertain our guests with this offer. Children exchange chocolates during their birthdays.

All non-alcoholic beverages contain alkaloids that stimulate central nervous system and also possess mild diuretic properties. In this part of chapter, we learn about three popular non-alcoholic beverages namely tea, coffee and cocoa.

Tea

Botanical name : *Camellia sinensis*

Family : Theaceae

Origin and Area of cultivation: Tea is native of China. Assam is the top tea producer in India, followed by Kerala and Tamil Nadu.

Uses

Tea is the most popular beverage among all sections of people in India. Regular consumption of green tea is believed to lower the bad cholesterol and increase the good cholesterol.

Coffee

Botanical name : *Coffea arabica*

Family : Rubiaceae

Why does a student or a driver prefer tea or coffee during night work?

Origin and Area of cultivation: *Coffea arabica* is the prime source of commercial coffee which is native to the tropical Ethiopia. An Indian Muslim saint, Baba Budan introduced coffee from Yemen to Mysore. Karnataka is the largest coffee producing state in India followed by Tamil Nadu and Kerala. Tamil Nadu is the largest consumer of coffee in India.

Uses

Drinking coffee in moderation provides the following health benefits:

Caffeine enhances release of acetylcholine in brain, which in turn enhances efficiency. It can lower the incidence of fatty liver diseases, cirrhosis and cancer. It may reduce the risk of type 2 diabetes.

Cocoa

Botanical name: *Theobroma cacao*

Family : Malvaceae

Origin and Area of cultivation: Cocoa is native of Tropical American region. The word Theobroma (Theos means god, broma means food) means 'food of the Gods'. Kerala is the largest producer of Cocoa in India followed by Karnataka.

Uses

Cocoa is mainly used in confectionaries and forms an important ingredient in nutritive drinks. Cocoa products are rich in fibres, minerals and antioxidants, thus preventing cancer, cardiovascular diseases, premature ageing.



Tea plantation



Coffee



Cocoa

Figure 10.11: Beverages



10.2 Spices and Condiments

“Aroma attracts everyone”

History:

Spices were used extensively throughout the world for several thousands of years. Records of use of garlic and onion dates back 2500 years.

Majority of the spices are native to Mediterranean region, India and South East Asian countries. Spices, especially pepper triggered the search for sea route to India and paved way for the exploratory voyages by Spanish and Portuguese.

Spices are accessory foods mainly used for flavouring during food preparation to improve their palatability. Spices are aromatic plant products and are characterized by sweet or bitter taste. Spices are added in minimal quantities during the cooking process. For example black pepper.

Condiments, on the other hand, are flavouring substances having a sharp taste and are usually added to food after cooking. For example, curry leaves.

The following spices and condiment are discussed in detail.

Spices

Cardamom

Botanical name : *Elettaria cardamomum*

Family : Zingiberaceae

Origin and Area of cultivation: It is indigenous to Southern India and Sri Lanka. Cardamom is called as “Queen of Spices”. In India it is one of the main cash crops cultivated in the Western Ghats, and North Eastern India



Cardamom



Black Pepper

Uses

The seeds have a pleasing aroma and a characteristic warm, slightly pungent taste. It is used for flavouring confectionaries, bakery products and beverages. The seeds are used in the preparation of curry powder, pickles and cakes. Medicinally, it is employed as a stimulant and carminative. It is also chewed as a mouth freshener.

Black Pepper

Botanical name : *Piper nigrum*

Family : Piperaceae

Origin and Area of cultivation: It is indigenous to Western Ghats of India. Pepper is one of the most important Indian spices referred to as the “King of Spices” and also termed as “Black Gold of India”. Kerala, Karnataka and Tamil Nadu are the top producers in India.

The characteristic pungency of the pepper is due to the presence of alkaloid Piperine. There are two types of pepper available in the market namely black and white pepper.

Uses

It is used for flavouring in the preparation of sauces, soups, curry powder and pickles. It is used in medicine as an aromatic stimulant for enhancing salivary and gastric secretions and also as a stomachic. Pepper also enhances the bio-absorption of medicines.

Turmeric

Botanical name : *Curcuma longa*

Family : Zingiberaceae

Origin and Area of cultivation: It is indigenous to Southern Asia India is the largest producer, consumer and exporter of



Turmeric



Chillies

Figure 10.12: Spices

turmeric. Erode in Tamil Nadu is the World's largest wholesale turmeric market.

Uses

Turmeric is one of the most important and ancient Indian spices and used traditionally over thousands of years for culinary, cosmetic, dyeing and for medicinal purposes. It is an important constituent of curry powders. Turmeric is used as a colouring agent in pharmacy, confectionery and food industry. Rice coloured with turmeric (yellow) is considered sacred and auspicious which is used in ceremonies. It is also used for dyeing leather, fibre, paper and toys.

Curcumin extracted from turmeric is responsible for the yellow colour. Curcumin is a very good anti-oxidant which may help fight various kinds of cancer. It has anti-inflammatory, anti-diabetic, anti-bacterial, anti-fungal and anti-viral activities. It stops platelets from clotting in arteries, which leads to heart attack.

Chillies / Red Pepper

Botanical name : *Capsicum annum*, *C. frutescens*.

Family : Solanaceae

Origin and Area of cultivation: *Capsicum* is native to South America and is popularly known as chillies or red pepper in English. India is leading producer and exporter. *C. annum* and *C. frutescens* are important cultivated species of chillies.

Uses

The fruits of *C. annum* are less pungent than the

fruits of *C. frutescens*. *C. annum* includes large, sweet bell peppers. Long fruit cultivars of this species are commercially known as 'Cayenne pepper' which are crushed, powdered and used as condiment. Chillies are used in manufacture of sauces, curry powders and preparation of pickles. Capsaicin is an active component of chillies. It has pain relieving properties and used in pain relieving balms. Chillies are a good source of Vitamin C, A and E.



Capsaicin is responsible for the pungency or spicy taste of chillies. Pungency of Chillies is measured in Scoville Heat Units (SHU). World's hottest chilli, Carolina reaper pepper measures 2,200,000 SHU. Naga viper chilli is the hottest in India that measures 1,349,000 SHU. Commonly used cayenne pepper measures 30,000 to 50,000 SHU.

Condiment

Tamarind

Botanical name : *Tamarindus indica*

Family : Fabaceae-Caesalpinioideae

Origin and Area of

cultivation: Tamarind is native of tropical African region and was introduced into India several thousand years before. It is cultivated



in India, Myanmar, south asian countries and several African and Central American countries.

Table 10.2 : Other common spices and condiments

S. No	Common Name	Tamil Name	Botanical Name	Family
1	Coriander	கொத்துமல்லி	<i>Coriandrum sativum</i> . L	Apiaceae
2	Cumin	சீரகம்	<i>Cuminum cyminum</i> . L	Apiaceae
3	Fenugreek	வெந்தயம்	<i>Trigonella foenum graecum</i> . L	Fabaceae
4	Cloves	இலவங்கம்	<i>Eugenia aromaticum</i>	Myrtaceae
5	Asafoetida	பெருங்காயம்	<i>Ferula asafoetida</i> .L	Umbelliferae (Apiaceae)
6	Onion	வெங்காயம்	<i>Allium cepa</i>	Amarillidaceae

Tamarind has long been used in Africa and in Southern Asia. The name tamarindus is of Arabian origin, which means “dates of India”. (tamar – dates; Indus – India).

Uses

It is used in flavouring sauces in the United States and Mexico. In India, the fruit pulp is major ingredients for many culinary preparations. Sweet tamarinds are sold as table fruits in India imported from Thailand and Malaysia.



Sambar – The World Inside

When we see the bowl of sambar, we can see the world inside. Mustard, Cumin and Coriander from Mediterranean, pepper from Western Ghats of India, turmeric from Southern Asia, chilly from South America, onion from Afganistan, tamarind from Tropical Africa, tomato from South America, potato from Peru and Bolivia, lady’s-finger from Africa, and redgram from South India make the Sambar as a global dish.

10.3 Fibres

Botanically a fiber is a long narrow and thick-walled cell. Plant fibres are classified according to their use (Table 10.3)

Table 10.3 Classification of fibres			
S. No	Types of fibre	Uses	Example
1	Textile fibre	Manufacture of fabrics, netting and cordage.	Cotton, hemp, jute.
2	Brush fibre	Making brushes and brooms.	Palm fibres and brooms.
3	Plaiting fibre	Making hats, baskets, furniture.	Cane, Vitex and Lantana.
4	Filling fibre	Stuffing pillows, cushions and beds.	Silk cotton, Calotropis.

Cotton

Botanical name : *Gossypium* spp.

Family : Malvaceae

Cotton is the world’s most important non-food commercial crop.

Origin and Area of cultivation: It is one of the oldest cultivated crops of the world. It has been cultivated for about 8000 years both in new world and in old world. Commercial cotton comes from four cotton species: two from the new world and two from the old world. (1) *G. hirsutum* (2) *G. barbadense* are the New world species and (3) *G. arboreum* (4) *G. herbaceum* are the old world species. In India cotton is cultivated in Gujarat, Maharashtra, Andhra Pradesh and Tamil Nadu.

Uses

It is mainly used in the manufacturing of various textile, hosiery products, toys and is also used in hospitals.

Jute

Botanical name : *Corchorus* spp.

Family : Malvaceae

Origin and Area of cultivation: Jute is derived from the two cultivated species (1) *Corchorus capsularis* and (2) *C. olitorius* is of African origin whereas *C. capsularis*, is believed to be Indo-Burmese origin. It is an important cultivated commercial crop in Gangetic plains of India and Bangladesh.

Uses

It is one of the largest exported fibre material of India. The jute industry occupies an important place in the national economy of India. Jute is used for ‘safe’ packaging in view of being natural, renewable, bio-degradable and eco-friendly product. It is used in bagging and wrapping textile. About 75% of the jute produced is used for manufacturing sacks and bags. It is also used in manufacture of blankets, rags, curtains etc. It is also being used as a textile fibre in recent years.



Cotton plant



Jute products



Coconut coir

Figure 10.14: Fibres

Coconut / Coir

Botanical name : *Cocos nucifera*

Family : Arecaceae

Commercial coir is obtained from the mesocarp of coconut. The fibre is known for its light mass, elasticity, high resistance to sea water and for its insulating capacity.

Origin and Area of cultivation: We have already studied the origin of Coconut under the oil crops. India and Sri Lanka are the top producers since 2001. Kerala and Tamil Nadu are the top producers in India.

Uses

It is used in manufacture of mats, cushion seats, bags, packaging material, water-proof and sound proof boards and thermal insulation. Using coir peat in horticulture also made demand for coir. It is also used for manufacturing ecofriendly horticultural products such as biodegradable planting pots.

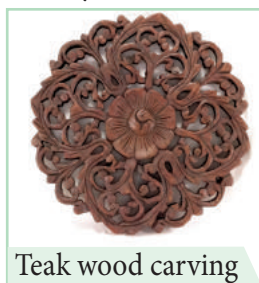
10.4 Timber

The basic need of shelter is obtained from the timber trees. In this lesson we learn about few timber plants.

Teak

Botanical name : *Tectona grandis*

Family: Lamiaceae



Teak wood carving



Rosewood

Figure 10.15: Timber

Origin and Area of cultivation: This is native to South east Asia. It is observed wild in Assam. But cultivated in Bengal, Assam, Kerala, Tamil Nadu and North-West India.

Uses

It is one of best timbers of the world. The heartwood is golden yellow to golden brown when freshly sawn, turning darker when exposed to light. Known for its durability as it is immune to the attack of termites and fungi.

The wood does not split or crack and is a carpenter friendly wood. It was the chief railway carriage and wagon wood in India. Ship building and bridge-building depends on teakwood. It is also used in making boats, toys, plywood, door frames and doors.

Rosewood

Botanical name : *Dalbergia latifolia*

Family: Fabaceae

Origin and Area of cultivation: Rose wood is native to India. It is cultivated in Uttar Pradesh, Bihar, Odisha, Central, Western and Southern India.

Uses

Indian rosewood has yellowish sapwood and dull brown to almost purple coloured heartwood. The wood is characterised by fragrant, heavy, narrowly interlocked grained and medium coarse textured. It is a durable and heavy wood and is suitable for under water use. Wood is used for making furniture, army wagons, temple chariots, cabinets, railway sleepers, musical instruments, hammer handles, shoe heels and tobacco pipes.

Ebony

Botanical name : *Diospyros ebenum*

Family: Ebenaceae

Origin and Area of cultivation: It is commonly found in tropical forests Southern India and Srilanka. Ebony is distributed in forests of Karnataka, Kerala and Tamil Nadu.

Uses

The heartwood is jet black with a metallic lustre when smoothened and is resistant to attack by insects and fungi. The wood is difficult to season and hence cut into small pieces before seasoning. It is used mainly for making piano keys, handles of cutlery, musical instruments, making sticks, umbrella handles, whips and furniture.

10.5 Latex

Rubber

Botanical name : *Hevea brasiliensis*

Family : Euphorbiaceae

Origin and Area of cultivation: It is a native of Brazil and was introduced outside its native range during the colonial period and has become an important cash crop. Asia contributed 90% of the world production. Kerala is the largest producer in India followed by Tamil Nadu.



Figure 10.16 : Rubber Tree

Uses

Tyre and other automobile parts manufacturing industries consume 70% of the rubber production. Rubber is used in manufacturing footwear, wire and cable insulations, rain-coats, household and hospital goods, shock absorbers, belts, sports goods, erasers, adhesives, and rubber-bands. Hard rubber is used in the electrical and radio engineering industries. Concentrated latex is used for making gloves, balloons and condoms.

Foamed latex is used in the manufacture of cushions, pillows and life-belts.



Rubber – Vulcanization

Charles Goodyear invented vulcanization in 1839. He found that the defects in rubber articles could be overcome by heating rubber with sulphur under pressure at 150° C. The process was called vulcanization. The name was given from the Roman God of Fire, Vulcan. Because of this, solid rubber tyres were used for first time in 1867. That is why we smoothly travel on road.

10.6 Pulp Wood

The term paper is derived from the word 'papyrus' a plant (*Cyperus papyrus*) that was used by Egyptians to make paper-like materials. Paper production is a Chinese invention. The Chinese discovered the paper that was prepared from the inner bark of paper mulberry in 105 A.D. For a long time, the art of paper making remained a monopoly of the Chinese until Arabs learned the technique and improved it around 750 A.D. Invention of printing increased the demand for paper.

Manufacture of Wood pulp:

Wood is converted into pulp by mechanical, and chemical processes. Wood of *Melia azadirachta*,



Figure 10.17 : Wood pulp

Neolamarkia chinensis, *Casuarina* spp, *Eucalyptus* spp are used for making paper pulp.



Purified dissolving pulp is used as a basic material in the manufacture of rayon or artificial silk, fabrics, transparent films (cellophane, cellulose acetate films), plastics. The viscose process of making rayon is the most common process.

10.7 Dyes

The ability to perceive colour is a wonderful aspect of human eyes and dyes add colour to the goods we use. They have been in use since the ancient times.

The earliest authentic records of dyeing were found in the tomb painting of ancient Egypt. Colourings on mummy cements (wrapping) included saffron and indigo. They can also be seen in rock paintings in India.

Indigo

Botanical name : *Indigofera*

Family : Fabaceae

Origin and Area of cultivation: *Indigofera tinctoria* is native to India. It was grown in many states in India. Now it is grown limited states mainly in Tamil Nadu and Andhra Pradesh.

Uses

A brilliant dark blue dye 'indigo' was extracted from the leaves of several species of *Indigofera*. The people of Asia, especially India have known the dye for over 4,000 years. It is also used in painting of murals. *Indigofera* have long been used in Southern India in temple arts and folk arts, popularly known as Kalamkari. Indigo used for dyeing and printing cotton, rayon and wool.

Henna

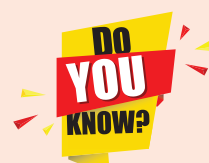
Botanical name : *Lawsonia inermis*

Family : Lythraceae

Origin and Area of cultivation: It is indigenous to North Africa and South-west Asia. It is grown mostly throughout India, especially in Gujarat, Madhya Pradesh and Rajasthan.

Uses

An orange dye 'Henna' is obtained from the leaves and young shoots of *Lawsonia inermis*. The principal colouring matter of leaves 'lacosone' is harmless and causes no irritation to the skin. This dye has long been used to dye skin, hair and finger nails. It is used for colouring leather, for the tails of horses and in hair-dyes.



Champaran Satyagraha

Indigofera is a very important cash crop among plants cultivated in India during the British regime. Farmers were forced to cultivate *Indigofera* instead of food crops. Gandhi started satyagraha at Champaran, a village in Bihar in support of farmers. This was the first satyagraha in India by Gandhi. Government accepted 'champaran farmers bill'. Gandhi's first satyagraha in India achieved a great success.

10.8 Cosmetics

Traditionally in Southern India, people have been using turmeric, green gram powder, henna, sigaikai and usilai for their skin and hair care. These were mostly home prepared products that are used for grooming. Today, cosmetics have a high commercial value and have become chemical based industrial products. Providing personal care services has become a major industry. In recent years, people have realized the hazards of chemical-based cosmetics and are turning back to



Indigo dye



Henna dye



Figure 10.18: Natural Dyes



natural products. In this chapter one of the major plants namely Aloe which is used in the cosmetic industries is discussed.

Aloe

Botanical name : *Aloe vera*

Family: Asphodelaceae (formerly Liliaceae)

Origin and Area of cultivation: It is a native of Sudan. It is cultivated on a large scale in Rajasthan, Gujarat, Maharashtra, Andhra Pradesh and Tamil Nadu.

Uses

‘Aloin’ (a mixture of glucosides) and its gel are used as skin tonic.

It has a cooling effect and moisturizing

characteristics and hence used in preparation of creams, lotions, shampoos, shaving creams, after shave lotions and allied products. It is used in gerontological applications for rejuvenation of aging skin. Products prepared from aloe leaves have multiple properties such as emollient, antibacterial, antioxidant, antifungal and antiseptic. Aloe vera gel is used in skin care cosmetics.



Figure 10.19: *Aloe vera*

10.8.1 Perfumes

The word **perfume** is derived from the Latin word **Per** (through) and **fumus** (to smoke), meaning **through smoke**. It refers to the age-old tradition of burning scented woods at religious ceremonies. In early days, when people were less conscious of personal hygiene, essential oils not only masked offensive odours, but also may have acted as antiseptics. Perfumes are added to baths and used for anointing the body.

Perfumes are manufactured from essential oil which are **volatile** and **aromatic**. Essential oils are found at different parts of the plant such as leaves, (curry leaf, mint), flowers (rose, jasmine), fruits (citrus, straw berry) and wood (sandal, eucalyptus).

Jasmine

Botanical name : *Jasminum grandiflorum*

Family: Oleaceae

Jasmine, as a floral perfume, ranks next to the rose oil. Major species cultivated on the commercial scale is *Jasminum grandiflorum*, a native of the north-western Himalayas. In Tamil Nadu, the major jasmine cultivation centres are Madurai and Thovalai of Kanyakumari District. The essential oil is present in the epidermal cells of the inner and outer surfaces of both the sepals and petals. One ton of Jasmine blossom yields about 2.5 to 3 kg of essential oil, comprising 0.25 to 3% of the weight of the fresh flower.

Uses

Jasmine flowers have been used since ancient times in India for worship, ceremonial purposes, incense and fumigants, as well as for making perfumed hair oils, cosmetics and soaps. Jasmine oil is an essential oil that is valued for its soothing, relaxing, antidepressant qualities.

Jasmine blends well with other perfumes. It is much used in modern perfumery and cosmetics and has become popular in air fresheners, anti-perspirants, talcum powders, shampoos and deodorants.



Madurai Malli

‘Madurai Malli’ is the pride of Madurai has a distinct reputation universally

because of its uniqueness and has been given the Geographical Indications (GI) mark by the Geographical Indication Registry of India. Madurai malli has thick petals with long stalk equal to that of petals and the distinct fragrance is due to the presence of chemicals such as jasmine and alpha terpineol. This makes it easy to distinguish Madurai Malli from other places. This is the second GI tag for Jasmine after ‘Mysore Malli’.





Jasmine



Rose



Sandal

Figure 10.20: Perfumes

Rose

Botanical name : *Rosa X damascena*

Family: Rosaceae

Origin and Area of cultivation: *R. X damascena*, has its origin from the Middle East. Major scented rose cultivating states include Rajasthan, Delhi, Haryana, Maharashtra, West Bengal, Karnataka, Andhra Pradesh and Tamil Nadu. Rose oil is one of the oldest and most expensive of perfume oils. The oil is concentrated in the epidermal cells on the inner surface of the petals. The average oil yield is a little less than 0.5 g. from 1000 g. of flowers.

Uses

Rose oil is largely used in perfumes, scenting soaps, flavouring soft drinks, liqueurs and certain types of tobacco, particularly snuff of chewing tobacco.

Rose water (panner) containing much of phenylethyl alcohol and other compounds in dissolved confectioneries syrups and soft drinks. In India, the water is much used in eye lotions and eye-washes. In addition, it is sprinkled on guests as a ceremonial welcome.

Sandalwood

Botanical name : *Santalum album*

Family: Santalaceae

Origin and Area of cultivation: Sandal tree is native of South East Asia. Karnataka and Tamil Nadu are states that possess large natural populations of *Santalum album* in India. The heart-wood is scented due to the presence of santalol, from which oil is extracted. The oil yield from a wood chips, varies from 4-5%

being the highest when distilled from roots (10% of the dry weight).

Uses

Sandalwood oil is a valuable fixative for other fragrances due to the excellent blending properties. More than 90% of the oil is used in the manufacture of scented soaps, talcum powder, face powder, creams, hair oils, hand lotions as well as in perfumery and pharmaceutical industries.

