Government of Tamil Nadu

Department of Employment and Training

Course : TNPSC Combined Civil Services Examination - IV(Group IV / VAO)

Subject : Botany

Topic : Nutrition and Dietetics

It is a cost-free service provided to the job seekers who are preparing for Competitive Exams.

Commissioner,

Department of Employment and Training.

NUTRITION AND DIETETICS

NUTRITION

The mode of taking food by an organism and utilizing it by the body is called **nutrition.**

Modes of Nutrition in Plants

There are two modes of nutrition in organisms. They are

1. Autotrophic nutrition
2. Heterotrophic nutrition.

1. Autotrophic Nutrition (Auto = self; trophos = nourishment)

Green plants are the only organisms which can synthesize food for themselves and also for other organisms including us.

The mode of nutrition in which organisms make their own food is called **Autotrophic Nutrition** and such organisms are called **autotrophs.** eg : Green plants, Euglena.

2. Heterotrophic nutrition: (Hetero = other; trophos = nourishment)

Non-green plants and most animals (like us) take in readymade food from plants and other animals.

The mode of nutrition in which organisms depend on others for their food is called **Heterotrophic Nutrition.** eg : All animals, including human beings.

Other Modes of Nutrition in Plants

There are some non-green plants which cannot prepare the food. They take readymade food prepared by other plants.

They follow heterotrophic nutrition. They may be saprophytes, parasites, insectivorous plants etc.

Saprophytes

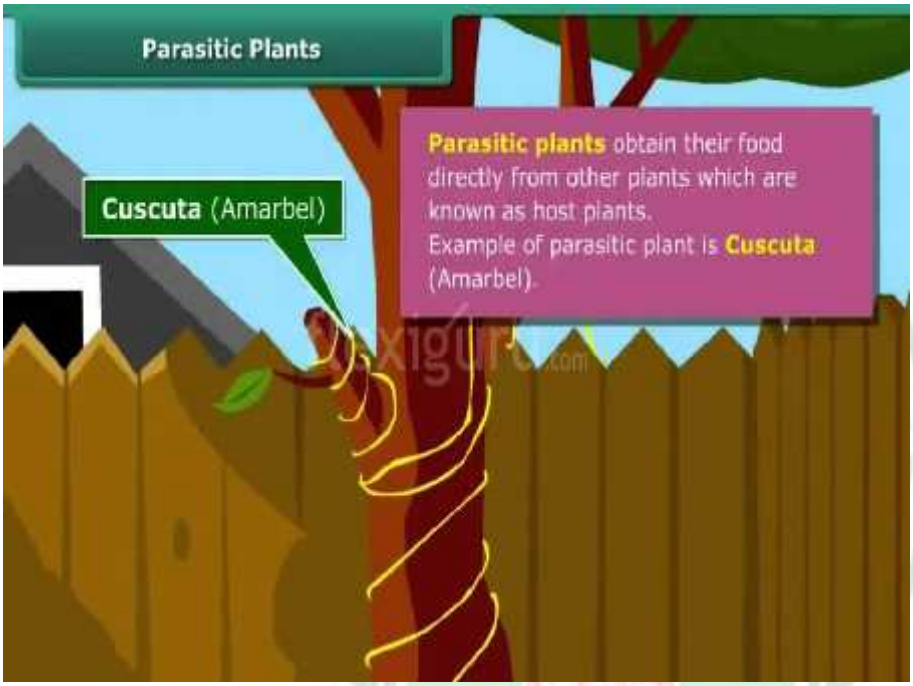
- Fungi grow on dead organic matter.
- They produce digestive enzymes on the dead matter and change it into simple nutrients.
- They absorb the nutrients in dissolved form (solution) and utilize it.

- Such a mode of nutrition is called **saprotrophic** nutrition and those plants are called **saprotrophs**. eg: mushroom, bread mould.

Parasites

Cuscuta cannot synthesize food. As it lacks chlorophyll, it depends on the tree on which it is climbing for food.

The plant which provides food is called **host** and the plants which consumes it is called **parasite**.



Symbiotic Plants

There is yet another mode of nutrition in which two different types of organisms live together and mutually help each other for nutrition.

Lichens

The symbiotic association between algae and fungi is called **lichens.**

The algal partner is called **Phycobiont** or **Photobiont** and the fungal partner is called **Mycobiont.**

Algae provide nutrition for fungal partner in turn fungi provide protection and also help to fix the thallus to the substratum through rhizinae.