10.9 Traditional Systems of Medicines

India has a rich medicinal heritage. A number of Traditional Systems of Medicine (TSM) are practiced in India some of which come from outside India. TSM in India can be broadly classified into **institutionalized** or documented and **non-institutionalized** or oral traditions. Institutionalized Indian systems include Siddha and Ayurveda which are practiced for about two thousand years. These systems have prescribed texts in which the symptoms, disease diagnosis, drugs to cure, preparation of drugs, dosage and diet regimes, daily and seasonal regimens. Non-institutional systems, whereas, do not have such records and are practiced by rural and tribal peoples across India. The knowledge is mostly held in oral form. The TSM focus on healthy lifestyle and healthy diet for maintaining good health and disease reversal.

Siddha system of medicine

Siddha is the most popular, widely practiced and culturally accepted system in Tamil Nadu. It is based on the texts written by 18



Siddhars. There are different opinions on the constitution of 18 Siddhars. The Siddhars are not only from Tamil Nadu, but have also come from other countries. The entire knowledge is documented in the form of poems in Tamil. Siddha is principally based on the **Pancabūta** philosophy. According to this system three humors namely **Vātam**, **Pittam** and **Kapam** that are responsible for the health of human beings and any disturbance in the equilibrium of these humors result in ill health. The drug sources of Siddha include plants, animal parts, marine products and minerals. This system specializes in using minerals for preparing drugs with the long shelf-life. This system uses about 800 herbs as source of drugs. Great stress is laid on disease prevention, health promotion, rejuvenation and cure.

Ayurveda system of medicine

Ayurveda supposed to have originated from Brahma. The core knowledge is documented by **Charaka**, **Sushruta** and **Vagbhata** in compendiums written by them. This system is also based on three humor principles namely, Vatha, Pitha and Kapha which would exist in equilibrium for a healthy living. This system Uses more of herbs and few animal parts as drug sources. Plant sources include a good proportion of Himalayan plants. The **Ayurvedic Pharmacopoeia** of India lists about 500 plants used as source of drugs.

Folk system of medicine

Folk systems survive as an oral tradition among innumerable rural and tribal communities of India. A consolidated study to document the plants used by ethnic communities was launched by the Ministry of Environment and Forests, Government of India in the form of All India Coordinated Research Project on Ethnobiology. As a result about 8000 plant species have been documented which are used for medicinal purposes. The efforts to document in several under-explored and

unexplored pockets of India still continue. Major tribal communities in Tamil Nadu who are known for their medicinal knowledge include **Irulas**, **Malayalis**, **Kurumbas**, **Paliyans** and **Kaanis**. Some of the important medicinal plants are discussed below.

10.10 Medicinal Plants

India is a treasure house of medicinal plants. They are linked to local heritage as well as to global-trade. All institutional systems in India primarily use medicinal plants as drug sources. At present, 90% collection of medicinal plants is from the non-cultivated sources. Growing demand for herbal products has led to quantum jump in volume of plant materials traded within and across the countries. Increasing demand exerts a heavy strain on the existing resources. Now efforts are being made to introduce cultivation techniques of medicinal plants to the farmers.

Medicinal plants play a significant role in providing primary health care services to rural and tribal people. They serve as therapeutic agents as well as important raw materials for the manufacture of traditional and modern medicines. Medicinally useful molecules obtained from plants that are marketed as drugs are called Biomedicines. Medicinal plants which are marketed as powders or in other modified forms are known as Botanical medicines. In this chapter you will be learning about a few medicinal plants that are commonly used in Tamil Nadu. All these plants are commonly available in and around dwelling places and can be easily cultivated in home gardens.

Keezhanelli

Botanical name : *Phyllanthus amarus*

Family : Euphorbiaceae (Now in Phyllanthaceae)

Origin and Area of cultivation: The plant is a native of Tropical American region and is naturalised in India and other tropical countries. It is not cultivated and is collected from moist

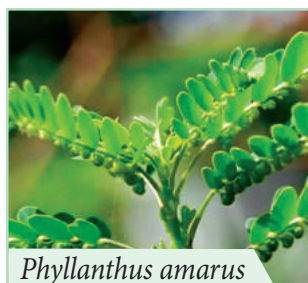


Figure 10.21: Medicinal Plants

places in plains. *Phyllanthus maderaspatensis* is also commonly sold in the medicinal plant markets collected from non-forest are as keezhanelli.

Active principle: Phyllanthin is the major chemical component.

Medicinal importance

Phyllanthus is a well-known hepato-protective plant generally used in Tamil Nadu for the treatment of Jaundice. Research carried out by Dr. S P Thyagarajan and his team from University of Madras has scientifically proved that the extract of *P. amarus* is effective against hepatitis B virus.

Adathodai

Botanical name : *Justicia adhatoda*

Family: Acanthaceae

Origin and Area of cultivation: It is native to India and Srilanka. This species is not known in wild in Tamil Nadu but widely cultivated as

a live fence and around temples.

Active principle: Vascin

Uses

Adhatoda possess **broncho dilating** property. The decoction is used in treating many bronchial disorders such as cough, cold and asthma. It is also used in treating fevers. The extract forms an ingredient of cough syrups.

Nilavembu

Botanical name : *Andrographis paniculata*

Family : Acanthaceae

Andrographis paniculata, known as the **King of Bitters** is traditionally used in Indian systems of medicines.

Active principle: Andrographolides.

Medicinal importance:

Andrographis is a **potent hepatoprotective** and is widely used to treat liver disorders.

Table 4: Other comomo Medicinal plants

S. No	Common Name	Tamil Name	Botanical Name	Family	Plant part used	Medicinal Uses
1	Holy basil	துளசி	<i>Ocimum sanctum</i>	Lamiaceae	Leaves and Roots	The leaves are stimulant, antiseptic, anti-hypertensive and anti-bacterial and expectorant used in bronchitis. Decoction of roots is given as a diaphoretic in malarial fever.
2	Indian gooseberry	நெல்லி	<i>Phyllanthus emblica</i>	Phyllanthaceae	Fruit	It is a potent rejuvenator and immune modulator. It has anti-ageing properties. It helps to promote longevity, enhance digestion, treat constipation and reduce fever and cough.
3	Indian Acalypha	குப்பைமேனி	<i>Acalypha indica</i>	Euphorbiaceae	Leaves	Used to cure skin diseases caused by ringworms. Powdered leaves are used to cure bedsores and infected wounds.
4	Vilvam	வில்வம்	<i>Aegle marmelos</i>	Rutaceae	Fruit	The unripe fruit is used to treat problems of stomach indigestion. It kills intestinal parasites.
5	Veldt grape	பிரண்டை	<i>Cissus quadrangularis</i>	Vitaceae	Stem and root	Paste obtained from the powdered stem and root of this plant is used in bone fractures. Whole plant is useful to treat asthma and stomach troubles.



Concoction of *Andrographis paniculata* and eight other herbs (Nilavembu Kudineer) is effectively used to treat malaria and dengue.

Turmeric

Botanical name : *Curcuma longa*

Family: Zingiberaceae

Origin and Area of Cultivation: You have already studied the details under the spices.

Active principle: Curcumin.

Medicinal importance:

Curcumin (the yellow colouring principle is the major pharmacologically active compound of turmeric) is well known for its medicinal properties.

It is used to treat **Alzheimer's** disease due to its property to cross over blood brain barrier. It has a very powerful anti-oxidant, anti-cancerous, anti-inflammatory, anti-diabetic, anti-bacterial, anti-fungal and anti-



Patenting Of Turmeric

University of Mississippi medical center, USA was granted a patent for wound healing property of Turmeric in 1995. The patent was granted both for oral and topical applications and provides an exclusive right to sell and distribute. Since the use of turmeric to heal wounds is a common domain knowledge in India, the Government of India has decided to fight against the patent through the Indian Council for Scientific and Industrial Research (CSIR). CSIR collected documentary evidences from various literature to prove that the knowledge on wound healing property of turmeric existed in India for a long time and provided the evidences to the United States Patent and Trade mark Office (USPTO). Based on the evidences the patent was revoked by USPTO. Hence the traditional knowledge (TK) on turmeric was safeguarded from Bio piracy.

viral properties. It is one of the traditional medicines used for wound healing.

Psychoactive Drugs

In the above chapter you have learnt about plants that are used medicinally to treat various diseases. Phytochemicals / drugs from some of the plants alter an individual's perceptions of mind by producing hallucination are known as psychoactive drugs. These drugs are used in all ancient culture especially by Shamans and by traditional healers. Here we focus on two such plants namely Poppy and Marijuana.

Opium poppy

Botanical name : *Papaver somniferum*

Family: Papaveraceae

Origin and Area of cultivation:

Opium poppy is native to South Eastern Europe and Western Asia. Madhya Pradesh, Rajasthan and Uttar Pradesh are the licenced states to cultivate opium poppy.

Opium is derived from the exudates of fruits of poppy plants. It was traditionally used to induce sleep and for relieving pain. Opium yields **Morphine**, a strong analgesic which is used in surgery. However, opium is an addiction forming drug.

Cannabis / Marijuana

Botanical name : *Cannabis sativa*

Family: Cannabiaceae

Origin and Area of Cultivation:

Marijuana is native to China. States such as Gujarat, Himachal Pradesh, Uttarkand, Uttarpradesh and Madhaya Pradesh have legally permitted to cultivate industrial hemp/Marijuana

The active principle in Marijuana is **trans-tetrahydrocannabinol** (THC). It possess a number of medicinal properties. It is an effective pain reliever and reduces hypertension. THC is used in treating **Glaucoma** a condition in which pressure develops in the eyes. THC is also used in

reducing nausea of cancer patients undergoing radiation and chemotherapy. THC provides relief to bronchial disorders, especially asthma as it dilates bronchial vessels. Because of these medicinal properties, cultivation of cannabis is legalized in some countries. However, prolonged use causes addiction and has an effect on individual's health and society. Hence most of the countries have banned its cultivation and use.



Narcotics Control Bureau (NCB)

Drugs come in various forms and can be taken in numerous ways. Some are legal and others are not. Drug abuse and misuse can cause numerous health problems and in serious cases death can occur.

The Narcotics Control Bureau (NCB) is the nodal drug law enforcement and intelligence agency of India and is responsible for fighting drug trafficking and the abuse of illegal substances.



10.11 Entrepreneurial Botany

Entrepreneurial Botany is the study of how new businesses are created using plant resources as well as the actual process of starting a new business. An **entrepreneur** is someone who has an idea and who works to create a product or service that people will buy, by building an organization to support the sales. **Entrepreneurship** is now a popular topic for higher secondary students, with a focus on developing ideas to create new ventures among the young people.

Vast opportunities are there for the students of Botany. In the present scenario students should acquire ability to merge skills and knowledge in a meaningful way. Converting botanical knowledge into a business idea that can be put into practice for earning a livelihood is the

much-needed training for the students.

This part of chapter is aimed to help the students to acquire such skills with practical knowledge to start a few activities of entrepreneurship.

10.11.1 Mushroom cultivation

Malnutrition caused by the lack of adequate protein and other nutrients in daily diet of people is becoming a major health hazard in developing countries. Under such circumstances, mushroom being a rich source of protein and other nutrients can be a part and parcel of every day's food.

Mushrooms are the **fruiting body** of edible fungi and is the most priced commodity among vegetables, not only because of its nutritive value but also for its characteristic aroma and flavor. Mushrooms are also called **white vegetable**. Mushroom cultivation has great scope in India and in other developing countries. Mushroom cultivation activities can play an important



Figure 10.22: Mushroom Cultivation

role in supporting the local economy. Selling mushroom in a local market form a source of additional income to the family.

Steps involved in mushroom cultivation

- The straw used for composting should be ripe and golden-yellow in colour. It should be cut into 2-4 inches and properly sterilized.
- The culture space should be clean and the ventilators and windows should be covered with fine wire mesh to prevent the entry of flies and birds.



- The culture space should be sprayed with 0.1% Nuvan and 5% Formalin, two days prior to spawning and transferring to bags to cropping rooms.
- The spawn used for mushroom should be free from contaminations. Bags should be filled with 8 kg of wet straw.
- During spawning running temperature and relative humidity should be maintained 20°C to 30°C, 75 to 85% respectively.
- Proper watering should be done when the growth coverings are removed. There should not be dry patches on blocks. Excess watering must be avoided.
- About 20 cm gap should be maintained in between two bags or blocks.
- Picking must be done as their caps become 10 – 12 cm by twisting.

Two kinds of mushrooms are cultivated namely **button** and **oyster**.

10.11.2 Single Cell Protein (SCP) Production

Single-cell proteins are the dried cells of microorganism, which are used as protein supplement in human foods or animal feeds. Microorganisms that can be used for the production of SCP have the capacity to synthesize proteins rapidly than higher living organisms. Microorganisms like algae, fungi, yeast and bacteria are used for this purpose. Here you will learn about the production of SCP from an algae, *Spirulina*.



Figure 10.23: Production of *Spirulina*

Small scale biomass production of *Spirulina*.

It requires an aquarium, air pump, nutrients and *Spirulina* mother culture.

- Take a 30 litre capacity aquarium and fill half of it with water.
- Check if any heavy metal concentration or fluorine or calcium carbonate in water.
- Fill the tank with water and add nutrients preferably **zarrouk medium**. (Add half of the required nutrients first and add another half later).
- To aerate the culture, fix the air pump (avoid centrifugal pump) after adding nutrients.
- Add the mother culture to the aquarium. For every 1 liter of water add 4 gm. mother culture.
- Place it in sunlight for 10-12 hrs. every day.
- After a week check the culture and add more water leave it for one more week, till the biomass becomes dark green.
- Use a very fine cloth and harvest the algae.
- Water can be reused in aquarium.
- Dry the algae for later use.

Single cell protein has a high nutritive value due to higher protein, vitamin, essential amino acids and lipid content. Hence it can form a good protein supplement. However it cannot completely replace the conventional protein sources due to their high nucleic acid content and slower in digestibility. They may result in allergic reactions.

10.11.3 Seaweed Liquid Fertilizer

Seaweed is rich in trace elements and potassium, which makes it ideal to add to compost in its raw state, to work in as a mulch, or to create a liquid fertilizer. This is easy to do. Seaweed fertilizer releases about 60 nutrients from which plants can benefit.

- Collect the seaweed that is not too stinky.
- Rinse the seaweed to remove the excess salt.
- Fill a bucket to three quarters way with



water. Add as much seaweed as will fit and leave to soak.

- Stir the seaweed mix every two to four days.
- Allow to soak for several weeks to months. So that the fertilizer grows stronger and stronger over time. (Make sure to keep the brew somewhere so that its odour will not affect the daily household.)
- It is ready for use once it no longer carries a smell of ammonium.
- When it is ready, use as a fertilizer for plants and garden beds (soil). (It should be diluted with water at a minimum of three parts to one).

Liquid seaweed extract enhances healthy growth of plants, flowers and vegetables. Regular use will help plants to withstand environmental stress, pests and disease attack. It can be used as a foliar spray for fruit, flower, vegetable crops as well as for shrubs and trees. It stimulates healthy growth for all plants.

10.11.4 Organic farming

Organic farming is an alternative agricultural system in which plants/crops are cultivated in natural ways by using biological inputs to maintain soil fertility and ecological balance thereby minimizing pollution and wastage. Indians were organic farmers by default until the green revolution came into practice.

Preparation of Organic Pesticide








			
<p>Mix 120g of hot chillies with 110 g of garlic or onion. Chop them thoroughly.</p> <p>1</p>	<p>Blend the vegetables together manually or using an electric grinder until it forms a thick paste.</p> <p>2</p>	<p>Add the vegetable paste to 500 ml of warm water. Give the ingredients a stir to thoroughly mix them together.</p> <p>3</p>	<p>Pour the solution into a glass container and leave it undisturbed for 24 hours. If possible, keep the container in a sunny location. If not, at least keep the mixture in a warm place.</p> <p>4</p>
			
<p>Strain the mixture. Pour the solution through a strainer, remove the vegetables and collect the vegetable-infused water and pour into another container. This filtrate is the pesticide. Either discard the vegetables or use it as a compost.</p> <p>5</p>	<p>Pour the pesticide into a squirt bottle. Make sure that the spray bottle has first been cleaned with warm water and soap to get rid of any potential contaminants. Use a funnel to transfer the liquid into the squirt bottle and replace the nozzle.</p> <p>6</p>	<p>Spray your plants with the pesticide. Treat the infected plants every 4 to 5 days with the solution. After 3 or 4 treatments, the pest will be eliminated. If the area is thoroughly covered with the solution, this pesticide should keep bugs away for the rest of the season.</p> <p>7</p>	
<p>Avoid spraying the plants during the sunny times of the day since it could burn plants. Many other plants possess insect repellent or insecticidal properties. Combinations of these plants can be fermented and used as biopesticide.</p>			

Figure 10.24: Preparation of organic pesticide

Use of biofertilizers is one of the important components of integrated organic farm management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. Several microorganisms and their association with crop plants are being exploited in the production of biofertilizers. Organic farming is thus considered as the movement directed towards the philosophy of **Back to Nature**.

I. Organic Pesticide

Pest like aphids, spider and mites can cause serious damage to flowers, fruits, and vegetables. These creatures attack the garden in swarms, and drain the life of the crop and often invite disease in the process. Many chemical pesticides prove unsafe for human and the environment. It turns fruits and vegetables unsafe for consumption. Thankfully, there are many homemade, organic options to turn to war against pests.

Preparation of Organic Pesticide

Refer figure: 10.24

II. Bio-pest repellent

Botanical pest repellent and insecticide made with the dried leaves of *Azadirachta indica*

Preparation of Bio-pest repellent

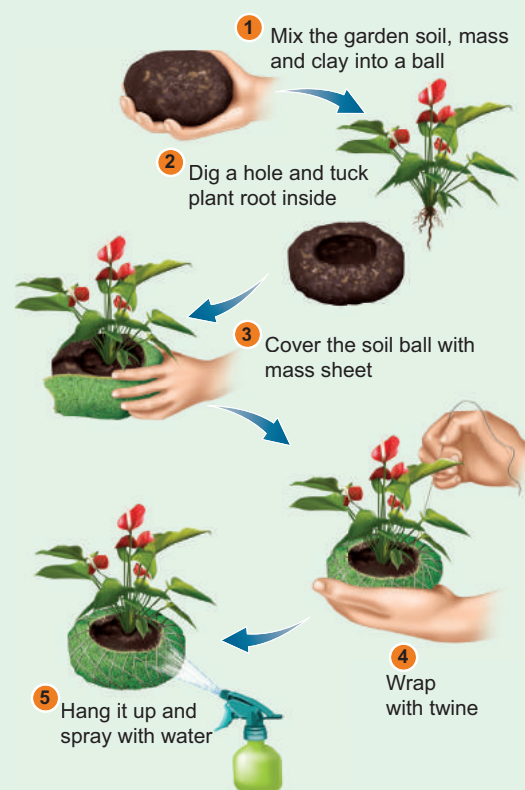
- Pluck leaves from the neem tree and chop the leaves finely.
- The chopped up leaves were put in a 50-liter container and fill to half with water; put the lid on and leave it for 3 days to brew.
- Using another container, strain the mixture which has brewed for 3 days to remove the leaves, through fine mesh sieve. The filtrate can be sprayed on the plants to repel pests.
- To make sure that the pest repellent sticks to the plants, add 100 ml of cooking oil and the same amount of soap water. (The role of

the soap water is to break down the oil, and the role of the oil is to make it stick to the leaves).

- The stewed leaves from the mixture can be used in the compost heap or around the base of the plants.

Activity

Hanging Garden



10.11.5 Terrarium

Can portable miniature indoor greenery be commercially sold?

A terrarium is a collection of small plants growing in a transparent, sealed container. Terrariums are easy to make, low maintenance gardens, and it can survive indefinitely with minimal water.

How to make a terrarium?

Prepare the Container: Collect whatever interesting glassware you have or source your container from a store and clean it thoroughly. Plan how to arrange the plants inside the glassware.

Add Drainage Layers: To create a false drainage layer, fill the bottom with pebbles so that water can settle and does not flood. The depth of the pebbles depends on the size of the container.

Add the Activated Charcoal: Cover the pebbles with charcoal to improve the quality of the terraria by reducing bacteria, fungi and odors.

Add Soil: Add enough soil so that the plant roots will have enough space to fit and grow.

Plant: Select the desired plant such as, *Caralluma spp*, *Asperagus spp*, *Portulaca spp*, *Begonia spp*, and *Chlorophytum spp*; trim the roots if they are too long. Dig a pit using a stick, and place the plants' roots in it. Add more soil around the top



and compact the soil down around the base of the plant. Place little plants in the container and try to keep them away from the edges of the container, so that the leaves do not touch the sides. After planting add accessories like a layer of moss (dried or living), little figurines (old toys, glass beads, stones) or a layer of miniature rocks. This is the little green world

Cleaning and Watering: Wipe if there is any dirt along the sides of the container. Give the terrarium a little bit of water and enjoy the beautiful miniature living world on your table or in your living room.

Ready made terrariums can fetch a good price as indoor garden objects or as gift articles.



Figure 10.25: Terrarium

BONSAI

Bonsai is a Japanese art form using miniature trees grown in containers that mimic the shape and scale of full size trees.

How do you make a Bonsai tree?

Visualize the finished product of bonsai while selecting a plant species and the pot.



① Plug out the sapling and clean and prune the roots.



② Prepare the pot and position the tree in it



③ After re-potting leave the plant in a semi shaded area until the roots have re-established.

COMMON BONSAI STYLES



Formal Upright



Informal upright



Broom style



Slant



Cascade - Overflowing potential of growth



Semi Cascade

10.11.6 Cultivation of Medicinal and Aromatic Plants

Globalization has brought opportunities and challenges in all business sectors. Government of India has identified medicinal and aromatic plants as one of the sectors that can make India a global leader in the 21st century owing to the treasure of about **8,000** medicinal and **2,500** aromatic plants that can provide large number of consumer products with national and international demand. Medicinal plants synthesize a number of secondary metabolites with pharmacological properties through secondary metabolism. The chemicals isolated from medicinal plants are used in traditional and biomedicine systems to treat diseases of both humans and animals. But most of the medicinal and aromatic plants are still wild collecting.