Asexual reproduction takes place through fragmentation, Soredia and Isidia. Phycobionts reproduce by akinetes, hormogonia, aplanospore etc., Mycobionts undergo sexual reproduction and produce ascocarps.

The phenomenon by which two different organisms live together for mutual help is called **symbiosis.** The organisms are called **symbionts.**

Chemosynthetic autotrophs

Organisms which use sunlight energy for synthesis of food materials are called photosynthetic organisms or photoautotrophs.

Those organisms which use chemical energy for the synthesis of carbon compounds are called chemosynthetic organisms.

Examples for chemosynthetic autotrophs are Nitrosomonas, Beggiatoa.

Nitrosomonas oxidizes ammonia into nitrite.The energy liberated during this process is used for the synthesis of carbohydrates.

Beggiatoa oxidises H_2S to sulphur and water. During this, energy is released and used for its growth.

Sulphur is stored as granules inside cell.

Chemosynthetic heterotrophs

Examples for chemosynthetic heterotrophs are fungi, most bacteria, animals and man.

Mineral Nutrition

Woodward (1699) Observes : Plants grow better in muddy water than rain water.

Characteristics of a Mineral element:-

1. Normal growth and reproduction must be dependent on particular mineral elements.

2. An essential element must have direct influence on plant.

3. Essential elements must be indispensable and their substitution by other elements must be impossible.

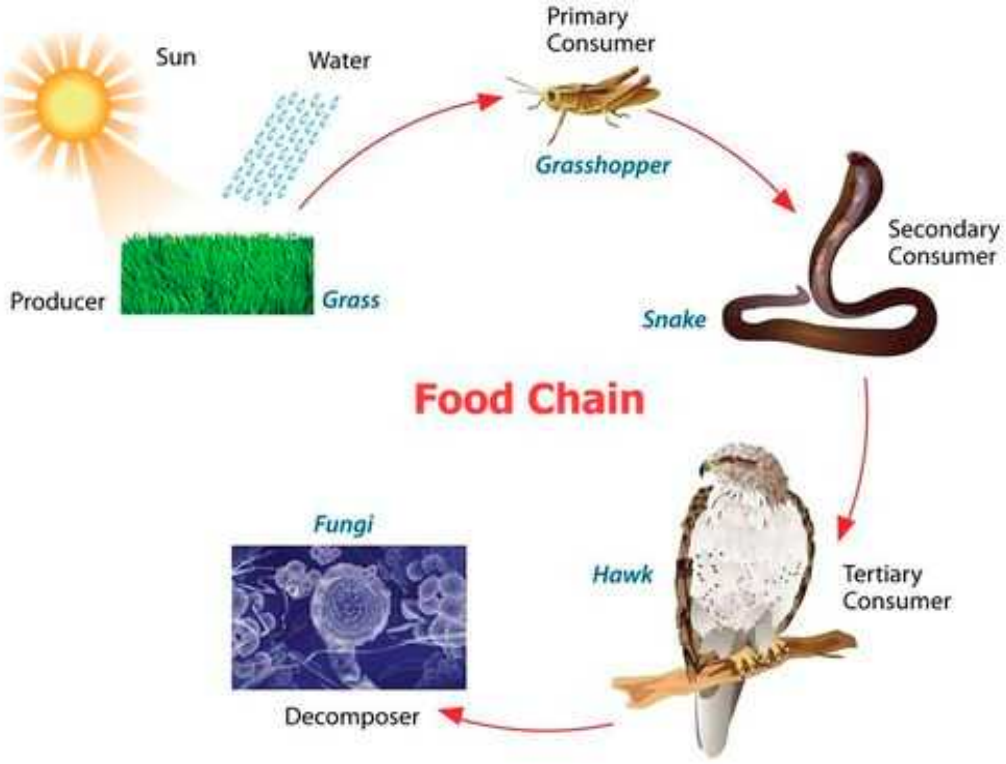
4. Some elements are required in very low quantities and status of essentiality (or) non-essentiality is doubtful (eg) silicon.