Central Institute of Medicinal and Aromatic Plants (CIMAP) has developed a number of high yielding varieties and processing technologies to promote cultivation of medicinal and aromatic plants. Profitable cultivation of medicinal plants can be practiced by the entrepreneurs along with traditional agriculture horticulture crops. They can be profitably intercropped in plantations. Cultivation of medicinal/aromatic plants offers following advantages:

- Generate employment through development of ancillary industries.
- Foreign exchange earnings through exports.
- Crops are not damaged by domestic animals or by birds.
- Technologies are farmer and eco-friendly.

I. Cultivation of Medicinal Plant - *Gloriosa superba*

Economically useful part – Seed, Rhizome.

Major constituents - Colchicine (0.5-0.7%) and Colchicoside

Uses - Cures gout, anti-inflammatory, anticancer.

National Medicinal Plants Board (NMPB)

Government of India has set up National Medicinal Plants Board (NMPB) on 24th November 2000. Currently this board is working under AYUSH Government of India. Developing an apt mechanism for coordination of various ministries and implementation of policies for overall growth of medicinal plant sector both at central / state and international level is the primary mandate of NMPB. It focusses on in-situ and ex-situ conservation and enhancing local medicinal plants and aromatic species of medicinal significance to meet the growing demand.



Figure 10.26: *Gloriosa superba*

Soil and Climate: Red loamy soils are well suited for cultivation. Glory lily is cultivated in Tamil Nadu mainly in the parts of Tirupur, Dindigul, Karur and Salem districts covering an area of 2000 hectare.

Planting: Planting is distributed from June – July. Plough the field 2 -3 times and add 10 tons of Farmyard Manure during last ploughing. Trenches of 30 cm depth are formed and tubers are planted at 30 – 45 cm spacing. The vines are trained over support.

Irrigation: Irrigation should be given immediately after planting. Subsequent irrigation is given at 5 days intervals of time.

Harvest: Pods are harvested at 160 – 180 days.

CSIR Aroma Mission of India

The Council of Scientific and Industrial Research (CSIR) has Catalyzing Rural Empowerment through Cultivation, Processing, Value Addition and Marketing of Aromatic Plants”. This program has contributed significantly in the development, nurturing and positioning of essential oil-based aroma industry in the country. This has led to creation of an ecosystem benefitting the industry, farmers and next generation entrepreneurs. The activities are pursued in a synergistic mode with the organization in public and private set ups. This program has also paved way for developing entrepreneurship in different parts of the country through cultivation and commercial utilization of aromatic crops.

II. Cultivation of Aromatic plant - *Cymbopogon citratus*(Lemongrass)

Lemongrass is a tropical herb packed with strong citrus flavor. The lemon taste is prized in Asian cooking, as well as in tea, sauces, and soups.



Figure 10.27: Lemon grass

Economic part: Stem base and leaves.

Major constituents: Citronella, geraniol and citronellol.

Uses: The aromatic oil has flavouring properties and is used in perfumery, cosmetics, confectionary, beverages, mosquito repellents and toilet cleaners.

Soil and Climate: Lemongrass grow well in

full sun, with plenty of water, in a rich, well-draining soil.

Planting: This plant can thrive well all through the year. Fill planting holes with composted manure to improve fertility and enhance the soil's ability to hold water. If you're adding several lemongrass plants to planting beds, space plants 60 cm apart.

Irrigation: Water requirements for this plant will vary dependent upon the type of soil they grow. Sandy, loose soils require more frequent watering than silty loam.

Harvest: Start harvesting as soon as plants are 30 cm tall and stem bases are at least 1.5 cm thick. Cut stalks at ground level.

Summary

Early civilization in different parts of the world has domesticated different species of plants for various purposes. Based on their utility, the economically useful plants are classified into food plants, fodder plants, fibre plants, timber plants, medicinal plants, and plants used in paper industries, dyes and cosmetics.

However, food base of majority of the population depends on very few Cereals, Millets, Pulses, Vegetables, Fruits, Nuts, Sugars, Oil seeds, Beverages, Spices and Condiments.

Oils can be classified into two types namely, essential oils and vegetable oils. Fatty acids in oil may be saturated or unsaturated. The oil yielding plants are groundnut, sesame, sunflower, coconut and mustard. The oils are used in cooking, making soaps and other purposes. Beverages contain alkaloids that stimulate central nervous system. Non alcoholic beverages are coffee, tea and cocoa. Spices were used throughout the world for several years. Cardamom is 'Queen of Spices' used for flavouring confectionaries and beverages. Black pepper is King of Spices.

Botanically a fibre is a long, narrow, thick walled cell. It is classified based on uses: textile fibres, brush fibres, plaiting fibres and



filling fibres. Cotton, Jute and Coconut are fibre yielding plants. Teak, Rosewood, and Ebony are woods used for making furniture. Rubber is produced from the latex of *Hevea brasiliensis*. Paper production is a Chinese invention. Dyes have been used since ancient times. Indigo was extracted from the leaves of *Indigofera*. The orange dye henna is from the leaves of *Lawsonia*. Cosmetics have a high commercial value and have become chemical based industrial products. Perfumes are volatile and aromatic in nature, manufactured from essential oils which are found at different parts of the plant. Medicinal plants serve as therapeutic agents. Medicinally useful molecules obtained from these plants are marketed as drugs are called Biomedicines. Whereas phytochemicals from some of the plants which alter an individual's perceptions of mind by producing hallucination are known as psychoactive drugs. Thus plants play a vital role in the lives of people throughout the world.

Entrepreneurial Botany is the study of how new businesses are created using plant resources as well as the actual process of starting a new business. Mushrooms are the fruiting body of edible fungi and is the most priced commodity among vegetables.

Single-cell proteins are the dried cells of microorganism, which are used as protein supplement in human foods or animal feeds. Microorganisms like algae, fungi, yeast and bacteria are used for this purpose.

A terrarium is a collection of small plants growing in a transparent, sealed container. Bonsai is the art and science of dwarfing and shaping of a tree. Specialty materials like essential oils and pharmaceuticals, are obtained from plants. Many species of medicinal and aromatic plants (MAPs) are cultivated for such industrial uses, but most are still wild collected.

Evaluation



- Consider the following statements and choose the right option.
 - Cereals are members of grass family.
 - Most of the food grains come from monocotyledon.
 - (i) is correct and (ii) is wrong
 - Both (i) and (ii) are correct
 - (i) is wrong and (ii) is correct
 - Both (i) and (ii) are wrong
- Assertion: Vegetables are important part of healthy eating.
Reason: Vegetables are succulent structures of plants with pleasant aroma and flavours.
 - Assertion is correct, Reason is wrong
 - Assertion is wrong, Reason is correct
 - Both are correct and reason is the correct explanation for assertion.
 - Both are correct and reason is not the correct explanation for assertion.
- Groundnut is native of _____
 - Philippines
 - India
 - North America
 - Brazil
- Statement A: Coffee contains caffeine
Statement B: Drinking coffee enhances cancer
 - A is correct, B is wrong
 - A and B – Both are correct
 - A is wrong, B is correct
 - A and B – Both are wrong
- This is an example of brush fibre yielding plant
 - Cyperus
 - Neem
 - Cotton
 - Palm
- Tectona grandis* is coming under family
 - Lamiaceae
 - Fabaceae
 - Dipterocarpaceae
 - Ebenaceae



7. *Tamarindus indica* is indigenous to

- a) Tropical African region
- b) South India, Sri Lanka
- c) South America, Greece
- d) India alone

8. New world species of cotton

- a) *Gossipium arboretum*
- b) *G. herbaceum*
- c) Both a and b
- d) *G. barbadense*

9. Assertion: Turmeric fights various kinds of cancer

Reason: Curcumin is an anti-oxidant present in turmeric

- a) Assertion is correct, Reason is wrong
- b) Assertion is wrong, Reason is correct
- c) Both are correct
- d) Both are wrong

10. Find out the correctly matched pair.

- a) Rubber *Shorea robusta*
- b) Dye *Indigofera annecta*
- c) Timber *Cyperus papyrus*
- d) Pulp *Hevea brasiliensis*

11. Find out the wrongly paired one

- a) Burma teak *Tectona grandis*
- b) Rosewood *Dalbergia* sp.
- c) Ebony *Diaspyros eberum*
- d) Henna *Shorea robusta*

12. Observe the following statements and pick out the right option from the following:

Statement I – Perfumes are manufactured from essential oils.

Statement II – Essential oils are formed at different parts of the plants.

- a) Statement I is correct
- b) Statement II is correct
- c) Both statements are correct
- d) Both statements are wrong

13. Observe the following statements and pick out the right option from the following:

Statement I: The drug sources of Siddha include plants, animal parts, ores and minerals.

Statement II: Minerals are used for preparing drugs with long shelf-life.

- a) Statement I is correct
- b) Statement II is correct
- c) Both statements are correct
- d) Both statements are wrong

14. Select the mismatch.

- a) *Andrographis* – hepato protective
- b) *Adhatada* – broncho dialator
- c) *Phyllanthus* – anti-diabetic
- d) *Curcumin* – anti-oxidant

15. The active principle trans-tetra hydro canabial is present in

- a) Opium b) *Curcuma*
- c) Marijuana d) *Andrographis*

16. Which one of the following matches is correct?

- a) *Palmyra* – Native of Brazil
- b) *Saccharun* – Abundant in Kanyakumari
- c) *Steveocide* – Natural sweetener
- d) *Palmyra sap* – Fermented to give ethanol

17. The only cereal that has originated and domesticated from the New world.

- a) *Oryza sativa* b) *Triticum asetumn*
- c) *Triticum durum* d) *Zea mays*

18. Which of the following statement(s) is/are correct?

- i. Mushrooms are the fruiting body of edible fungi.
- ii. Single-cell proteins are the dried cells of macro organism.
- iii. Regular use of liquid seaweed fertilizer will help plants to withstand environmental stress.
- iv. SCP can completely replace the conventional protein sources.

- A. (i) and (ii), B. (i) and (iii),
- C. (i) and (iv), D. (i) alone



19. Select the incorrect pair/pairs of statements about single cell protein
- Chemical pesticides - Safe for human and the environment
 - Mushrooms - White vegetable
 - Zarrouk medium- Culture medium
 - Seaweed - Rich in potassium
- A. (i) and (ii), B. (i) and (iv),
C. (i) and (iii), D. (i) alone
20. Match the following pairs about mushroom cultivation.
- | | |
|---------------------------|----------------|
| A. Straw size | (i) 75-85% |
| B. Distant between blocks | (ii) 20 cm |
| C. Cap size at harvesting | (iii) 2-4 inch |
| D. Relative humidity | (iv) 10-12 cm |
- A. A-(ii), B-(iii), C-(iv), D-(i)
B. A-(iii), B-(ii), C-(iv), D-(i)
C. A-(ii), B-(iii), C-(iv), D-(i)
D. A-(i), B-(ii), C-(iii), D-(iv)
21. Assertion: In *Spirulina* culture, half of the required nutrients added first and the rest in later.
- Reason: If all the nutrients are added first, it will affect the culture growth.
- (a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) Both A and R are false.
22. Write the cosmetic uses of *Aloe*.
23. What is pseudo cereal? Give an example.
24. What are cucurbits? Why it is considered as an important summer vegetable?
25. Which fruit is rich in potassium? Mention its economic importance.
26. Discuss which wood is better for making furniture.
27. A person got irritation while applying chemical dye. What would be your suggestion for alternative?
28. Name the humors that are responsible for the health of human beings.
29. Give definitions for organic farming?
30. Define bonsai?
31. What is terrarium?
32. Which is called as the "King of Bitters"? Mention their medicinal importance.
33. Differentiate bio-medicines and botanical medicines.
34. Write the origin and area of cultivation of green gram and red gram.
35. What are millets? What are its types? Give example for each type.
36. Write the economic importance of *Lycopersicon esculentum*.
37. If a person drinks a cup of coffee daily it will help him for his health. Is this correct? If it is correct, list out the benefits.
38. Enumerate the uses of turmeric.
39. What is TSM? How does it classified and what does it focuses on?
40. What are the advantages of cultivation of aromatic plants?
41. How will you make a Bonsai tree
42. What is NMPB?
43. Write the uses of nuts you have studied.
44. Give an account on the role of *Jasminum* and *Rosa* in perfuming.
45. Give an account of active principle and medicinal values of any two plants you have studied.
46. Write the economic importance of rice.
47. Which TSM is widely practiced and culturally accepted in Tamil Nadu? - explain.
48. What are psychoactive drugs? Add a note *Marijuana* and *Opium*
49. Describe the types of fibres.
50. What are the King and Queen of spices? Explain about them and their uses.



51. How will you prepare an organic pesticide for your home garden with the vegetables available from your kitchen?
52. What will you do if you want to make a portable indoor greenery?
53. Give an account on cultivation of *Gloriosa superba* / *Cymbopogon citrates*

Glossary

Term: Description

Lubricant: Oily substance reduces friction.

Odour: Smell (pleasant or unpleasant).

Diuretic: Substance that promote urine production

Cirrhosis: A chronic liver disease typically caused by alcoholism or hepatitis.

Antioxidant: A substance that scavenges free radicals.

Carminative: A drug causing expulsion of gas from the stomach or bowel.

Malnutrition: Deficiencies, excesses or imbalances in a person's intake of energy and / or nutrients

Spawn: Mycelium especially prepared for propagating mushrooms

Aromatic crops: Plants that produce aromatic oils.

Perfumery: The art or process of making perfume

Cosmetics: substances or products used for personal grooming.

confectionary: a place where confections/ sweets are kept or made

Anti-inflammatory: the property of a substance or treatment that reduces swelling.

Alzheimer's disease: A type of dementia that causes problems with memory, thinking and behavior

Ethnobiology: Ethnobiology is the study of relationships between peoples and plants.

Pharmacopoeia: Is a book containing directions for the identification of compound medicines, and published by the authority of a government or a medical or pharmaceutical society.

Fixative: A substance used to reduce the evaporation rate and improve stability when added to more volatile components.

Antiperspirant: Products whose primary function is to inhibit perspiration / sweat

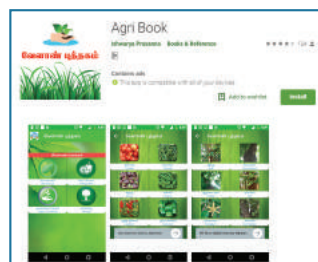
Seasoning: The processing of food with spices and condiments to enhance the flavour.



ICT Corner

Economically Useful Plants

Let us know about the agriculture in detail through this activity



B266_12_BOT_EM

Steps

- Type the URL or scan the QR code to open the activity page then Introduction page will open.
- Select Package of Practices to know the various methods of agricultural crops breeding system.
- Click on Chat with expert helps the farmers to clarify their doubts.
- Click on Videos to know about the agricultural methods visually through videos.



Step 1



Step 2



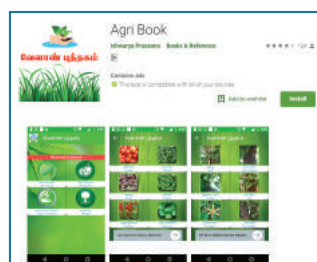
Step 3



Step 4

URL: <https://play.google.com/store/apps/details?id=com.criyagen>

Let us know about the Agri book in detail through this activity.



B266_12_BOT_EM

Steps

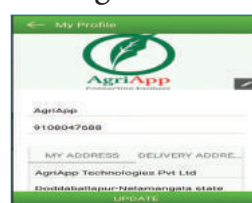
- Type the URL or scan the QR code to open the activity page then Introduction page will open.
- Click on Agriculture it will display the approaches to cultivate the planted paddy, cotton and sugarcane.
- Click on Horticulture it will display the approaches to cultivate the agricultural crops like tea, coffee.
- Click on Organic Farming it will explain the Traditional method of farming and Traditional Fertilizers.
- Click on Forestry it will explain the gardening methods about plants.



Step 1



Step 2



Step 3



Step 4

URL:

<https://play.google.com/store/apps/details?id=com.agribook.venkatmc.agri>

* Pictures are indicative only

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English – Tamil Terminology

Unit VI – Reproduction in plants

Apomixis	கருவுறா இனப்பெருக்கம்
Apospory	கருவுறா வித்து
Archeporium	முன்வித்து திசு
Cleistogamous flower	மூடிய பூ
Cryopreservation	குளிர்பாதுகாப்பு
Embryo sac	கருப்பை
Floral primordium	மலர் தோற்றுவி
Funiculus	தூல் காம்பு
Microsporogenesis	நுண் வித்துருவாக்கம்
Polyembryony	பல்கருநிலை
Scion	ஒட்டுத் தண்டு
Stock	வேர்கட்டை

Unit VII - Genetics

Allele	அல்லீல்
Allopolyploidy	அயல்பன்மடியம்
Alternative splicing	மாற்று இயைத்தல்
Anticodons	எதிர் குறியன்கள்
Autopolyploidy	தன்பன்மடியம்
Backcross	பிற்கலப்பு
Blending inheritance	கலப்பு பாரம்பரியம்
Branch migration	கிளைவழி இடம்பெயர்தல்
Capping	நுனி மூடுதல்
Coding strand	குறியீட்டு இழை
Codominance	இணைஒங்குத்தன்மை
Complete linkage	முழுமையான பிணைப்பு
Complementation test	நிரப்பு சோதனை
Coupling	இணைப்பு
Crossing over	குறுக்கேற்றம்
DNA metabolism	DNA வளர்சிதை மாற்றம்
Dominance	ஒங்குத்தன்மை
Duplication	இரட்டிப்பாதல்
F ₁ generation (first filial generation)	முதல் மகவுச்சந்ததி



Frame shift mutation	கட்ட நகர்வு சடுதி மாற்றம்
Gene interaction	மரபணு இடைச்செயல்
Gene mapping	மரபணு வரைபடம்
Genome	மரபணுத்தொகையம்
Genotype	மரபணுவகையம்
Haploidy	ஒருமடியம் (பன்மம்)
Heredity	பாரம்பரியம்
Heterozygous	மாறுபட்டபண்பிணைவு
Homologous chromosome	ஒத்த அமைவிட குரோமோசோம்
Incomplete dominance	முழுமைபெறா ஒங்குத்தன்மை
Incomplete linkage	முழுமையற்ற பிணைப்பு
Independent assortment	சாராஒதுங்கு விதி
Internal methylation	அக மெத்திலாக்கம்
Inversion	தலைகீழ் திருப்பம்
Jumping genes	தாவும் மரபணுக்கள்
Linkage group	பிணைப்புத் தொகுதி
Locus	நிலையிடம்
Map unit	வரைபட அலகு
Mis-sense mutation	தவறாக வெளிப்பாட்டடையும் சடுதிமாற்றம்
Monohybrid	ஒரு பண்புக்கலப்புயிரி
Multiple alleles	பல்கூட்டு அல்லீல்கள்
Mutagen	சடுதிமாற்றக் காரணி
Mutation	சடுதிமாற்றம்
Non-sense mutation	வெளிப்பாட்டடையாத சடுதி மாற்றம்
Palindrome	முன்பின்ஒத்தவரிசை
Phenotype	புறத்தோற்றவகையம்
Purity of gametes	இனச்செல்கலப்பற்றது
Recessive	ஒடுங்குத்தன்மை
Repulsion	விலகல்
Restriction enzymes	தடைக்கட்டு நொதிகள்
RNA Splicing	RNA இயைத்தல்
Saltation	திடீர் மாற்றம்
Segregation	தனித்தொதுங்குதல்

Sequence	தொடர்வரிசை
Sex linkage	பால் பிணைப்பு
Silent mutation	அமைதி சடுதிமாற்றம்
Split genes	பிளவுறு மரபணு
Start codon	தொடக்கக் குறியன்
Synaptonemal complex	இணைப்பிணைப்புக் கூட்டமைப்பு
Synopsis	இணைச் சேர்தல்
Tailing	வாலாக்கம்
Tassel seed	கதிர் குஞ்சுவிதை
Template strand	வார்ப்பு இழை
Test cross	சோதனைக்கலப்பு
Tetrad stage	நான்மய நிலை
Three point test cross	முப்புள்ளி சோதனைக் கலப்பு
Translocation	இடம்பெயர்தல்

UNIT VIII - Biotechnology

Artificial seeds	செயற்கை விதைகள்
Aseptic condition	நுண்ணுயிர் அற்ற நிலை
Autoradiography	கதிரியக்க படமெடுப்பு
Biochip	உயிரி சில்லு
Biomass	உயிரி கூளம்
Biopharming	உயிரி மருந்தாக்கம்
Biopiracy	உயிரிபொருள் கொள்ளை
Bioreactor / Fermentor	உயிரி வினைகலன் / நொதிகலன்
Biosynthesis	உயிரி உற்பத்தி
Buffer	தாங்கல் கரைசல்
Carriers	கடத்தி
Cloned Plants	நகலொத்த தாவரங்கள்
Cloning	நகல்பெருக்கம்
Cloning Site	நகலாக்க களம்
Cryoconservation	உறைகுளிர் வெப்பநிலை பேணல்
Cybrids	கலப்பின பிளாஸ்மிட்கள்



Dedifferentiation	வேறுபாடு இழத்தல்
Differentiation	வேறுபாடுறுதல்
DNA Bank	DNA வங்கி
Downstream Process	கீழ்காற் பதப்படுத்தம்
Embryogenesis	கரு உருவாக்கம்
Embryoids	சிறுகருக்கள்
Explant	பிரிகுறு
Fermentation	நொதித்தல்
Gel Electrophoresis	இழும மின்னாற் பிரித்தல்
Gene	மரபணு
Gene Bank	மரபணு வங்கி
Gene Gun	மரபணு துப்பாக்கி
Gene Manipulation Technique	மரபணு கையாளும் தொழில்நுட்பம்
Genetically modified plants	மரபணு மாற்றப்பட்ட தாவரங்கள்
Genome	மரபணு தொகையம்
Green Fluorescence Protein	பசுமை ஒளிர் புரதம்
Hardening	வன்மையாக்குதல்
Human Genome Sequence	மனித மரபணு தொகைய தொடர் வரிசை
Inoculation	உள்நுழைத்தல்
Insert	செருகி
invitro culture	ஆய்வுகூட சோதனை வளர்ப்பு
Isolation	தனிமைபடுத்துதல்
Laminar air flow chamber	சீரடுக்கு காற்று பாய்வு அறை
Liquid medium/ liquid culture	திரவ ஊடகம் / திரவ வளர்ப்பு
Marker	அடையாளக்குறி
Microinjection	நுண்செலுத்துதல்
Micropropagation	நுண்பெருக்கம்
Mycoremediation	பூஞ்சை சீரமைப்பாக்கம்
Nutritional medium	ஊட்ட ஊடகம்
Organogenesis	உறுப்புகளாக்கம்
Palindrome Sequence	முன்பின் ஒத்த வரிசை
Phytoremediation	தாவர சீரமைப்பாக்கம்

Pollen Bank	மகரந்த வங்கி
Probe	துருவி
Recombinant DNA	மறுகூட்டிணைவு DNA
Recombinant	மறுகூட்டிணைவு
Redifferentiation	மறுவேறுபாடுறுதல்
Regeneration	மீள் உருவாக்கம்
Replica Blotting Technique	நகல் முலாம் தொழில்நுட்பம்
Restriction Enzyme	தடை கட்டு நொதி
Somatic Embryoids	உடல் கருவுருக்கள்
Sterile condition	நுண்ணுயிர் நீக்கிய நிலை
Sterilization	நுண்ணுயிர் நீக்கம்
Tissue culture	திசு வளர்ப்பு
Totipotency	முழு ஆக்குத்திறன் பெற்றவை
Transfection	தொற்றுதல்
Transposon	இடமாற்றிக் கூறுகள்
Upstream Process	மேல்காற் பதப்படுத்தம்
Vector	தாங்கி கடத்தி
Virus free plants	வைரஸ் அற்றத் தாவரங்கள்
Walking Genes	நடக்கும் மரபணுக்கள்

UNIT IX – Plant Ecology

Agroforestry	வேளாண்காடுகள்
Alien Invasive species	அயல் ஊடுருவும் சிற்றினங்கள்
Allelopathic chemicals	வேதியத்தடைப் பொருட்கள்
Altitude	குத்துயரம்
Autecology	சுய சூழ்நிலையில்
Benthic	ஆழ்மிகு மண்டலம்
Benthos	ஆழ் உயிரிகள்
Biochar	உயிரித்தொகுப்பு
Biome	உயிர்மம்
Biotope	உயிரி நில அமைவு

UNIT X - Economic Botany

Carbon foot print	கார்பன் தடம்
Carbon sequestration	கார்பன் ஒதுக்கமடைதல்
Carbon sink	கார்பன் தேக்கி
Co-evolution	கூட்டுப் பரிணாமம்
Decomposers	சிதைப்பவைகள்
Ecological hierarchy	தூழ்நிலைப்படிிகள்
Ecotone	இடைச்சூழலமைப்பு
Ecotope	தூழல் நில அமைவு
Furgivores	பழ உண்ணிகள்
Gnana	கடல் அருகு வாழ் பறவைகளின் எச்சம்
Habitat	புவி வாழிடம்
Humus	மட்கு
Latitude	விரிவகலம்
Mimicry	பாவனை செயல்கள்
Niche	செயல் வாழிடம்
Ozone depletion	ஓசோன் குறைதல்
Photosynthetically active radioactive	ஒளிச்சேர்க்கை சார் செயலூக்கக் கதிர்வீச்சு
Plant Ecology	தாவர தூழ்நிலையியல்
Predation	கொன்றுண்ணும் வாழ்க்கை முறை
Sacred groves	கோயில் காடுகள்
Seedball	விதைப்பந்து
Social forestry	சமூகக்காடுகள்
Soil profile	மண்ணின் நெடுக்குவெட்டு விவரம்
Standing crops	நிலைப்பயிர்
Standing quality	நிலைத்தரம்
Succession	வழிமுறை வளர்ச்சி
Synecology	கூட்டுச் சூழ்நிலையில்
Topographic factors	நிலப்பரப்பு வடிவமைப்பு காரணிகள்
Trophic level	ஊட்டஞ்சார் மட்டம்

Acclimatization	புதிய தட்பவெப்ப நிலைக்கு பழகுதல்
Archeological records	தொல்லியல் பதிவுகள்
Aromatic plant	நறுமண தாவரம்
Bio medicine	உயிரிமூலக்கூறு மருந்து
Biofertilizers	உயிரி உரம்
Culinary	சமையல்
Decoction	வடிநீர்
Domestication	வளர்ப்புச் சூழலுக்கு உட்படுத்துதல்
Emasculation	மகரந்தத்தாள் நீக்கம்
Entrepreneur	தொழில் முனைவோர்
Essential oil	நறுமண எண்ணெய்
Fruiting body	கனி உடலம்
Gluten	பசையம்
Green manuring	தழை உரம்
Kelp	பழுப்பு பாசி
Organic agriculture	இயற்கை வேளாண்மை
Pelleting	சிற்றுருண்டைகள் ஆக்குதல்
Plant pathology	தாவர நோயியல்
Pseudo cereal	பொய் தானியம்
Pungent	நெடி (அல்லது) காரம்
Resin	பிசின்
Sapwood	மென்கட்டை
Saturated fatty acids	நிறைவுற்ற கொழுப்பு அமிலம்
Seed treatment / seed dressing	விதை நேர்த்தி
Spawn	பூஞ்சை வித்து
Stimulant	தூண்டி
Tillering	புல் கிளைத்தல்
Unsaturated fatty acids	நிறைவுறா கொழுப்பு அமிலம்
Vigour	வீரியம்
Volatile oil	எளிதில் ஆவியாகும் எண்ணெய்



Competitive Examination Questions

UNIT VI – Reproduction in plants

1. Which of the following plant reproduces by leaf (DPMT 2003)
 - a) *Agave*
 - b) ***Bryophyllum***
 - c) *Gladiolus*
 - d) Potato
2. Advantage of cleistogamy (NEET 2013)
 - a) Higher genetic variability
 - b) More vigorous offspring
 - c) **No dependence on pollinators**
 - d) Vivipary
3. An example for edible underground stem is (NEET 2014)
 - a) Carrot
 - b) Groundnut
 - c) Sweet potato
 - d) **Potato**
4. Pollen tablets are available in the market for (NEET 2014)
 - a) *invitro* fertilization
 - b) Breeding programmes
 - c) **supplementing food**
 - d) *ex situ* conservation
5. Geitonogamy involves (NEET 2014)
 - a) **Fertilization of a flower by pollen from another flower of a same plant**
 - b) Fertilization of a flower by pollen of the same flower
 - c) Fertilization of a flower by pollen from a flower of another plant in a same population
 - d) Fertilization of a flower by the pollen from a flower of another plant belongs to distant population.
6. Which one of the following generates new genetic combinations leading to variations? (NEET 2016)
 - a) vegetative reproduction
 - b) parthenogenesis
 - c) **Sexual reproduction**
 - d) Nucellar polyembryony
7. Functional megaspore in angiosperm develops into an (NEET 2017)
 - a) endosperm
 - b) **Embryo sac**
 - c) embryo
 - d) ovule
8. Which of the statement is not true. (NEET 2016)
 - a) Pollen grain of many species cause severe allergies
 - b) Stored pollen in liquid nitrogen can be used in crop breeding programmes
 - c) **Tapetum helps in the dehiscence of anther**
 - d) Exine of pollen grains is made up of sporopollenin
9. When a diploid female plant is crossed with a tetraploid male, the ploidy of endosperm cells in the resulting seed is (AIPMT 2004)
 - a) pentaploidy
 - b) diploidy
 - c) triploidy
 - d) **tetraploidy**
10. Which one of the following pairs of plant structures has haploid number of chromosomes? (AIPMT 2008)
 - a) Egg nucleus and secondary nucleus
 - b) Megaspore mother cell and antipodal cells
 - c) **Egg cell and antipodal cells**
 - d) Nucellus and antipodal cells
11. The arrangement of nuclei in a normal embryo sac in the dicot plant is (AIPMT 2006)
 - a) $2 + 4 + 2$
 - b) **$3 + 2 + 3$**
 - c) $2 + 3 + 3$
 - d) $3 + 3 + 2$
12. Wind pollinated flowers are (AIPMT PRE 2010)
 - a) Small, producing nectar and dry pollen
 - b) small, brightly colored, producing large number of pollen grains
 - c) **small, producing large number of pollen grains**
 - d) large, producing abundant nectar and pollen



13) Function of filiform apparatus is to
(AIPMT 2014)

- a) recognize the suitable pollen at stigma
- b) stimulate division of generative cell
- c) produce nectar
- d) **guide the entry of pollen tube**

14) The coconut water from tender coconut represents
(NEET 2016)

- a) endocarp
- b) fleshy mesocarp
- c) free nuclear proembryo
- d) **free nuclear endosperm**

15) Pollination in water hyacinth and water lily is brought about by the agency of
(NEET 2016)

- a) **insects or wind**
- b) birds
- c) bats
- d) water

16) Perisperm differs from endosperm in
(NEET 2013)

- a) being haploid tissue
- b) having no reserve food
- c) **being a diploid tissue**
- d) its formation by fusion of secondary nucleus with several sperms

17) Male gametes in angiosperms are formed by the division of
(AIPMT 2007)

- a) microspore mother cell
- b) microspore
- c) **generative cell**
- d) vegetative cell

18) In a type of apomixes known as adventive polyembryony, embryo develop directly from the
(AIPMT 2005)

- a) synergids or antipodals in an embryo sac
- b) **nucellus or integuments**
- c) zygote
- d) accessory embryo sac in the ovule

19) In a cereal grain the single cotyledon of the embryo is represented by
(AIPMT 2006)

- a) coleorhizae
- b) **scutellum**
- c) prophyll
- d) coleoptiles

20) An ovule which becomes curved so that the nucellus and embryo sac lie at right angles to the funicle is
(AIPMT 2004)

- a) camylotropous
- b) anatropous
- c) orthotropous
- d) **hemianatropous**

21) Endosperm is formed during the double fertilization by
(AIPMT 2000)

- a) **two polar nuclei and one male gamete**
- b) one polar nuclei and one male gamete
- c) ovum and male gametes
- d) two polar nuclei and two male gametes

UNIT VII – Genetics

1. Genes for cytoplasmic male sterility in plants are generally located in
(AIPMT 2005)

- a) **Mitochondrial genome**
- b) Cytosol
- c) Chloroplast genome
- d) Nuclear genome

2. In which mode of inheritance do you expect more maternal influence among the off spring
(AIPMT 2006)

- a) Autosomal
- b) **Cytoplasmic**
- c) Y-linked
- d) X-linked

3. Which one of the following cannot be explained on the basis of Mendel's Law of Dominance?
(AIPMT 2010)

- a) Factors occur in pairs
- b) The discrete unit controlling a particular character is called a factor
- c) Out of one pair of factors one is dominant and the other is recessive
- d) **Alleles does not show any blending and both the characters recover as such in F₂ generation**

4. F₂ generation in a Mendelian cross shows that both genotypic and phenotypic ratios are same as 1:2:1. It represents a case of
(AIPMT 2012)

- a) **Monohybrid crosses with incomplete dominance**
- b) Co-dominance
- c) Dihybrid cross
- d) Monohybrid cross with complete dominance



5. A Pleiotropic gene
(AIPMT 2015 – Re-exam)
a) **Controls multiple traits in an individual**
b) Is expressed only in primitive plants
c) Is a gene evolved during Pliocene
d) Controls a trait only in combination with another L gene
6. A true breeding plant is
(NEET Phase II 2016)
a) **Near homozygous and produces offspring of its own kind**
b) Always homozygous recessive in its genetic construction
c) One that is able to breed on its own
d) Produced due to cross pollination among unrelated plants
7. Mendel obtained wrinkled seeds in pea due to the deposition of sugars instead of starch. It was due to which enzyme?
(AIPMT 2001)
a) Amylase b) Invertase c) Diastase
d) **Absence of starch branching enzyme**
8. Ratio of complementary gene is
(AIPMT 2001)
a) 9:3:4 b) 12:3:1 c) 9:3:3:4 d) **9:7**
9. If there are 999 bases in an RNA that codes for a protein with 333 amino acid and the base at position 901 is deleted such that the length of the RNA becomes 998 bases, how many codons will be altered?
(NEET 2017)
a) 1 b) 11 c) 33 d) **333**
10. If a homozygous red flowered plant is crossed with a homozygous white flowered plant, then the off-springs will be
(AIIMS 1999, 2002, 2007)
a) Half-white flowered b) Half-red flowered
c) All white flowered d) **All red flowered**
11. The ratio in a dihybrid test cross between two individuals is given by (AIIMS 2001)
a) 2:1 b) 1:2:1 c) 3:1 d) **1:1:1:1**
12. Pure line breed refers to
(AIIMS 2002, AIIMS 2007)
a) Heterozygosity only
b) Heterozygosity and linkage
c) **Homozygosity only**
d) Homozygosity and self assortment
13. How many different types of gametes can be formed by F_1 progeny, resulting from the following cross AABBCc x aabbcc
(AIIMS 2004)
a) 3 b) **8** c) 27 d) 64
14. Which of the following conditions represents a case of co-dominant genes?
(AIIMS 2009)
a) A gene expresses itself, suppressing the phenotypic effect of its alleles
b) Genes that are similar in phenotypic effect when present separately, but when together interact to produce a different trait
c) Alleles both of which interact to produce a trait which may or may not resemble either of the parental type
d) **Alleles, each of which produces an independent effect in a heterozygous condition.**
15. If 'A' represents the dominant gene and 'a' represents its recessive allele, which of the following would be most likely result in the first generation off spring when Aa is crossed with aa?
(AIIMS 2016)
a) All will exhibit dominant phenotype
b) All will exhibit recessive phenotype
c) **Dominant and recessive phenotypes will be 50% each**
d) Dominant phenotype will be 75%
16. In *Pisum Sativum*, there are 14 chromosomes. How many types of homologous pairs can be prepared?
(JIPMER 2010)
a) 14 b) **7** c) 2^{14} d) 2^{10}



17. The year 1900 AD is highly significant for geneticists due to (JIPMER 2013)
a) Discovery of genes
b) Principle of linkage
c) Chromosomal theory of heredity
d) **Rediscovery of Mendelism**
18. The phenotypic ratio of trihybrid cross in F_2 generation is (JIPMER 2016)
a) **27:9:9:9:3:3:3:1** b) 9:3:3:1
c) 1:4:6:4:1 d) 27:9:3:3:9:1:2:1
19. In a mutational event when adenine is replaced by guanine, it is the case of (AIPMT 2004)
a) Frameshift mutation b) Transcription
c) **Transition** d) Transversion
20. Mutations can be induced with (AIPMT 2011)
a) **Gamma radiations** b) Infrared radiations
c) IAA d) Ethylene
21. The mechanism that causes a gene to move from one linkage group to another is called (AIPMT 2015, NEET (Phase – II) 2016)
a) **Translocation** b) Crossing over
c) Inversion d) Duplication
22. A point mutation comprising the substitution of a purine by pyrimidine is called (AIIMS 2002)
a) Transition b) Translocation
c) Deletion d) **Transversion**
23. Frameshift mutation occurs when (AIPMT 2008)
a) Base is substituted
b) **base is deleted or added**
c) Anticodons are absent
d) None of these
24. The distance between two genes in a chromosome is measured in cross-over units which represent (AIIMS 2008)
a) Ratio of crossing over between them
b) **Percentage of crossing over between them**
c) Number of crossing over between them
d) None of these
25. When a cluster of genes show linkage behaviour they (AIPMT 2003)
a) do not show a chromosome map
b) show recombination during meiosis
c) **do not show independent assortment**
d) induce cell division
26. Genetic map is one that (AIPMT 2003)
a) **Establish sites of the genes on a chromosome**
b) Establishes the various stages in gene evolution
c) Shows the stages during the cell division
d) Shows the distribution of various species in a region
27. After a mutation at a genetic locus of the character of an organism changes due to the change in (AIPMT 2004)
a) DNA replication
b) Protein synthesis pattern
c) RNA transcription pattern
d) **Protein structure**
28. In a hexaploidy wheat, the haploid (n) and basic (x) numbers of chromosomes are (AIPMT 2007)
a) **n = 21 and x = 7** b) n = 7 and x = 21
c) n = 21 and x = 21 d) n = 21 and x = 14
29. Point mutation involves (AIPMT 2009)
a) Deletion b) Insertion
c) **Change in single base pair**
d) duplication
30. Which one of the following is a wrong statement regarding mutations? (AIPMT 2012)
a) UV and Gamma rays are mutagens
b) **Change in a single base pair of DNA does not cause mutation**
c) Deletion and insertion of base pairs cause frame shift mutations.
d) Cancer cells commonly show chromosomal aberrations.





31. Which of the following statement is not true of two genes that show 50% recombination frequency? (NEET 2013)
- The genes may be on different chromosomes
 - The genes are tightly linked**
 - The genes show independent assortment
 - If the genes are present on the same chromosome, they undergo more than one crossover in every meiosis.
32. Haploids are more suitable for mutation studies than the diploids. This is because (AIPMT 2008)
- All mutations, whether dominant or recessive are expressed in haploids**
 - Haploids are reproductively more stable than diploids
 - Mutagens penetrate in haploids more effectively than diploids
 - Haploids are more abundant in nature than diploids
33. Crossing over that results in genetic recombination in higher organisms occurs between (AIPMT 2004)
- Non-sister chromatids of a bivalent**
 - Two daughter nuclei
 - Two different bivalents
 - Sister chromatids of bivalents
34. Removal of introns and joining the exons in a defined order in a transcription unit is called (AIPMT 2009, AIPMT Pre 2012)
- Tailing
 - Transformation
 - Capping
 - Splicing**
35. Selection the correct option (AIPMT 2014)\
- | | Direction of RNA synthesis | Direction of reading of the template DNA strand |
|----|----------------------------|---|
| a) | 5' – 3' | 3' – 5' |
| b) | 3' – 5' | 5' – 3' |
| c) | 5' – 3' | 5' – 3' |
| d) | 3' – 5' | 3' – 5' |
36. Peptide synthesis inside a cell takes place in (AIPMT 2011)
- Ribosomes**
 - Chloroplast
 - Mitochondria
 - Chloroplast
37. During protein synthesis in a organism at one point the process comes to a halt. Select the group of the three codons from the following from which any one of the three could bring about this halt. (AIIMS 2006)
- UUU, UCC, UAU
 - UUUC, UUA, UAC
 - UAG, UGA, UAA**
 - UUG, UCA, UCG
38. The binding site of tRNA with mRNA and amino acids respectively are (AIIMS 2009)
- mRNA with DHU loop and amino acid with CCA end
 - mRNA with CCA end and amino acid with anticodon loop
 - mRNA with anticodon loop and amino acid with DHU loop
 - mRNA with anticodon loop and amino acid with CCA end**
39. Which of the following is correct regarding genetic code? (AIIMS 2010)
- UUU is the initiation codon which also codes for phenylalanine
 - There are 64 triplet codons and only 20 amino acids**
 - Three random nitrogen bases specify the placement of one amino acid
 - UAA is the nonsense codon which also codes for methionine
40. Which of the following set of options is used in translation? (AIIMS 2015)
- hnRNA, tRNA, rRNA
 - mRNA, tRNA, rRNA**
 - mRNA, tRNA, hnRNA
 - hnRNA, rRNA, lRNA
41. Sequence of DNA (non-coding) is known as (JIPMER 2006)
- exon
 - intron**
 - cistron
 - none of these



42. During transcription holoenzyme RNA polymerase binds to a DNA sequence and the DNA assumes a saddle like structure at that point. What is that sequence called

(JIPMER 2007)

- a) CAAT box b) GGT T box
c) AAAT box d) **TATA box**

43. The successive nucleotides of RNA are covalently linked through (JIPMER 2001)

- a) Hydrogen bonds
b) **Phosphodiester bonds**
c) Glycosidic bonds d) None of these

44. The Okazaki fragments in DNA chain growth

(AIPMT 2007, JIPMER 2004)

- a) Polymerize in the 3' - to 5' direction and forms replication fork
b) Prove semi conservative nature of DNA replication
c) **Polymerize in the 5' to 3' direction and explains 3' - to - 5' DNA replication**
d) Result in transcription

45. Taylor conducted the experiment to prove semiconservative mode of chromosome replication on (NEET (Phase II) 2016)

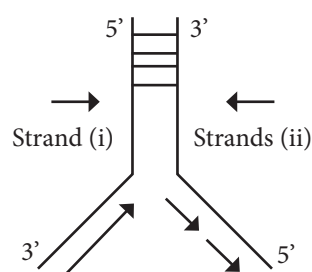
- a) *Drosophila melanogaster* b) *e-coli*
c) *Vinca rosea* d) ***vicia faba***

46. The new strand synthesized in small pieces and then joined together during DNA replication is called (AIIMS 1994)

- a) Dead strand b) **Lagging strand**
c) Leading strand d) All of these

47. What is incorrect about the following figure representing DNA replication

(AIIMS 2009)



- a) The direction of DNA replication in strand (i)

- b) The direction of DNA replication in strand (ii)

- c) **Discontinuous replication of strand (i)**

- d) Discontinuous replication of strand (ii)

48. DNA multiplication is called

(JIPMER 2009)

- a) Translation b) **Replication**
c) Transduction d) Transcription

49. The complete set of chromosome inherited as a single unit from one parent is known as

(AIIMS 1994)

- a) **Genome** b) Linkage
c) Gene pool d) Genotype

50. The mobile genetic element is

(JIPMER 2014)

- a) **Transposon** b) Mutation
c) Endonuclease d) Variation

UNIT VIII - Biotechnology

1. What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis? (NEET 2017)

- a) **The smaller the fragment size, the farther it moves.**

- b) Positively charged fragments move to farther end.