Functions of Minerals

1. Calcium - found in middle lamella
2. Nitrogen and Sulphur - in Proteins
3. Phosphorous - in nucleic acids.
4. Minerals influence Osmotic pressure of plant cell. It absorbed from soil, affects pH of cell sap.
5. Elements like Fe, Cu, Mn and Zn acts as catalyst.
6. Elements like Ca, Mg, Na, K - Neutralize the toxic effects of other elements.
7. Elements like As, Cu, Hg show toxic effects at plants.
8. Deposition of ions like K+ and Ca++ on cell membrane changes its permeability.

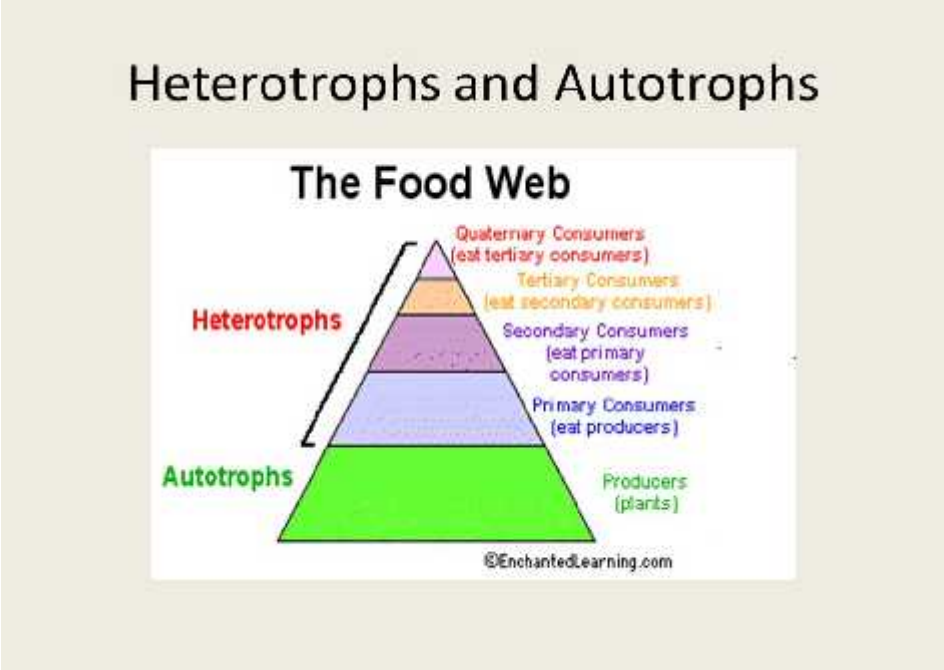
Food Chain

Food chain, in ecology, the sequence of transfers of matter and energy in the form of food from organism to organism. Food chains intertwine locally into a food web because most organisms consume more than one type of animal or plant.