- c) Negatively charged fragments do not move.

- d) The larger the fragment size, the farther it moves.

2. Stirred-tank bioreactors have been designed for (NEET - II 2016)

- a) Purification of product.

- b) Addition of preservatives to the product

- c) **Availability of oxygen throughout the process**

- d) Ensuring anaerobic conditions in the culture vessel.

3. Which of the following is not a component of downstream processing? (NEET-II 2016)



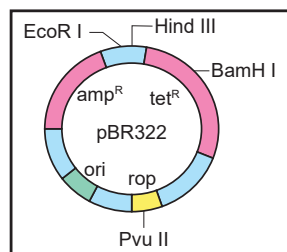
- a) Separation b) Purification
c) Preservation d) **Expression**
4. Which of the following is not a feature of the plasmids? (NEET-I 2016)
a) Transferable b) **Single-stranded**
c) Independent replication
d) Circular structure
5. Which of the following is not required for any of the techniques of DNA fingerprinting available at present? (NEET-I 2016)
a) Restriction enzymes
b) DNA-DNA hybridization
c) Polymerase chain reaction
d) **Zinc finger analysis**
6. Which vector can clone only a small fragment of DNA? (AIPMT 2014)
a) Bacterial artificial chromosome
b) Yeast artificial chromosome
c) **Plasmid** d) Cosmid
7. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of (NEET 2013)
a) Insertional inactivation of alpha galactosidase in recombinant bacteria.
b) Inactivation of glycosidase enzyme in recombinant bacteria.
c) **Non-recombinant bacteria containing beta galactosidase.**
d) Insertional inactivation of alpha galactosidase in non-recombinant bacteria.
8. During the process of isolation of DNA, chilled ethanol is added to (Karnataka NEET 2013)
a) **Precipitate DNA**
b) Break open the cell to release DNA
c) Facilitate action of restriction enzymes
d) Remove proteins such as histones.
9. For transformation, micro-particles coated with DNA to be bombarded with gene gun are made up of (AIPMT 2012)
a) Silver or platinum b) Platinum or zinc
c) Silicon or platinum d) **Gold or tungsten.**
10. Biolistics (gene-gun) is suitable for (AIPMT Mains 2012)
a) disarming pathogen vectors
b) **transformation of plant cells**
c) constructing recombinant DNA by joining with vectors
d) DNA fingerprinting.
11. Genetic engineering is possible because (CBSE 1998)
a) phenomenon of transduction in bacteria understood
b) we can see DNA by electron microscope
c) we can cut DNA at specific sites by endonuclease like DNAase I
d) **restriction endonuclease purified from bacteria can be used invitro**
12. Genetic Engineering is (BHU 2003)
a) Making artificial genes
b) **Hybridisation of DNA of one organism to that of the others**
c) Production of alcohol by using microorganisms
d) Making artificial limbs, diagnostic instruments such as ECG, EFG, etc.
13. Ligase is used for (AMU 2006)
a) **Joining of two DNA fragments**
b) Separating DNA
c) DNA polymerase reaction
d) All of these
14. In genetic engineering, gene of interest is transferred to the host cell through a vector. Consider the following four agents (1-4) in this regard and select the correct option about which one or more of these can be used as vectors
1. A bacterium 2. Plasmid
3. Plasmodium 4. Bacteriophage
(AIPMT Main 2010)
a) 1 and 4 only b) **2 and 4 only**
c) 1 only d) 1 and 3 only



15. Given below is a sample of a portion of DNA strand giving the base sequence on the opposite strands. What is so special shown in it? (AIPMT 2014)

5'---GAATTC---3' 3'---CTTAAG---5'

- a) **Palindromic sequence of base pairs**
 - b) Replication completed
 - c) Deletion mutation
 - d) Start codon at the 5'end
16. There is a restriction endonuclease called EcoRI. What does "co" part in it stand for? (AIPMT 2011)
- a) Coelom
 - b) Colon
 - c) **Coli**
 - d) Coenzyme
17. The figure below is the diagrammatic representation of the vector pBR322. Which one of the given options correctly identifies its certain components? (AIPMT 2012)



- a) Ori-original restriction enzyme
 - b) rop-reduced osmotic pressure
 - c) Hind III, EcoRI – selectable markers
 - d) **amp^R, tet^R – antibiotic resistance genes**
18. A mixture containing DNA fragments a,b,c,d with molecular weights of $a+b=c$, $a>b$ and $d>c$, was subjected to agarose gel electrophoresis. The position of these fragments from cathode to anode sides of the gel would be (DPMT 2010)
- a) **b,a,c,d**
 - b) a,b,c,d
 - c) c,b,a,d
 - d) b,a,d,c
19. An analysis of chromosomal DNA using the southern hybridisation technique does not use (AIPMT 2014)
- a) Electrophoresis
 - b) Blotting

- c) Autoradiography
- d) **PCR**

20. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of (NEET 2013)
- a) Non-recombinant bacteria containing beta galactosidase
 - b) Insertional inactivation of α -galactosidase in non-recombinant bacteria
 - c) **Insertional inactivation of β -galactosidase in recombinant bacteria**
 - d) Inactivation of glycosidase enzyme in recombinant bacteria
21. Which one of the following palindromic base sequence in DNA can be easily cut at about the middle by some particular restriction enzyme? (AIPMT 2010)
- a) 5'CGTTCG3' 3'ATCGTA 5'
 - b) 5' GATATG 3' 3' CTACTA 5'
 - c) **5' GAATTC 3' 3' CTTAAG 5'**
 - d) 5' CACGTA 3' 3' CTCAGT 5'
22. Silencing of mRNA has been used in producing transgenic plants resistant to (AIPMT, 2011)
- a) Boll worms
 - b) **Nematodes**
 - c) White rusts
 - d) Bacterial blights
23. Some of the characteristics of Bt cotton are (AIPMT,2010)
- a) Long fibre and resistant to aphids
 - b) Medium yield, long fibre and resistant to beetle pests
 - c) High yield and production of toxic protein crystals which kill dipteran pests
 - d) **High yield and resistant to boll worms**
24. An improved variety of transgenic basmati rice (AIPMT,2010)
- a) Does not require chemical fertilisers and growth hormones
 - b) **Gives high yield and is rich in vitamin A**





- c) Is completely resistant to all insect pests and diseases of paddy
d) Gives high yield but no characteristic aroma
- 25) Consumption of which one of the following foods prevent the kind of blindness associated with vitamin A deficiency?
(AIPMT 2012)
- a) Flavr Savr b) Canola
c) **Golden rice** d) Bt brinjal
26. A protoplast is a cell (NEET 2016)
- a) undergoing division
b) without cell wall
c) without plasma membrane
d) without nucleus.
27. A technique of micropropagation is (NEET 2015)
- a) Protoplast fusion
b) embryo rescue
c) somatic hybridization
d) somatic embryogenesis
28. To obtain virus-free healthy plants from a diseased one by tissue culture technique, which part/parts of the diseased plant will be taken? (AIPMT 2014)
- a) Apical meristem only
b) Palisade parenchyma
c) Both apical and axillary meristems
d) Epidermis only.
29. Cellular totipotency was demonstrated by
(AIPMT 1991)
- a) Theodore Schwann
b) A.V. Leeuwenhoek
c) F.C. Steward
d) Robert Hooke
30. Tissue culture technique can produce infinite number of new plants from a small parental tissue. The economic importance of the technique is raising. (Karnataka NEET 2013)
- a) **genetically uniform population identical to the original parent.**
b) homozygous diploid plants
c) new species
d) variants through picking up somaclonal variations
31. Which of the following statements is not true about somatic embryogenesis? (Karnataka NEET 2013).
- a. The pattern of development of a somatic embryo is comparable to that of a zygotic embryo.
b) Somatic embryos can develop from microspores.
c) Somatic embryo is induced usually by an auxin such as 2, 4-D.
d) A somatic embryo develops from a somatic cell.
32. Which one of the following is a case of wrong matching? (AIPMT 2012)
- a) Somatic - Fusion of two diverse hybridization cells
b) Vector DNA - Site for tRNA synthesis
c) Micropropagation - *in vitro* production of plants in large numbers
d) Callus - Unorganised mass of cells produced in tissue culture.
33. Polyethylene glycol method is used for
(AIPMT 2010)
- a) biodiesel production
b) seedless fruit production
c) energy production from sewage
d) gene transfer without a vector.
34. Somaclones are obtained by (AIPMT 2009)
- a) Plant breeding
b) Irradiation
c) genetic engineering
d) tissue culture.
35. The technique of obtaining large number of plantlets by tissue culture method is called
- a) Plantlet culture (AIPMT 2005)
b) Organ culture
c) Micropropagation
d) Macropropagation



36. Coconut milk is used in tissue culture in which present (AIPMT 2000)

- a) **cytokinin** b) auxin
c) gibberellins d) ethylene.

37. Haploid plants can be obtained by culturing. (AIPMT 1994)

- a) **pollen grains** b) root tips
c) young leaves d) endosperm.

UNIT IX - Plant Ecology

1. Plants which produce characteristic pneumatophores and show vivipary belong to (NEET 2017)

- a) **Halophytes** b) psammophytes
c) hydrophytes d) mesophytes

2. Mycorrhizae are the example of (NEET I 2017)

- a) amensalism b) antibiosis
c) **mutualism** d) fungistasis

3. If '+' sign is assigned to beneficial interaction, '-' sign to detrimental and '0' sign to neutral interaction, then the population interaction represented by '+' '-' refers to (NEET 2016)

- a) mutualism b) amensalism
c) commensalism d) **parasitism**

4. Which of the following is correctly matched? (NEET Phase 2 – 2016)

- a) Aerenchyma - *Opuntia*
b) Age pyramid - Biome
c) ***Parthenium*** - **Threat to**
hysterophorus **biodiversity**
d) Stratification - Population

5. An association of individuals of different species living in the same habitat and having functional interactions is

(Re-AIPMT 2015)

- a) Population b) Ecological niche
c) **Biotic community** d) Ecosystem

6. Roots play in significant role in absorption of water in (Re-AIPMT 2015)

- a) Wheat b) Sunflower
c) ***Pistia*** d) Pea

7. If we uncover half of the forest covering the earth, what crisis will be produced at most and the first? (AIPMT 1996)

- a. **Some species will be extinct**
b. Population and ecological imbalance will rise up
c. Energy crisis will occur
d. Rest half forests will maintain this imbalance.

8. Most animals are tree dwellers in a (AIPMT 2015)

- a) **Tropical rain forest**
b) Coniferous forest
c) Thorn woodland
d) Temperate deciduous fo

9. *Cuscuta* is an example of (AIPMT Mains 2012)

- a) **Ectoparasitism** b) Brood parasitism
c) Predation d) Endoparasitism

10. Large woody vines are more commonly found in (AIPMT Prelims 2011)

- a) Alpine forests
b) Temperate forests
c) Mangroves
d) **Tropical rain forests**

11. Niche overlap indicates (AIPMT Prelims 2006)

- a) Active co-operation between two species
b) Two different parasites on the same host
c) **Sharing of one or more resources between the two species**
d) Mutualism between two species



12. Which one of the following pairs is **mismatched**? (AIPMT Prelims 2005)

- a) Savanna – Acacia trees
- b) **Prairie** – **Epiphytes**
- c) Tundra – Permafrost
- d) Coniferous forest – Evergreen trees

13. Which ecosystem has the maximum biomass? (NEET 2017)

- a) Grassland ecosystem
- b) Pond ecosystem
- c) Lake ecosystem
- d) **Forest ecosystem**

14. Which of the following would appear as the pioneer organisms on bare rocks? (NEET 2016)

- a) Mosses
- b) Green algae
- c) **Lichens**
- d) Liverworts

15. In which of the following both pairs have correct combination? (NEET 2015)

a)	Gaseous nutrient cycle Sedimentary nutrient cycle	Nitrogen and Sulphur Carbon and Phosphorous
b)	Gaseous nutrient cycle Sedimentary nutrient cycle	Sulphur and Phosphorous Carbon and Nitrogen
c)	Gaseous nutrient cycle Sedimentary nutrient cycle	Carbon and Nitrogen Sulphur and Phosphorous
d)	Gaseous nutrient cycle Sedimentary nutrient cycle	Carbon and Sulphur Nitrogen and Phosphorous

16. Secondary succession takes place on / in (NEET 2015 cancelled)

- a) newly created pond
- b) newly cooled lava
- c) bare rock
- d) **degraded forest**

17. In an ecosystem the rate of production of organic matter during photosynthesis is termed as (NEET 2015 cancelled)

- a) Secondary productivity

- b) net productivity
- c) Net primary productivity
- d) **gross primary productivity**

18. Natural reservoir of phosphorous is (NEET 2013)

- a) **rock**
- b) fossils
- c) sea water
- d) animal bones

19. Secondary productivity is rate of formation of new organic matter by (NEET 2013)

- a) **consumers**
- b) decomposers
- c) producers
- d) parasites

20. Which one of the following processes during decomposition is correctly described? (NEET 2013)

- a) Catabolism – Last step in the decomposition under fully anaerobic condition
- b) Leaching – Water soluble inorganic nutrient rise to the top layers of soil
- c) **Fragmentation – Carried out by organisms such as earthworms.**
- d) Humification – Leads to the accumulative of a dark coloured substance humus which undergoes microbial action in a very fast rate.

21. Which one of the following is not a functional unit of an ecosystem? (AIPMT 2012)

- a) Energy flow
- b) decomposition
- c) Productivity
- d) **stratification**

22. The upright pyramid of number is absent in (AIPMT 2012)

- a) Pond
- b) **forest**
- c) lake
- d) grassland

23. The rate of formation of new organic matter by rabbit in a grassland is called (Mains 2012)

- a) net productivity
- b) **secondary productivity**
- c) net primary productivity
- d) gross primary productivity



24. The second stage of hydrosere is occupied by plants like (Mains 2012)
- a) *Azolla* b) *Typha*
c) *Salix* d) *Vallisneria*

25. Which one of the following is a characteristic feature of cropland ecosystem? (NEET 2016)
- a) Ecological succession
b) Absence of soil organisms
c) **Least genetic diversity**
d) Absence of weeds

26. Most animals that live in deep oceanic waters are (Re-AIPMT 2015)
- a) **Detritivores**
b) Primary consumers
c) Secondary consumers
d) Tertiary consumers

27. During ecological succession (Re-AIPMT 2015)
- a) The changes lead to a community that is in near equilibrium with the environment and is called pioneer community.
b) **The gradual and predictable change in species composition occurs in a given area.**
c) The establishment of a new biotic community is very fast in its primary phase.
d) The number and types of animals remain constant.

28. The mass of living material at a trophic level at a particular time is called (AIPMT 2015)
- a) **Standing crop**
b) Gross primary productivity
c) Standing state
d) Net primary productivity

29. Match the following and select the **correct** option (AIPMT 2014)

Column I

(I) Earthworm

(II) Succession

(III) Ecosystem service

(IV) Population growth

Column II

(i) pioneer species

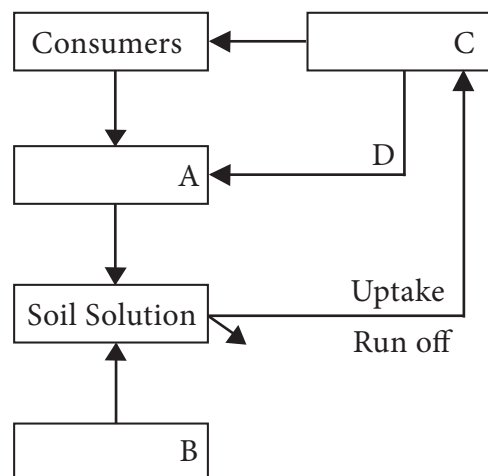
(ii) Detritivore

(iii) Natality

(iv) Pollination

	I	II	III	IV
a)	i	ii	iii	iv
b)	iv	i	iii	ii
c)	iii	ii	iv	i
d)	ii	i	iv	iii

30. Given below is a simplified model of phosphorous cycling in a terrestrial ecosystem with four blanks (A – D). Identify the blanks. (AIPMT 2014)



	A	B	C	D
a)	Rock minerals	Detritus	Litter fall	Producers
b)	Litter fall	Producers	Rock minerals	Detritus
c)	Detritus	Rock minerals	Producers	Litter fall
d)	Producers	Litter fall	Rock minerals	Detritus

31. If 20 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain? (AIPMT 2014)

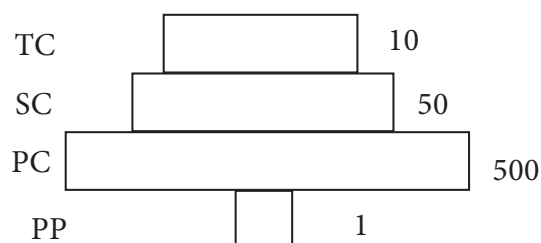
Plant → Mice → Snake → Peacock

- a) **0.02 J** b) 0.002 J
c) 0.2 J d) 0.0002 J

32. Given below is an imaginary pyramid of numbers. What could be one of the possibilities about certain organisms at some of the different levels?

(AIPMT Prelims 2012)





- a) Level one PP is 'pipal trees' and the level SC is 'sheep'.
b) Level PC is 'rats' and level SC is 'cats'
c) **Level PC is 'insects' and level SC is 'small insectivorous birds'**
d) Level PP is 'phytoplanktons' in sea and 'whale' on top level TC
33. Which one of the following statements for pyramid of energy is incorrect, whereas the remaining three are correct? (AIPMT Prelims 2011)
a) It is upright in shape
b) Its base is broad
c) It shows energy content of different trophic level organisms
d) **It is inverted in shape**
34. Which one of the following animals may occupy more than one trophic levels in the same ecosystem at the same time? (AIPMT Mains 2011)
a) Goat b) Frog
c) **Sparrow** d) Lion
35. Both hydrarch and xerarch successions lead to (AIPMT Mains 2011)
a) Highly dry conditions
b) Excessive wet conditions
c) **Medium water conditions**
d) Xeric conditions
36. Of the total incident solar radiation the proportion of PAR is (AIPMT Prelims 2011)
a) More than 80% b) About 70%
c) About 60% d) **Less than 50%**
37. The breakdown of detritus into smaller particles by earthworm is a process called (AIPMT Mains 2011)
a) **Fragmentation**
b) **Net primary productivity**
c) Secondary productivity
d) Standing crop
39. The correct sequence of plants in a hydrosere is (AIPMT Prelims 2009)
a) **Volvox → Hydrilla → Pistia → Scirpus → Lantana → Oak**
b) Pistia → Volvox → Scirpus → Hydrilla → Oak → Lantana
c) Oak → Lantana → Volvox → Hydrilla → Pistia → Scirpus
d) Oak → Lantana → Scirpus → Pistia → Hydrilla → Volvox
40. About 70% of the total global carbon is found in (AIPMT Prelims 2008)
a) Forests b) Grasslands
c) Agro ecosystems d) **Oceans**
41. Consider the following statements concerning food chains
i) Removal of 80% tigers from an area resulted in greatly increased growth of vegetation.
ii) Removal of most of the carnivores resulted in an increased population of deer.
iii) The length of food chains is generally limited to 3 – 4 trophic levels due to energy loss.
iv) The length of food chains may vary from 2 to 8 trophic levels.
Which two of the above statements are correct? (AIPMT Prelims 2008)
a) i and ii b) **ii and iii**
c) iii and iv d) i and iv



42. Which one of the following is not used for construction of ecological pyramids?
(AIPMT Prelims 2006)
- Dry weight
 - Number of individuals
 - Rate of energy flow
 - Fresh weight**
43. The UN Conference of Parties on climate change in the year 2012 was held at (NEET 2015)
- Lima
 - Warsaw
 - Durban
 - Doha.**
44. Which of the following are most suitable indicators of SO_2 pollution in the environment? (NEET 2015)
- Algae
 - Fungi
 - Lichens**
 - Conifers
45. Which of the following is not one of the prime health risks associated with greater UV radiations through the atmosphere due to depletion of stratospheric ozone? (NEET 2015)
- Damage to eyes
 - Increased liver cancer**
 - Increased skin cancer
 - Reduced Immune system
46. A location with luxuriant growth of lichens on the trees indicates that the
(AIPMT 2014)
- trees are very healthy
 - trees are heavily infested
 - location is highly polluted
 - location is not polluted.**
47. The ozone of atmosphere in which the ozone layer is present is called
(AIPMT 2014)
- ionosphere
 - mesosphere
 - stratosphere**
 - troposphere
48. Which one of the following is a wrong statement? (AIPMT 2012)
- Most of the forests have been lost in tropical areas.
 - Ozone in upper part of atmosphere is harmful to animals.**
 - Greenhouse effect is a natural phenomenon.
 - Eutrophication is a natural phenomenon in freshwater bodies.
49. Good ozone is found in the (Mains 2011)
- mesosphere
 - troposphere
 - stratosphere**
 - ionosphere
50. Chipko movement was launched for the protection of
(AIPMT 2009)
- forests**
 - livestock
 - wetlands
 - grasslands
51. Identify the correctly matched pair.
(AIPMT 2005)
- Basal convention - Biodiversity conservation
 - Kyoto protocol - Climatic change**
 - Montreal protocol - Global warming
 - Ramsar convention - Ground water pollution
52. Common indicator organism of water pollution is (AIPMT 2004)
- Lemna paucicostata*
 - Eichhornia crassipes*
 - Escherichia coli***
 - Entamoeba histolytica*
53. Which country has the greatest contribution for the hole formation in ozone layer?
(AIPMT 1996)
- Russia**
 - Japan
 - USA
 - Germany

UNIT X - Economic Botany

- The name of Dr. Norman Borlaug is associated with (JIPMER 2007)
 - Green revolution**
 - Yellow revolution
 - White revolution
 - Blue revolution
- Which of the following is generally used for induced mutagenesis in crop plants (JIPMER 2007)
 - Alpha
 - X-ray
 - UV ray
 - Gamma ray**
- A man-made allopolyploid cereal crop is (OJEE 2010)
 - Hordeum vulgare*
 - Triticale**
 - Raphanus brassica*
 - Zea mays*
- Objective of plant breeding is (MP PMT 2001)
 - better yield
 - better quality
 - disease / stress resistance
 - All of the above**
- Selection is a method of (MP Pmet 2001)
 - cytology
 - plant phycology
 - plant breeding**
 - genetics
- Green revolution in India occurred during (AIPMT 2012)
 - 1960's**
 - 1970's
 - 1980's
 - 1950's
- Jaya and ratna developed for green revolution in India are the varieties of (AIPMT 2011)
 - maize
 - rice**
 - sugarcane
 - wheat.
- First man-made cereal triticales is (HPMT 2008)
 - Octaploid
 - hexaploid**
 - Both a & b
 - diploid
- In plant breeding programmes, the entire collection (of plants / seeds) having all the diverse alleles for all genes in a given crop is called (NEET 2013)
 - cross hybridization among the selected parents
 - evaluation is selection of parents
 - germplasm collection**
 - selection of superior recombinants
- An example for semi dwarf variety of wheat is (HPPMT 2012)
 - IR 8
 - Sonalika**
 - Triticum*
 - Saccharum*
- Himgiri developed by hybridization is selection for disease resistance against rust pathogen is a variety of (AIPMT 2011)
 - Chilli
 - Maize
 - Sugarcane
 - Wheat**
- Breeding of crops with high levels of minerals, vitamins and proteins is called (CBSE AIPMT 2010)
 - somatic hybridization
 - biofortification**
 - bio magnification
 - micro propagation
- The reason for vegetatively reproducing crop plants to suit for maintaining hybrid vigour is that (AIPMT 1998)
 - they are more resistant to disease
 - once a desired hybrid produced, no chances of losing it**
 - they can be easily propagated
 - they have a longer life span.
- Wonder wheat is a new wheat variety developed by (AIIMS 2009)
 - Mexico's International Wheat and Maize improvement centre**
 - Indian National Botanical Research Institute
 - Australian crop Improvement centre
 - African Crop Improvement centre

HIGHER SECONDARY - SECOND YEAR BOTANY PRACTICALS

INTRODUCTION

Laboratory is a place where ideas and concepts can be tested through experiments. Laboratory investigations in biology increase the reasoning abilities, brings scientific attitude in a learner and also helps in acquisition of skills of scientific processes. Hence, a biology student too, is obliged to attend practical in laboratory with utmost sincerity, honesty and inquisitiveness. The practical work includes

- ❖ Study of permanent slides
- ❖ Microscopic preparation of slides
- ❖ Study of preserved and fresh specimens
- ❖ Section, cutting and mounting
- ❖ Analysing the problem and solving it
- ❖ Physiological experiments, etc.

GENERAL INSTRUCTIONS

In order to perform experiments successfully, a learner needs to go to the Biology Laboratory well prepared. This includes the following.

1. Laboratory record book
2. Dissection box
3. Laboratory manual
4. A laboratory coat or apron
5. A hand towel
6. Drawing pencil (HB) and pencil eraser to record various experiments and to draw diagrams
7. Any item more as per the instructions of the teacher



While in the laboratory, a student should be very careful and methodical. One should listen carefully to the instructions given by the teacher / instructor before performing an experiment. Maintain a complete silence and working atmosphere in the laboratory. Record keeping is most important in practical. Diagrams should be correctly drawn and well labelled. Always get the signature of the teacher in the practical note book on each day after the practical class.

However, it is important that every student of Botany / Biology may pay proper attention to the practical work and should try to acquire basic laboratory skills and develop a keen sense of observation and acquire a sound training in the reporting of the work done.

If the material suggested for a particular experiment is not available, a suitable alternate material may be used.

BOTANY PRACTICALS

MODEL QUESTION

I.	Identify the given slide 'A' and give any two reasons. Draw a neat, labelled diagram.
II.	Identify the given fresh / preserved specimen 'B' and give any two reasons.
III.	Identify the given model / photograph / picture 'C' and give any two reasons.
IV.	Analyse the given ecological / genetic problem 'D'. Solve/Construct it by giving appropriate reasons.
V.	Write the aim, procedure, observation and inference of the given experiment 'E'
VI.	Identify the economically important plant / plant product 'F'. Mention its Botanical name, useful part and their uses.

MARKS ALLOTMENT-PRACTICAL EXAMINATION

I.	A	Identification – 1 , Reason (any two) – 1 , Diagram and Labelling – 1	3
II.	B	Identification – 1, Reason (any two) – 1	2
III.	C	Identification – 1, Reason (any two) – 1	2
IV.	D	Identification – 1 , Solve/ Construct– 1, Reason/ Observation and Inference/ Answer – 1	3
V.	E	Aim – 1, Procedure – 1, Table (Observation, Inference) – 1	3
VI.	F	Identification – ½ Botanical name – ½ , Useful part – ½, use – ½.	2

Total 15 marks

Record 3 marks

Skill 2 marks

Maximum marks 20 marks



QUESTION No- I (A) - Preparation and Demonstration of Slides

Note: Teacher has to prepare a temporary slide using fresh specimen for demonstration. (During examination permanent slides can be used if temporary slide preparation is not possible).

Exercise 1 T.S. of Mature anther

Exercise 2 L.S. of an Angiospermic ovule

Exercise 3 T.S. of *Nerium* leaf

QUESTION No- II (B) - Fresh or preserved specimens

Exercise 4 Natural methods of vegetative propagation in plants - Rhizome, Sucker, Epiphyllous buds.

Exercise 5 Adaptations of flowers for pollination by different agents – Wind, Insects.

Exercise 6 Structure of Dicotyledonous seed – Gram (*Cicer*).

Exercise 7 Dispersal of seeds by various agents – Wind, Water, Animal.

Exercise 8 Ecological adaptations of plants - Hydrophytic, Xerophytic, Halophytic and Epiphytic.

QUESTION No- III (C)- Models / Photographs / Charts

Exercise 9 Types of ovules – Anatropous, Orthotropous, Campylotropous

Exercise 10 Picture of a vector (pBR 322)

Exercise 11 Plant tissue culture – Callus with plantlets

Exercise 12 Types of ecological pyramids – Number, Biomass, Energy

QUESTION No- IV (D) - Problems – Genetics and Ecology

Exercise 13 To verify Mendel's Monohybrid cross

Exercise 14 Analysis of seed sample to study Mendelian Dihybrid Ratio

Exercise 15 Flow of energy and Ten percent law

Exercise 16 Determination of population density and percentage frequency of different plant species of given area by Quadrat method

Exercise 17 Chromosomal aberration – Deletion, Duplication, Inversion

Exercise 18 Genetic / Linkage maps

QUESTION No- V (E) - Experiments

Exercise 19 Dissect and display the Pollinia of *Calotropis*

Exercise 20 Study of pollen germination on a slide

Exercise 21 Study of pH of different types of soils

Exercise 22 Water holding capacity of garden soil and road side soil

Exercise 23 Isolation of DNA from plant material

QUESTION No- VI (F) -Economic importance of plants

Exercise 24 Economically important plants and their uses
Wheat, Black pepper, Cotton, Keezhanelli, Green gram, Banana

Exercise 25 Economically important plant products and their uses: Sesame / Gingelly oil, Rubber, Aval (Flaked rice), Rose water, Henna powder, Aloe gel



BOTANY PRACTICALS

I - Preparation and Demonstration of Slides

Note: Teacher has to prepare a temporary slide using fresh specimen for demonstration. (During examination permanent slides can be used if temporary slide preparation is not possible)

Exercise 1: T.S of Anther

Aim: To study and identify the given slide – T.S of Anther

Principle: Androecium is made up of stamens. Each stamen possesses an anther and a filament. Anther bears pollen grains which represent the male gametophyte.

Requirements: Anther of *Datura metel*, glycerine, safranin, slide, cover slip, blade, brush, needle to prepare temporary slides, permanent slide of T.S. of mature anther and compound microscope.



Collect buds and opened flowers of *Datura metel*. Dissect the stamens, separate the anthers and take thin sections and observe the structure under the microscope. Record the various stages of anther from your observation.

Diagnostic Features

- A mature anther is bilobed (dithecous) and the two lobes are joined by a connective.
- Each anther lobe has two pollen chambers in which pollen grains are produced.
- A microsporangium or pollen sac is surrounded by four wall layers. They are epidermis, endothecium, middle layers and tapetum.
- Centre of the microsporangium (pollen sac) is filled with haploid pollen grains.

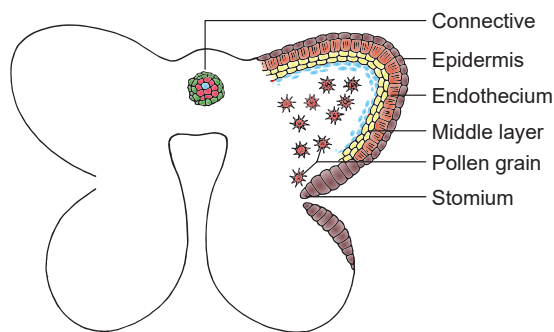


Figure 1: Pollen grain stage of anther

Exercise 2: L.S of an Angiospermic ovule.

Aim: To study and identify the L.S. of an Angiospermic Ovule.

Principle: In female reproductive part of a flower, the basal swollen part is ovary. The ovules are present inside the ovary, later they develop to seed.

Requirement: Permanent slide of L.S. of Ovule, microscope



Diagnostic Features

- Ovule or megasporangium is protected by one / two coverings called integuments.
- The stalk of the ovule is called funicle.
- The point of attachment of funicle to the body of the ovule is known as hilum.
- The body of the ovule is made up of a central mass of parenchymatous tissue called nucellus.
- The integuments form a pore called micropyle and the region opposite to the micropyle is called as chalaza.
- The nucellus has a large, oval, sac like structure towards the micropylar end called embryo sac.
- A mature ovule, has 8 nuclei in its embryo sac.

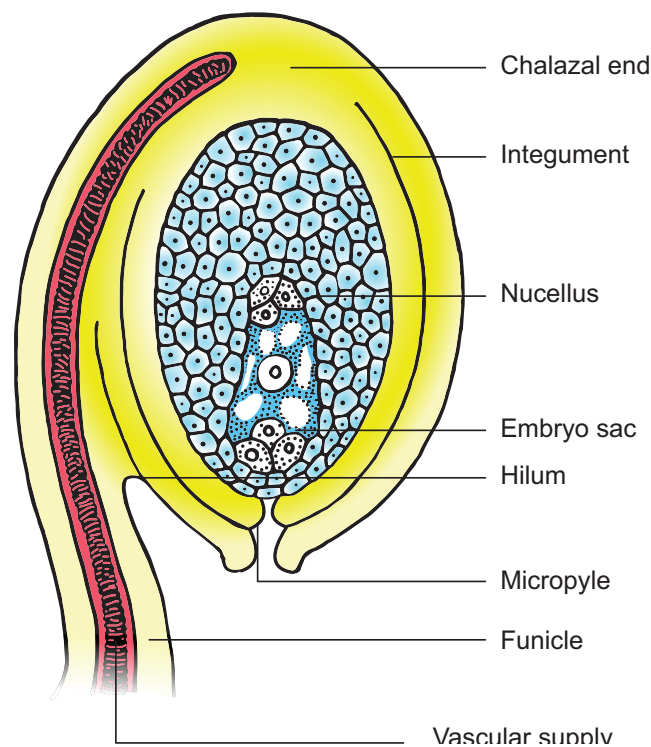


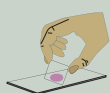
Figure 2: L.S of ovule

Exercise 3: T.S. of *Nerium* Leaf

Aim: To observe and understand the xerophytic adaptations found in *Nerium* leaves for living in dry or xeric habitat.

Principle: The plants which are living in dry or xeric condition are known as Xerophytes.

Requirements: *Nerium* leaf, few pieces of carrot / pith / styrofoam, blade, brush, needle, compound microscope, glycerine, coverslip, wash glass, microslide, saffranin solution, petri dish, etc.



Start cutting transverse sections of *Nerium* leaf placing it in between a piece of carrot. Select the thinnest section of the material with the help of a delicate brush. Take a clean watch glass with water, transfer thin sections of the material. Put a few drops of saffranin stain in the watch glass with water. Leave it for 3-5 minutes. Drain off stain and wash with water if necessary. Put the thinnest section in the centre of the slide. Put a drop of glycerine over the material. Cover it with a coverslip with the help of needle. Observe it under a compound microscope.

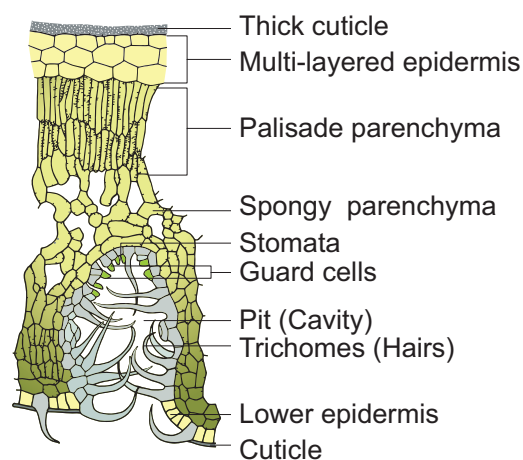


Figure 3: T.S. of *Nerium* leaf



Diagnostic Features

- Presence of multilayered epidermis with thick cuticle.
- Sunken stomata are present only in the lower epidermis.
- Mesophyll is well differentiated into palisade and spongy parenchyma.
- Mechanical tissues are well developed.

II - Fresh or Preserved Specimens

Exercise 4: Natural methods of Vegetative Propagation in Plants

Aim: To study and identify the types of natural methods of vegetative propagation in plants.

Principle: Natural vegetative reproduction is a form of asexual reproduction in which vegetative bud grows and develops into a new plant.

Requirements: Fresh / preserved specimens of *Zingiber*, *Chrysanthemum*, *Bryophyllum*.

Ask the students to visit the nearest vegetable market and classify the vegetable into root, stem or leaf based on their utility and identify how many of them can be propagated through vegetative methods.

4 A. Vegetative Propagation by underground stem – Rhizome

Diagnostic Features

- Ginger is a underground stem which is called as Rhizome.
- Rhizomes are horizontal and swollen due to the storage of food materials.
- The terminal buds turn upwards to produce the aerial flowering shoot and the lateral buds grow out to form new rhizomes.

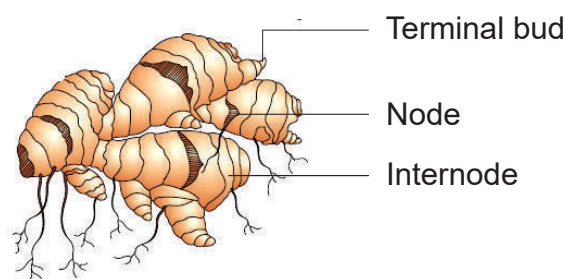


Figure 4a: Rhizome – Ginger

4 B. Vegetative Propagation by sub-aerial stem – Sucker

Diagnostic Features

- The suckers of *Chrysanthemum* are used for propagating plants.
- Suckers grow horizontally under the soil and then emerge out obliquely from the soil and give rise to a new plant or leafy shoot.
- The sucker has nodes and internodes. In the nodal region, it bears axillary buds above and adventitious roots below.

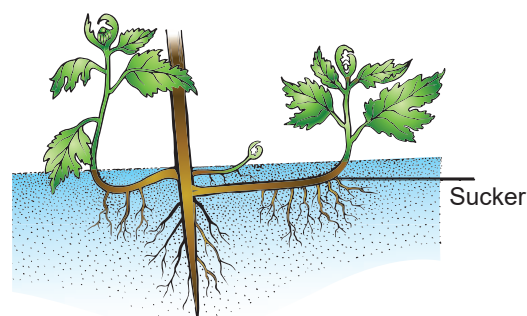


Figure 4b: Sucker - *Chrysanthemum*



4 C. Vegetative Propagation by epiphyllous buds - *Bryophyllum*

Diagnostic Features

- In *Bryophyllum*, adventitious buds arise on the leaf margins. These are called epiphyllous buds.
- When the leaves fall off the epiphyllous buds develop roots into the soil and becomes independent plants.

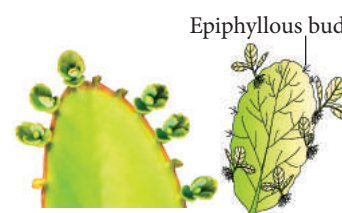


Figure 4a: *Bryophyllum* leaf

Exercise 5: Adaptations of flowers for pollination by different agents.

Aim: To study the adaptations in flowers for pollination by different agents (wind and insects)

Principle: The process of transfer of pollen grains from the anther to stigma of a flower is called **pollination**.

Requirements: Fresh flowers of maize or any other cereal / gram, any insect pollination flowers like *Salvia*, *Calotropis*, *Ocimum* and Asteraceae flowers.

Place the given flower on a slide and observe it with the help of hand lens. Note down the adaptations of the flowers meant for pollination by the external agents.

5 A. Wind Pollinated Flowers - Anemophily

Diagnostic Features

- The flowers are small, inconspicuous, colourless, odourless and nectarless.
- Anthers and stigmas are commonly exerted.
- Pollen grains are light, small, powdery and produced in large numbers.
- The stigmas are large, sometimes feathery and branched adapted to catch the pollens.

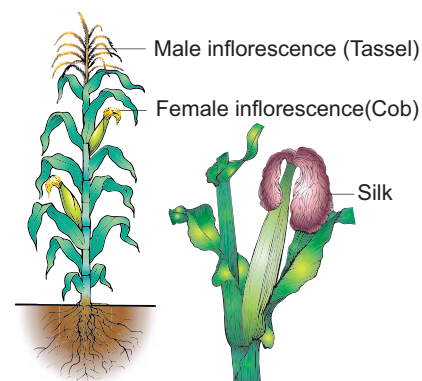


Figure 5a: Maize

5 B. Insect Pollinated Flowers - Entomophily

Diagnostic Features

- The flowers are showy, brightly coloured and scented.
- The flowers produce nectar or edible pollen.
- Anthers and stigmas are commonly inserted.
- Stigmas are usually unbranched and flat or lobed.

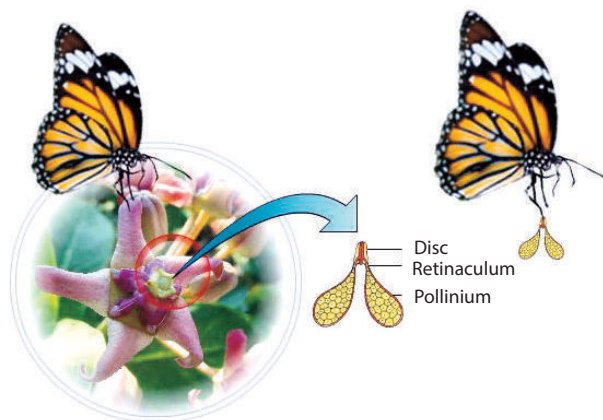


Figure 5b: *Calotropis*

Exercise 6: Dicot seed

Aim: To study and identify the Dicot seed

Principle: The fertilized ovule is called seed and possesses an embryo, endosperm and a protective coat. Seeds may be endospermous or non endospermous.

Requirements: Chick pea, bowl, water

Soak the seeds of chick pea or gram in water for 2 – 3 hours. Drain the water and place the seeds in a moist cotton cloth for 2 – 3 days. Observe for germination. Select some sprouted seeds, observe under a dissection microscope and record the parts.

Diagnostic Features

- Seeds of gram have two cotyledons and an embryonal axis.
- Each seed is covered by two seed coats (a) Testa – outer coat and (b) Tegmen – inner coat.
- The embryonal axis consists of radicle and plumule.
- The portion of the embryonal axis above the level of cotyledons is called epicotyl. It terminates into the plumule.
- The portion of the embryonal axis below the level of cotyledons is called hypocotyl. It terminates into the radicle or root tip.

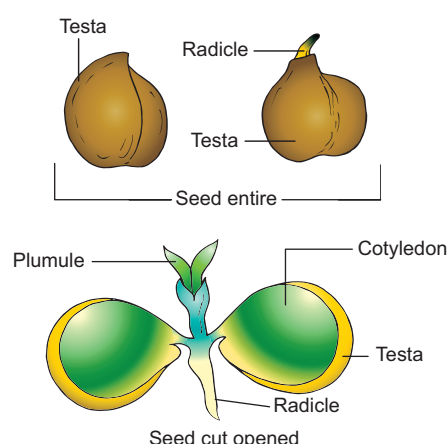


Figure 6: Dicot seed – Gram (*Cicer*)

Exercise 7: Dispersal of seeds by various agents

Aim: To study and understand the agents that help in the dispersal of fruits and seeds.

Principle: The dissemination of seeds and fruits to various distances from the parent plant is called seed and fruit dispersal. It takes place with the help of ecological factors such as wind, water and animals.

Requirements: Fruits of *Tridax*, Coconut and *Achyranthes*, knife, forceps, petridish, hand-lens etc.

7 A. Dispersal by wind – Anemochory (Example: *Tridax*)

Diagnostic Features

- Fruits are light so that wind may carry them away.
- Fruits are minute, very small and with inflated covering.
- Fruits have feathery appendages (pappus) which greatly increase their buoyancy to disperse in high altitudes.

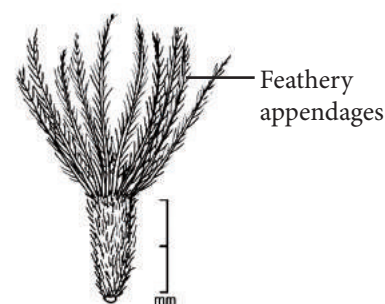


Figure 7a: Fruit of *Tridax*

7 B. Dispersal by water – Hydrochory (Example: Coconut)

Diagnostic Features

- Fruits have outer coats that are modified to enable them to float.
- The mesocarp of coconut is fibrous, which is easily carried away by water currents.