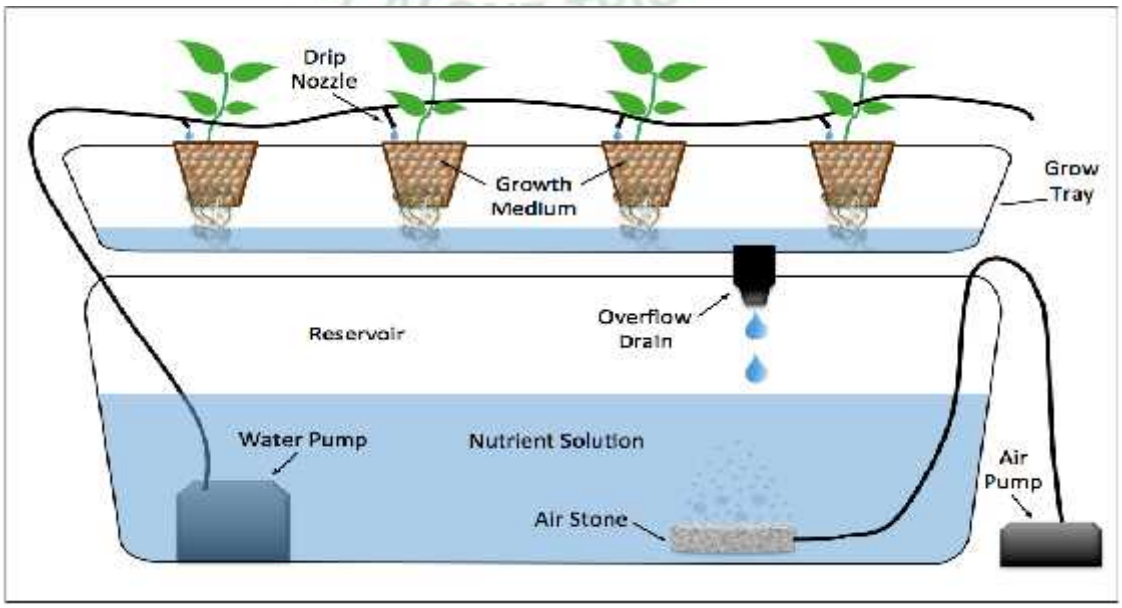
Food Web

A food web (or food cycle) is a natural interconnection of food chains and a graphical representation of what-eats-what in an ecological community.



Hydroponics

- Growth of plants in water and sand culture.
- Also known as soil-less agriculture, test-tube farming, tank farming (or) chemical gardening.



Uses

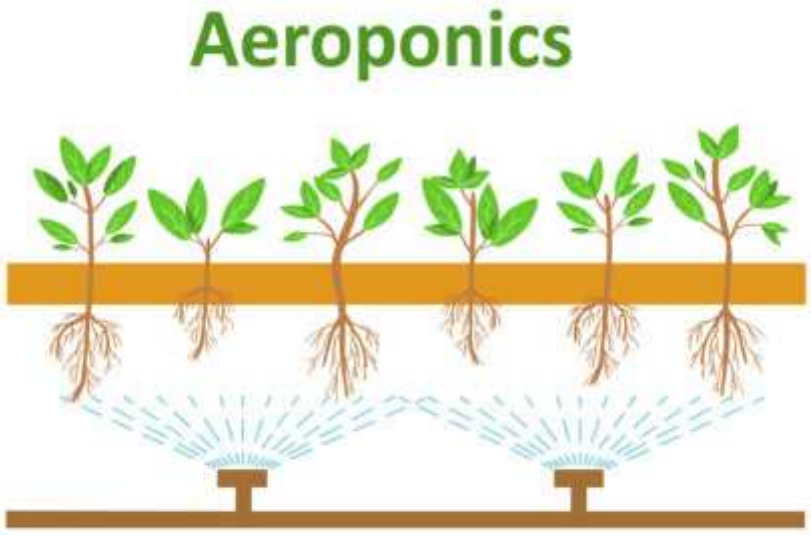
- To know which mineral essential for growth and development of plant.
- Increase yield of ornamentals such as gladioli, snapdragon, roses and vegetables such as carrot, radish, potatoes, tomatoes & lettuce.

Advantages

1. Provide desired nutrient environment.
2. Acid-base balance can be easily maintained.
3. Mulching, changing of soil and weeding are eliminated.
4. Proper aeration of nutrition solution is possible.
5. Labour for watering of plants can be avoided
6. Tilling is not necessary.

Aeroponics

The aeroponic system is the high-tech type of hydroponic gardening. The growth medium in this type is primarily air. The roots hang in the air and are misted with nutrient solution.The misting is usually done for every few minutes, as roots will dry out rapidly if the misting cycles are interrupted.