Figure 7b: Coconut

7 C. Dispersal by animals –Zoochory (Example: *Achyranthes*)

Diagnostic Features

- Fruits are provided with hooks, spines, bristles, stiff hairs, etc. on their outer coat.
- The sharp pointed fruits of *Achyranthes* stick to the hairs of the animals and clothes and get carried away from one place to another.



Figure 7c: *Achyranthes*

Exercise 8: Ecological adaptations of plants found in hydrophytic, xerophytic, halophytic and epiphytic conditions.

Aim: To study plants found in different habitats and comment upon their adaptations.

Principle: The modifications in the structure of organisms to survive successfully in an environment are called adaptations of organisms. Observe different plants existing under various ecological habitats. The corresponding adaptations of plants and their interaction with the environment can be better understood.

Requirements: Fresh or preserved specimens of *Eichhornia*, *Opuntia*, *Avicennia* and *Vanda*.

8 A. Adaptations of Hydrophytes - *Eichhornia* (Water hyacinth)

Eichhornia is a free floating hydrophyte that grows in ponds, lakes and water bodies containing fresh water.

Diagnostic Features

- Root system is poorly developed.
- Root pockets are present.
- The petioles become swollen and spongy, providing buoyancy.
- Cortex is well developed with numerous air chambers. It helps in buoyancy and rapid gaseous exchange.
- Mechanical tissues are generally absent.

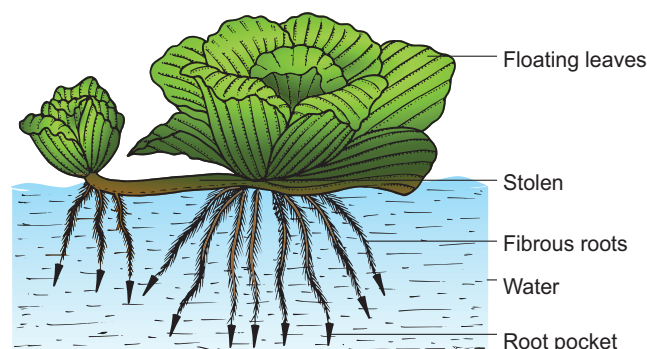


Figure 8a: Free floating hydrophyte – *Eichhornia*



8 B. Adaptations of Xerophytes - *Opuntia*

Opuntia is a succulent or drought resisting xerophyte, which grows wild in arid areas.

Diagnostic Features

- The stem is flattened, green, thick and fleshy called phylloclade
- Mucilage is present which helps to retain the water.
- Leaves are modified into spines

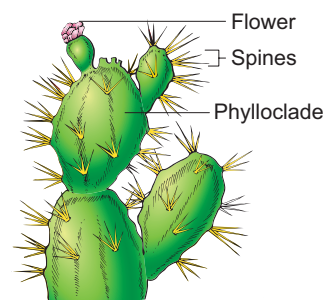


Figure 8a: Succulent xerophyte - *Opuntia*

8 C. Adaptation of Halophytes – Pneumatophores of *Avicennia*

Avicennia is a plant which grows and survives in saline environment like salty lakes and sea shores (mangrove vegetation).

Diagnostic Features

- A special kind of negatively geotropic root called pneumatophores (respiratory roots) are present.
- The leaves excrete salts through the salt glands.

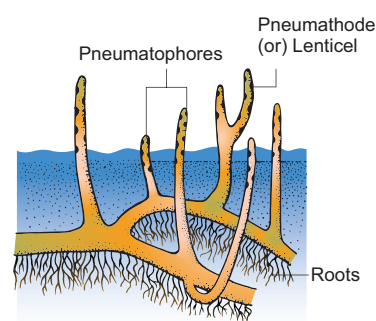


Figure 8c: Pneumatophores of *Avicennia*

8 D. Adaptation of Epiphytes – *Vanda*

Vanda is an epiphytic plant that grows perched on other plants (supporting plants). They use supporting plants only as shelter and not for water or food supply.

Diagnostic Features

- Root system is extensively developed. These roots are of two types (1) clinging roots and (2) aerial roots.
- The clinging roots fix epiphytes firmly on the surface of the supporting plant.
- Aerial roots are green coloured, hang downwardly and absorb moisture from the atmosphere with the help of spongy tissue called velamen.

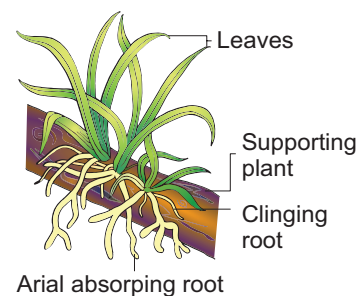


Figure 8d: Epiphytic roots of *Vanda*

III - Models / Photographs / Pictures

Exercise 9: Types of ovules

Aim: To recognize different types of ovules in flowering plants

Principle: To identify ovules based on the orientation, form and position of the micropyle with respect to funicle and chalaza

Requirements: Models / Photographs/ Pictures of different types of ovules.



9 A. Anatropous Ovule

Diagnostic Features

- The body of the ovule becomes completely inverted so that micropyle lies close to the funicle.
- Micropyle and chalaza lie on the same straight line. Example: Asteraceae.

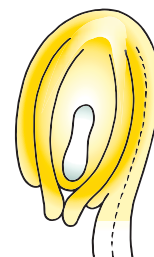


Figure 8a: Anatropous ovule

9 B. Orthotropous Ovule

Diagnostic Features

- In this type of ovule, the micropyle is at the distal end.
- The ovule is erect or straight so that the funicle, chalaza and micropyle lie on the same vertical line. Example: Piperaceae and Polygonaceae.



Figure 8b: Orthotropous ovule

9 C. Campylotropous Ovule

Diagnostic Features

- In this type, the body of the ovule at the micropylar end is curved and more or less bean shaped.
- The embryo sac is slightly curved.
- The funicle, micropyle and chalaza are adjacent to one another with the micropyle oriented towards the placenta. Example: Leguminosae.



Figure 8c: Campylotropous ovule

Exercise 10: E.coli cloning vector (pBR 322)

Aim: To study and identify the features of cloning vector – pBR 322

Principle: Vectors are used as carriers to deliver the desired foreign DNA into a host cell.

Requirements: Models/ Photographs / Pictures of E.coli Cloning vector pBR 322.

Diagnostic Features

- pBR 322 plasmid is a reconstructed plasmid containing 4361 base pairs and most widely used as cloning vector.
- In pBR, p denotes plasmid and B and R respectively the notes of scientists Boliver and Rodriguez who developed the plasmid. The number 322 is the number of plasmids developed from their laboratory.
- It contains two different antibiotic resistance genes and recognition site for several restriction enzymes (Hind III, Eco R I, Bam H I, Sal I, Pvu II, Pst I, Cla I), Ori and antibiotic resistance genes (amp^R and tet^R). Rop codes for the proteins involved in the replication of the plasmid.

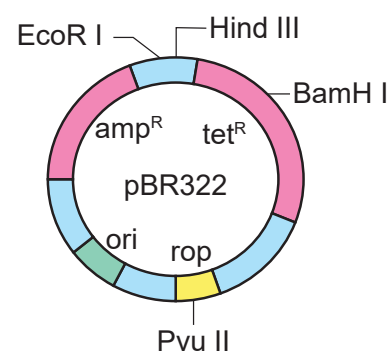


Figure 10: E-coli cloning vector (pBR 322)

Exercise 11: Plant tissue culture – Callus with plantlets

Aim: To study and identify the Callus with plantlets.

Principle: Growing the plant cells, tissues and organs in an artificial, synthetic medium under controlled conditions is called plant tissue culture. The technique of cloning plant is easier than animals because plant cells are simple in structure and most plant cells shows totipotency (i.e) ability to regenerate from cells.

Requirements: Model / Photograph / Picture of callus with plantlets.

Diagnostic Features

- The callus is an unorganized mass of undifferentiated tissue.
- The mechanism of callus formation is that auxin induce cell elongation and cytokinin induces cell division as a result of which masses of cells are formed.
- Roots and shoots are differentiated from the callus.

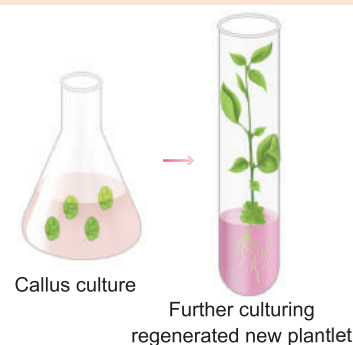


Figure 11: Callus with plantlets

Exercise 12: Types of ecological pyramid

Aim: To study and identify the different types of ecological pyramids

Principle: The relationship between different trophic levels in an ecosystem when shown diagrammatically appear as 'ecological pyramids'. In these ecological pyramids, the successive tiers represent successive trophic levels towards the apex. The base of the pyramid is of producers, the next one above it is of herbivores and the top tiers are of carnivores. The top most or apex represents the tertiary or top level consumers.

Requirements: Models / Photographs / Pictures of different types of ecological pyramid.

12 A. Pyramid of numbers

Diagnostic Features

- The number of organism that are present in successive trophic levels of an ecosystem is shown in the pyramid of numbers of a grassland ecosystem.
- There is a gradual decrease in the number of organisms in each trophic level from producers to primary consumers, then to secondary consumer, and finally to tertiary consumers.
- Therefore, pyramid of number in grassland ecosystem is always upright.

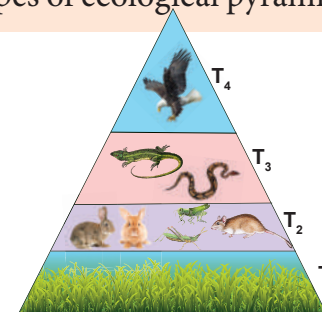


Figure 12 a: Pyramid of numbers in grassland ecosystem

T₁ - Producers | T₂ - Herbivores | T₃ - Secondary consumers | T₄ - Tertiary consumers

12 B. Pyramid of biomass

Diagnostic Features

- Pyramid of biomass represents the total biomass or standing crop (dry weight) of organisms in each trophic level at a particular time.
- In aquatic ecosystem, the bottom of the pyramid is occupied by the producers, which comprises very small organisms (algae and phytoplanktons) possessing the least biomass and so the value gradually increases towards the tip of the pyramid.
- Therefore, here the pyramid of biomass is always inverted in shape.

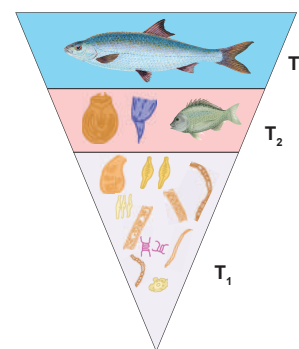


Figure 12 b: Pyramid of biomass in aquatic ecosystem

T₁ - Producers | T₂ - Herbivores | T₃ - Secondary consumers |

12 C. Pyramid of energy

Diagnostic Features

- Pyramid of energy represents the number of joules transferred from one trophic level to next.
- The bottom of the pyramid of energy is occupied by the producers. There is a gradual decrease in energy transfer at successive trophic levels from producers to the upper levels.
- Therefore pyramid of energy is always upright.

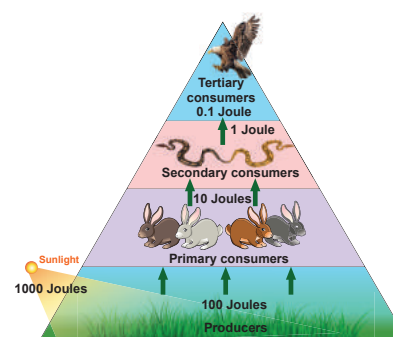


Figure 12 c: Pyramid of Energy

IV - Solving the Problems

Exercise 13: To verify Mendel's Monohybrid cross

NOTE: Student have to work in pairs to perform this experiment and record the data in the observation and record note book with the help of the teacher.

Need not consider this Monohybrid cross experiment for Board Practical Examination.

Aim:

To verify Mendel's Monohybrid cross.

Principle:

When two pure lines with contrasting traits of a particular character (phenotype) are crossed to produce the next generation (F₁ generation), all the members of the progeny are of only one phenotype, i.e. of one of the two parents. The phenotype that appears is called dominant and the one that does not appear is called recessive. When the F₁ plants are selfed, the progeny i.e. the F₂ generation, is in the ratio of 3 dominant : 1 recessive ($\frac{3}{4}$: $\frac{1}{4}$ of 75% : 25%). This reappearance of the recessive phenotype in F₂ generation, verifies Mendel's Monohybrid cross.

Requirements:

64 yellow and 64 green plastic beads, all of exactly same shape and size (when beads are not available, pea seeds may be painted and used). Plastic beakers, petri dish and a napkin / hand towel.

Procedure

Make the student to work in pairs to perform the experiment. Follow the steps in given sequence.

1. Put 64 yellow beads in one beaker and 64 green beads in the other to represent male and female gametes respectively. Let the yellow bead be indicated by 'Y' and the green bead by 'y'
2. Take a bead from each container and place them together (it represents fertilization) on the hand towel spread before you on the table.
3. Just like the previous step, continue to pick beads and arrange them in pairs. Thus 64 pairs of beads are obtained representing the 64 heterozygous F_1 progeny.
4. Put 32 F_1 progeny in one petridish and the remaining 32 in another petridish (representing the F_1 males and females).
5. To obtain the F_2 generation, the student should withdraw one bead from one beaker labelled male and one from the other beaker labelled female keeping his / her eyes closed (to ensure randomness) and put them together on the hand towel spread over the table. Continue this process till all the beads are paired. Thus 64 offsprings of F_2 progeny are obtained.
6. Note the genotype (YY or Yy or yy) of each pair and their possible phenotype.
7. Pool all the data and calculate the genotypic and phenotypic ratios.

Observation:

Record the result in the following table:

Generation	Total Number of individuals	Genotypes			Phenotype(s)
		YY	Yy	yy	
F_1					
	Total				
F_2					
	Total				

Phenotypic ratio : in F_1 _____

in F_2 _____

Genotypic ratio : in F_1 _____

in F_2 _____

Inference:

The results are so because when the F_1 individuals are crossed together to raise the F_2 generation, each F_1 individual produces two types of gametes: 50% having dominant allele and the remaining 50% having recessive allele. These gametes undergo random fusion during fertilization to produce the F_2 generation. According to simple probability of mixing of opposite sex gametes, offsprings of three genotypes are likely to appear as follows:

Among these, proportion of dominant phenotype would be $YY + Yy =$ yellow and recessive phenotype $yy =$ green, which occur in 3 : 1 or 75% : 25% ratio.

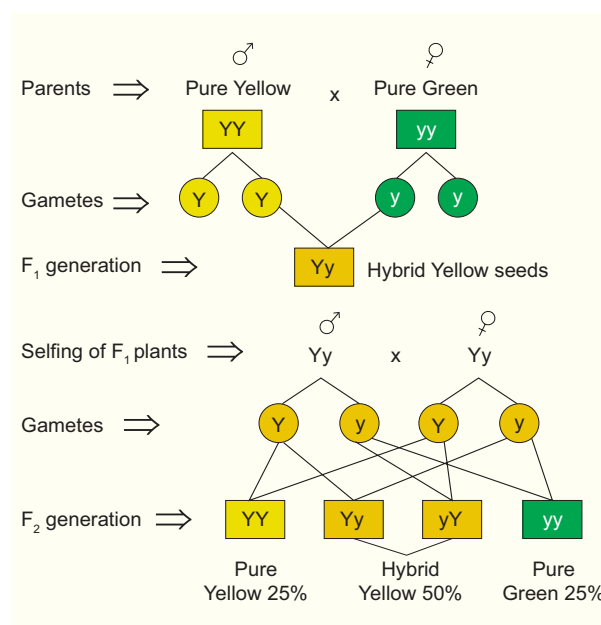


Figure 13 : Monohybrid cross

This ratio of 3 :1 in the F_2 suggests that the hybrids or heterozygotes of F_1 generation have two contrasting factors or alleles of dominant and recessive type. These factors, though remain together for a long time, do not contaminate or mix with each other. They separate or segregate at the time of gamete formation so that a gamete carries only one factor, either dominant or recessive.

Precautions:

1. Take a sufficiently large number of seeds for analysis to minimise the error.
2. Observe the contrasting form of trait carefully.

Exercise 14: Analysis of seed sample to study Mendelian dihybrid ratio

Aim:

To analyse seed sample of pea for Mendelian dihybrid ratio of 9 : 3 : 3 : 1.

Principle:

In a dihybrid cross, the segregation of one gene pair is independent of the segregation of the other pair. It means that when the factors (genes) for different characters inherited from parents do not remain linked in the offsprings, but their distribution in the gametes and in the progeny of subsequent generations is independent of each other.

Requirement:

Plastic beakers, Pea seed samples or plastic beads, tray, petri dishes, notebook, pencil / pen.

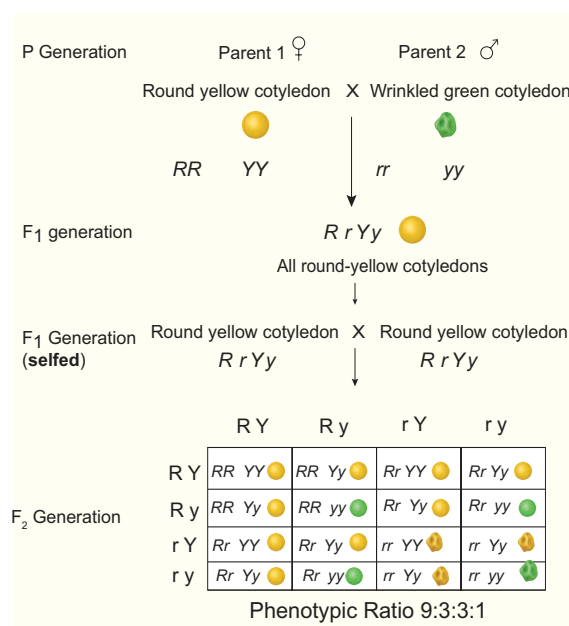


Figure 14 : Dihybrid cross

Teachers should select the Pea seed or plastic beads which represents the four types of traits such as yellow round, yellow wrinkled, green round and green wrinkled in the ratio of 9:3:3:1

Procedure:

1. Take a lot of about 160 Pea seeds or plastic beads in a tray.
2. Separate out yellow round, yellow wrinkled, green round and green wrinkled and put them in separate petridishes.
3. Note down the number of seeds in each plate and find out their approximate ratio.

Observation:

Present your finding in the form of a table.

Total Number of seeds observed	No. of yellow round seeds	No. of yellow wrinkled seeds	No. of green round seeds	No. of green wrinkled seeds	Approximate ratio
160	90	30	30	10	9 : 3:3:1

Inference:

The ratio of yellow round : yellow wrinkled : Green round : green wrinkled is approximately 9 : 3 : 3 : 1 which is exactly the same as obtained by Mendel for a dihybrid cross. This indicates that the contrasting genes for seed colour and seed shape show an independent assortment in the population of pea seeds.

Exercise 15: Flow of energy and Ten percent law

Aim:

To understand the unidirectional flow of energy in an ecosystem and transfer of energy follows the 10% law.

Principle:

The student studies about flow of energy and that only about 10% of energy is made available to the next trophic level. Large amount of energy about 90% is lost at each trophic level in a food chain.

Requirements:

Problems to be given to students based on different examples with alternating food chain and amount of energy.

The teacher must train the student by giving them various kinds of food chain with different values.

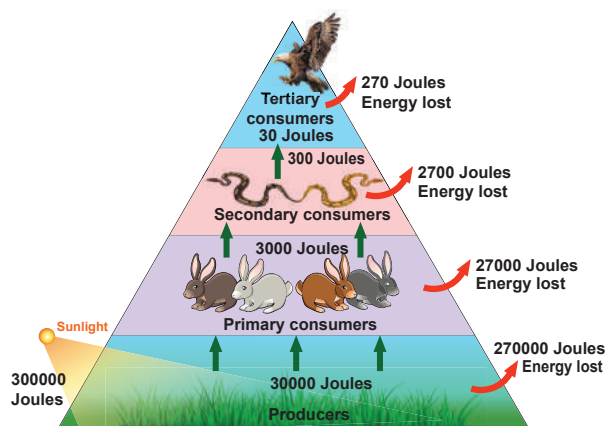
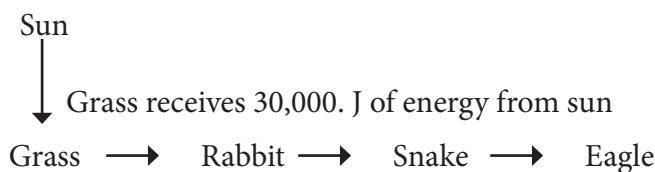


Figure 15: Ten percent law

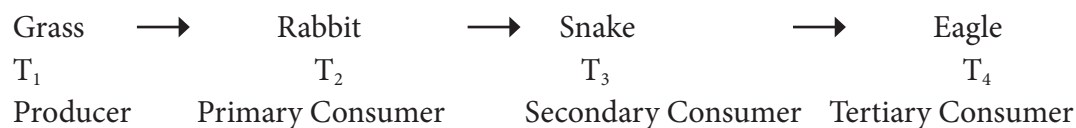
Problem

Analyse the food chain given below and find out the amount of energy received by the organism in third trophic level.



Given: The amount of energy in the producers, i.e. grass = 30,000 J.

Solution:



T₁ – Grass (Producer) = 30,000 J of energy

T₂ – Rabbit (Primary Consumer) = ?

T₃ – Snake (Secondary Consumer) = ?

According to the ten percent law, during the transfer of energy, only about 10% of the energy flows from each trophic level to the next lower trophic level. So 10% of energy from T₁ gets transferred to T₂

So T₂ – Rabbit (primary consumer) receives $30000 \times \frac{10}{100} = 3000 \text{ J}$

Similarly, 10% of energy from T₂ gets transferred to T₃

So T₃ – Snake (Secondary consumer) receives $3000 \times \frac{10}{100} = 300 \text{ J}$

Answer:

1. The third trophic level T₃ – (Snake) receives 300 J of energy.



Exercise 16: Determination of Population density and Percentage frequency by Quadrat method.

NOTE: Teachers can take the students to open space and teach them how to construct plot/quadrats and to record the number of individuals of each plant species occurring in the quadrat. The percentage frequency should be calculated and entered in the practical observation and record note book. Examiner need not consider this experiment for Board Practical Examinations.

Aim:

To study population density and percentage frequency of different plant species of a given area by quadrat method.

Principle:

The number of individuals in a population never remains constant. It may increase or decrease due to many factors like birth rate, death rate, migration, etc. The number of individuals of a species presents per unit area or space of a given time is called population density. The population density and percentage frequency of different plant species can be determined by laying quadrats / segments of suitable size and recording of the number of individuals of each species occurring in the quadrat.

Requirements:

Metre scale, string or cord, hammer, nails, paper, pencil, etc.

Procedure:

1. In the selected site of study, hammer the nails firmly in the soil without damaging the vegetation.
2. Fix four nails to make a square plot.
3. Tie each end of the nails using a thread, to make 1 m X 1 m plot.
4. If the number of plants in the plot is large, the plot can be divided into quadrats.
5. Count the number of individuals of a species "A" present in the first quadrat and record the data in the table.
6. Similarly count the individuals of the species "A" in other quadrats respectively and record the data in the table.
7. Count the number of individuals of a species "B" present in the all quadrats and record the data in the table.
8. Repeat the same procedure for other species and record the data in the table.

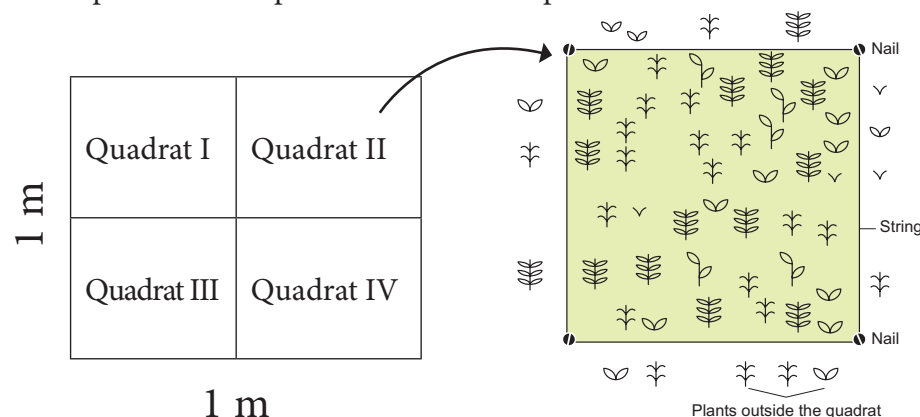


Figure: A plot

Figure 16: Occurance of plant species in a quadrat



$$\text{Population Density} = \frac{\text{Total number of individuals in all the quadrats studied}}{\text{Total number of quadrats studied}}$$

$$\text{Percentage frequency} = \frac{\text{Total number of quadrats in which species occurred}}{\text{Total number of quadrats studied}} \times 100$$

Observation and Inference:

Different plant species, their population density and percentage frequency occurring in a given area.

S. No.	Plant species	No. of individuals per quadrat				Total number of individuals in all the quadrats studied (N)	Total number of quadrats in which each species occurred (A)	Total Number of quadrats studied (B)	Population Density (N/B)	Frequency percentage (A/B) x 100
		I	II	III	IV					
1										
2										
3										
4										
5										

Precautions:

1. The measurement of quadrat should be accurate.
2. The string or cord used should not be very thick.

Exercise 17: Chromosomal aberrations – Deletion, Duplication and Inversion

Problem:

Given below is the representation of a kind of chromosomal aberration such as deletion, duplication and inversion. Identify and give reasons for identification. Also mentions its significance.

Aim:

To understand the abnormality in the chromosomal structure in an organism.

Principle:

To study about the chromosomal aberration which can occur due to ionizing radiations or chemicals. On the basis of breaks and reunions in the chromosomal segment different types of aberrations can be recognized.

Requirements:

Copper wire, Alphabets marked (A to H) yellow colour beads denotes gene, and red colour bead without alphabet denote centromere. Using this materials make different kinds of chromosomal segments with specific gene sequence, that can be given to the students and asked to analyse the aberration involved in it.

Procedure:

1. Make a normal chromosome model using copper wire and yellow beads and place it on the table. In the model chromosome with gene sequence A to H, along with centromere (red bead).
2. For Deletion - Give yellow colour beads without one or more marked alphabets A to H (The lack





of any one or more beads denotes deletion type of chromosomal aberration).

3. For Duplication – Give yellow colour beads with addition of one or more marked alphabets A to H (The repetition of one or more beads denotes duplication type of chromosomal aberration).
4. For Inversion – Give yellow colour beads which marked alphabets from A to H as in normal chromosome. (There is no addition or deletion of beads (A to H) given, so the students can construct the inverted segment of the chromosome using the given beads).

Based on the type of beads given the student has to identify and construct the relevant chromosomal aberration.

17 A. Chromosomal Aberration – Deletion

Reasons:

1. The deletion of the chromosomal segment A and D. (Refer figure 17a)
2. When there is a loss of a segment of the genetic material in a chromosome it is called deletion.

Significance:

Most of the deletions lead to death of an organism.

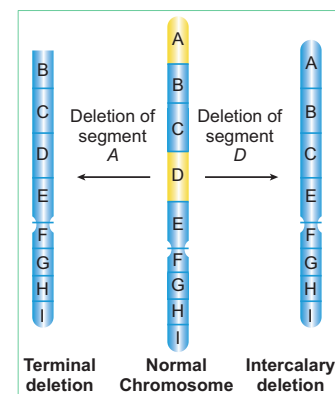


Figure 17 a: Deletion

17 B. Chromosomal Aberration - Duplication

Reasons:

1. When a segment of a chromosome is present more than once in a chromosome, then it is called duplication (Tandem duplication)
2. The order of the genes in a chromosome is A, B, C, D, E, F, G, H and I. Due to aberration, the genes B and C are duplicated and the sequence of genes becomes A, B, C, B, C, D, E, F, G, H and I. (Refer figure 17b)

Significance:

Some duplications are useful in the evolution of the organism.

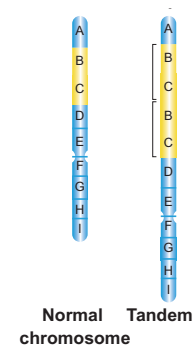


Figure 17 b: Duplication

17 C. Chromosomal Aberration - Inversion

Problem:

Given below is the representation of a kind of chromosomal aberration. Identify it giving reasons for your identification. Also mentions its significance.

Identification:

The given genetic problem is identified as inversion type of chromosomal aberration.

Reasons:

1. When the order of genes in a chromosomal segment is reversed due to rotation by an angle of 180° , it is called inversion.
2. The order of genes in a chromosome is A, B, C, D, E, F, G, H and I. Due to aberration, the sequence of genes become A, D, C, B, E, F, G, H and I (Refer figure 17c)

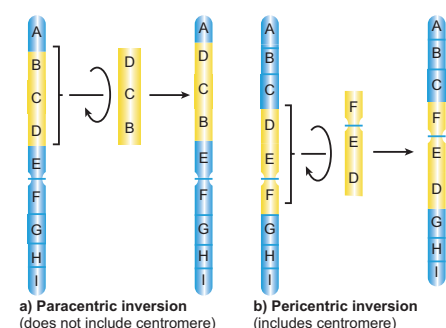


Figure 17 c: Inversion



Significance:

Sometimes inversion is responsible for evolution of the organism.

NOTE: Likewise the teacher can give different types of chromosomal aberrations with various gene sequence to students for practise. The external examiner can also use the same technique by giving different gene sequence.

Exercise 18: Genetic / linkage maps

Aim:

To understand the frequency of recombination between the gene pairs on the same chromosome.

Principle:

To analyse the relative distance between the various genes and map their position in the chromosome, which is called genetic or linkage maps.

Requirements:

Different kinds of linkage / genetic maps can be constructed by giving the students the relative distance between the linked genes of a chromosome. A diagrammatic representation can be drawn showing the location and arrangement of genes and their relative distance between them.

Solve the Problem

Problem: There are three linked genes A, B and C in a chromosome. Percentage of crossing over (recombination frequency) between A and B is 20, B and C is 28 and A and C is 8. What is the sequence of genes on the linkage map?

Given: Percentage of crossing over between the 3 linked genes A – B = 20%, B – C = 28% and A – C = 8%.

Solution

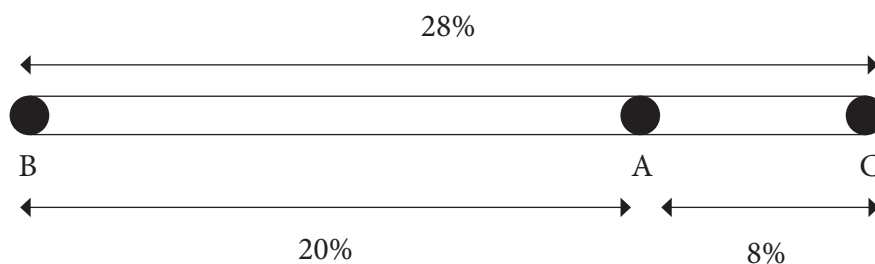


Figure 18: Linkage Map

Reasons:

1. The frequency of crossing over is directly proportional to the relative distance of the genes on the chromosomes.
2. More crossing over = More distance between two genes and
Less crossing over = Less distance between the two genes.

In the above problem, the sequence of the genes on the linkage map is B, A, C



NOTE: Teachers can give different crossing over percentage between its linked genes in a chromosome and make the students construct the linkage maps. The external examiner can also do the same for the Board Practical Examinations.

IV - Experiments

Exercise 19: To dissect and display the pollinia of *Calotropis*

Aim:

To dissect and observe the structure of pollinia and understand the mechanism of pollination in *Calotropis* flowers. (Translator Mechanism)

Principle:

In *Calotropis* the pollen in each anther lobe of a stamen unites into a mass, forming a pollinium.

Requirements:

Flowers of *Calotropis*, dissection needle, dissection microscope, slide, blade, glycerine, coverslip, scissors.

Procedure:

Take a mature flower of *Calotropis*. Observe the parts of the flower and remove the calyx and corolla with the help of scissors. Identify the pentangular stigmatic disc. Insert the needle at the angles of the stigma where the pollinia are adhered. Dissect it and place the pollinia on a clean slide. Mount it in glycerine and place a coverslip on it. Observe the pollinia under the dissection microscope and record your observation.

Observation:

The stamens of *Calotropis* produce pollinium. Two pollinia are found attached to a glandular adhesive disc called corpusculum by a thread like structure called retinaculum. The whole structure looks like inverted letter 'Y' and is called translator. The sticky disc gets attached with the legs of pollinator (bees or butterflies) and is carried to the stigma of another flower, thus ensuring pollination.

Inference:

The structure of pollinia of *Calotropis* is well suited to achieve pollination.

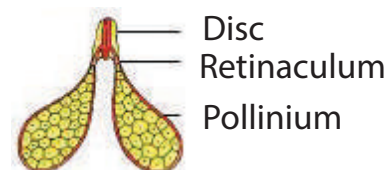


Figure 19: Pollinia of *Calotropis*

Exercise 20: Study of Pollen germination on a slide

NOTE: Pollen germination can be studied by dusting some pollens from common flowers like *Crotalaria*, *Hibiscus*, *Pisum*, etc. on a glass slide containing a drop of 10% sugar solution or tender coconut water or any nutrient medium.

Observe the slide after about 10 – 15 minutes under the low power of compound microscope. You will be able to observe the pollen tubes coming out of the pollen grains.

Aim:

To study the pollen germination on a slide.





Requirements:

Fresh seasonal flowers, cavity slide, cover slip, compound microscope, sucrose, boric acid, distilled water, beakers, etc.

Procedure:

1. Prepare a nutrient solution by dissolving 1 gm. of sucrose / 1 gm. of boric acid in 100 ml. of distilled water.
2. Take a clean cavity slide and put a few drops of nutrient solution in the cavity of the slide.
3. Dust a few pollen grains from the stamen of a mature flower on it.
4. View the slide in the microscope after 5 minutes and then observe it regularly for about half an hour.

Observation:

In nutrient medium, the pollen grains germinate. The tube cell enlarges and comes out of the pollen grain through one of the germ pores to form a pollen tube. The tube nucleus descends to the tip of the pollen tube. The generative cell also passes into it. It soon divides into two male gametes.

Inference: Different stages of germinating pollens are observed. Some pollens are in their initial stage of germination while others have quite long pollen tube containing tube nucleus and two male gametes.

Precautions:

1. Flowers should be freshly plucked.
2. Use clean cavity slide to observe the pollen grains.
3. The slides should not be disturbed, otherwise position of pollen grains will get changed.

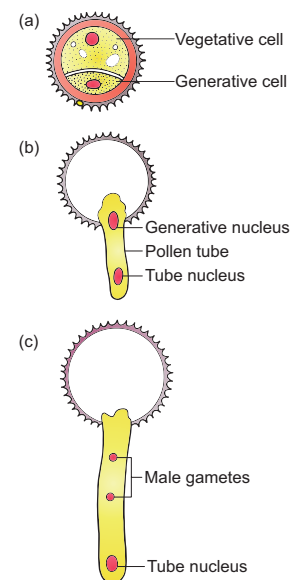


Figure 20: Pollen germination

Exercise 21: Study of pH of different types of soil

Some nutrients become toxic in higher concentration. Therefore pH of the soil is an important chemical property of the soil. Plants thrive well in neutral or slightly acidic soils. The pH of the soil determines the types of soil organisms and also controls the solubility of different nutrients. The pH of soil ranges from 0 - 14.

- a. pH level 7 - Neutral soil
- b. pH level below 7 - Acidic soil
- c. pH level above 7 - Alkaline soil
- d. Optimum pH for plant growth ranges from 5.5 to 7.

Most plants thrive best in neutral pH. Slight acidity favours tree growth and forms forests. Slight alkalinity is favourable for grasses and legume crops.

Aim:

To study pH of different types of soil.

Requirements:

Soil samples (from two different sites such as crop soil, garden soil, roadside soil, pond soil, river bank soil), test tubes, funnel, filter papers, pH papers of different range, distilled water, beaker.

Procedure:

Dissolve one tablespoon or 1 gram of soil from each soil sample in 100 ml of distilled water in separate beakers. Stir the solutions well and keep aside for half an hour to settle down the suspended particles. Filter off each solution separately in different test tubes. Dip a small piece of broad range pH paper on each of the solution. Match the colour of the pH paper with the colour scale given on the pH paper booklet. This gives an approximate pH.

Observation:

Record the pH of different soil samples in the observation table.

S. No.	Soil sample	pH Value
1		
2		
3		

Inference:

Thus the pH value of different soil samples required for plant growth can be determined.

Precautions:

1. Wash the glassware thoroughly and get it dried before the experiment.
2. Dry the pH papers before comparing the colour with the colour scale.
3. Match the colour carefully and determine pH accurately.



Figure 21: Study of pH of different types of soil

Exercise 22: Water holding capacity of garden soil and roadside soil

The maximum amount of water retained by soil per unit of its dry weight after the gravitational flow has ceased is called water holding capacity or field capacity of the soil. The water holding capacity varies in different type of soils and depends upon the types of soil particles and porosity of the soil. Sandy soils have poor water holding capacity then the loam and clay soils.

Aim:

To study the water holding capacity of garden soil and roadside soil.

Requirements:

Garden soil, roadside soil, measuring cylinders, funnels, filter papers, beakers, balance, etc.

Procedure:

Take two funnels and line them with filter paper. Label them A and B. Place them on measuring cylinders. Take 100 gm dried sample each of the garden soil and roadside soil. Put the garden soil in funnel A and roadside soil in funnel B. Pour 100 ml of water in each funnel. Record the volume of filtered out water in the measuring cylinder when the dripping of water stops from the funnel.

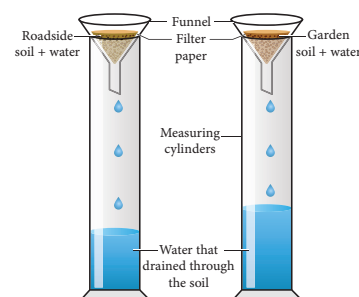


Figure 22: Water holding capacity of soil



Observation:

Record the observation in the table as follows:

S. No.	Soil types	Weight of soil (X)	Volume of water poured (Y)	Volume of water collected in measuring cylinder (Z)	Volume of water retained by the soil (Y - Z)	Water holding capacity of the soil in percentage $(Y - Z) / X \times 100$
1	Garden soil					
2	Roadside soil					

Inference:

Garden soil has a high water holding capacity than the roadside soil, because roadside soil has larger quantities of sand and silt.

Precautions:

1. Weighing of soil samples should be done accurately.
2. Pour water slowly and gently on the soil in the funnel
3. Record the volume of collected water in the measuring cylinders carefully.

Exercise 23: Isolation of DNA from plant materials

DNA is one of the nucleic acids found in living systems. DNA acts as the genetic material in most of the organisms.

Principle: Recombinant DNA technology has allowed breeders to introduce foreign DNA in other organisms including bacteria, yeast, plants and animals. Such organisms are called Genetically Modified Organisms (GMOs). Thus rDNA technology involves isolation of DNA from a variety of sources and formation of new combination of DNA.

Aim: To isolate DNA from available plant materials such as spinach leaves, fresh green pea seeds, green papaya, etc.

Requirements: Plant materials, mortar and pestle, beakers, test tubes, ethanol, etc.

Procedure: Take a small amount of plant material and grind it in a mortar with a little amount of water and sodium chloride. Make it into a solution and filter it. To this filtrate, add liquid soap solution or any detergent solution and mix it with a glass rod. Then tilt the test tube and add chilled ethanol and leave it aside in the stand. After half-an-hour we can observe the precipitated DNA as fine threads. DNA that separates can be removed by spooling

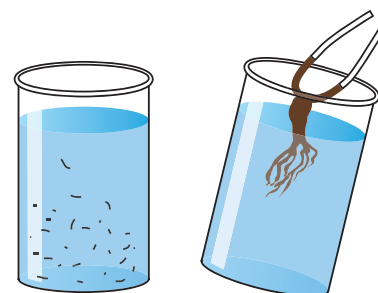


Figure 22: Isolation of DNA

Observation: DNA appears as white precipitate of very fine threads on the spool.

Inference: Thus DNA can be isolated from the plant cell nucleus by this technique.

Precautions:

1. All the glasswares must be thoroughly cleaned and dried.
2. The chemicals used for the experiments must be of standard quality.
3. If ordinary ethanol is used, the time duration for obtaining precipitated DNA may extend further.



VI - Economic Importance of Plants

Exercise 24: Economically important plants

S.No	Identification (Plant name)	Botanical Name	Useful parts	Uses
1	Wheat	<i>Triticum aestivum</i>	Whole grain	1. Wheat flour is suitable to make bread and bakery products. 2. Malted wheat is a major raw material for producing alcoholic beverages and nutritive drinks.
2	Black pepper	<i>Piper nigrum</i>	Seeds	1. It is used as an aromatic stimulant for enhancing salivary and gastric secretion. 2. Pepper also enhances the bio-absorption of medicine.
3	Cotton	<i>Gossypium barbadense</i>	Seed coat fibres	1. It is mainly used in the manufacturing of various textile, hosiery products, toys and is also used in hospitals. 2. Cotton fibres are used in stuffing pillows and cushions.
4	Keezhanelli	<i>Phyllanthus amarus</i>	Entire shoot system	Extract of the plant is generally used for the treatment of jaundice
5	Green gram	<i>Vigna radiata</i>	Seeds	1. Roasted, cooked or sprouted seeds are edible. 2. Fried, dehulled and broken or whole green gram is used as a popular snack and breakfast dish.
6	Banana	<i>Musa x paradisiaca</i>	Fruit	1. The banana fruit contains potassium and essential vitamins which can be eaten raw or cooked. 2. The fruit can be processed into flour and can be fermented for the production of beverages such as banana juice, vinegar, beer and wine.

Exercise 25: Economically important plant products

S. no	Identification (Product name)	Botanical Name	Useful parts	Uses
1.	Sesame/ Gingelly oil	<i>Sesamum indicum</i>	Seeds	1. Sesame oil is mostly used for culinary purposes. 2. Lower grades are used in manufacture of soaps, in paint industries, as a lubricant and as an illuminant.
2.	Rubber	<i>Hevea brasiliensis</i>	Latex	1. Rubber is used in the manufacture of footwear, wire and cable insulations, rain coat, sports goods, erasers, adhesives, rubber bands, household and hospital goods and shock absorbers. 2. Concentrated latex is used for making gloves and balloons. 3. Foamed latex is used in the manufacture of cushions, pillows and life-belts.
3.	Flaked Rice (Aval)	<i>Oryza sativa</i>	Seeds	1. Flaked rice (aval) is used as breakfast cereal or as snacks.
4.	Rose Water	<i>Rosa x damascena</i>	Petals	1. Rose water (panneer) is used in confectionaries, syrups and soft drinks. 2. In India, rose water is much used in eye lotions and eye washes.
5.	Henna Powder	<i>Lawsonia inermis</i>	Leaves	1. An orange dye "henna" obtained from leaves and young shoots is used to dye skin, hair and fingernails. 2. It is also used for colouring leather, tails of horses and hair.
6.	Aloe Gel	<i>Aloe vera</i>	Leaves	1. Aloe gel is used as skin tonic. 2. Because of its cooling effect and moisturizing characteristics, it is used in the preparation of creams, lotions, shampoos, shaving creams and allied products. 3. It is used in gerontological applications for rejuvenation of ageing skin.



Botany - Class XII

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