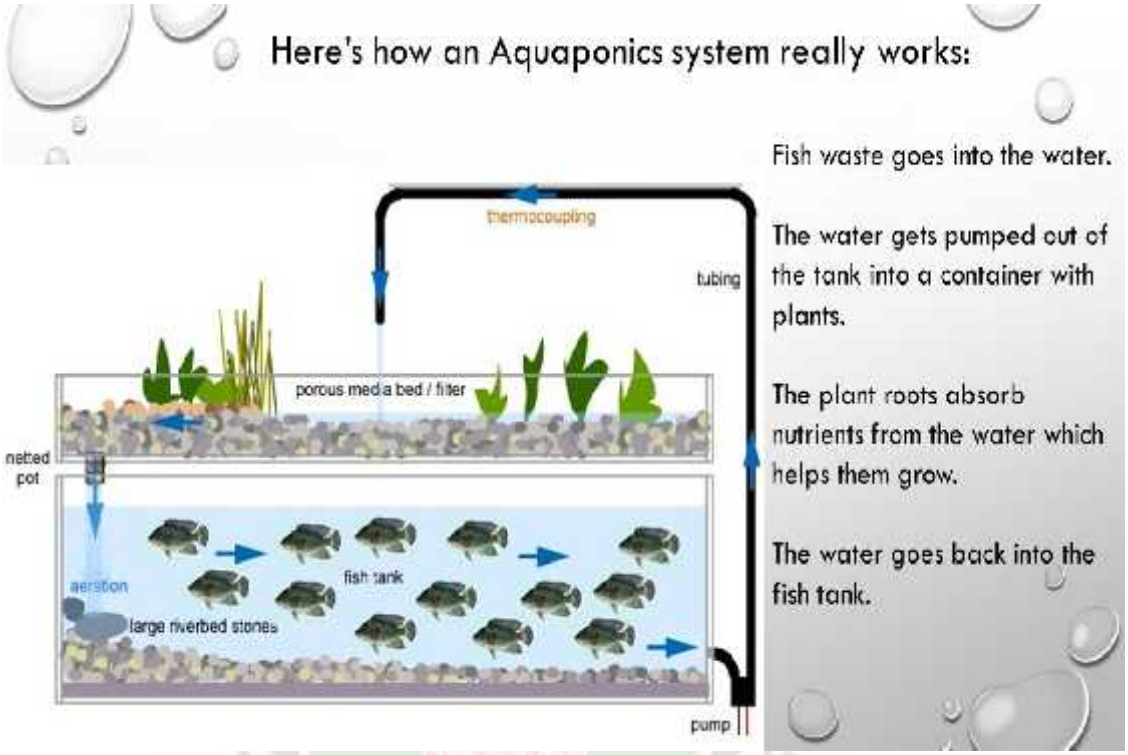


A timer controls the nutrient pump much like other types of hydroponic systems, except the aeroponic system needs a short cycle timer that runs the pump for a few seconds every couple of minutes.

Aquaponics

Aquaponics is a system of a combination of conventional aquaculture with hydroponics in a symbiotic environment, in which plants are fed with the aquatic animals' excreta or wastes.

Aquaponics consists of two main parts, aquaculture- for raising aquatic animals like fish and hydroponics-for raising plants.



Biotechnology

Biotechnology is the science of applied biological process. In other words it is science of development and utilization of biological processes, forms and systems for the benefit of mankind and other life forms.

The term biotechnology was coined by Karl Ereky, a Hungarian Engineer in 1919.

Biotechnology has been extended to include any process in which organisms, tissues, cells, organelles or isolated molecules such as enzymes are used to convert biological or other raw materials to products of greater value.

Green manure

Green manure is obtained by collection and decomposition of green leaves, twigs of trees, shrubs and herbs growing in wastelands, field bunds etc.

Green manure improves soil structure, increases water holding capacity and decreases soil loss by erosion. It also helps in reclamation of alkaline soils and reduces weed proliferation.

It is a manure obtained from undecomposed green material derived from leguminous plants e.g. Sunhemp (*Crotolaria juncea*), Dhaincha (*Sesbania aculeata*), Sesbania (*Sesbania speciosa*).

Nanotechnology in Agriculture

Currently nanotechnology provides different nano devices and nano material that have a unique role in agriculture.

For example, Nano biosensors is used to detect moisture content and nutrient status in the soil.

Nanotechnology can offer Nano-fertilizers for efficient nutrient management, Nano-herbicides for selective weed control in crop field, Nano nutrient particles to increase seed vigor, Nano-pesticides for efficient pest management.

Hence, nanotechnology have greater role in crop production with environmental safety, ecological sustainability and economic stability.

Bioremediation

It is defined as the use of microorganisms or plants to clean up environmental pollution. It is an approach used to treat wastes including wastewater, industrial waste and solid waste.

Bioremediation process is applied to the removal of oil, petrochemical residues, pesticides or heavy metals from soil or ground water.

Biofertilizers

Biofertilizers are substances that contain living microorganisms which, when applied to seeds, plant surfaces, or soil, colonize the rhizosphere or the interior of the

plant and promote growth by increasing the supply or availability of primary nutrients to the host plant.

Biopharming also known as molecular pharming is the production and use of transgenic plants genetically engineered to produce pharmaceutical substances for use of human beings. This is also called "**molecular farming or pharming**".

These plants are different from medicinal plants which are naturally available.

Bioprospecting

Bioprospecting is the process of discovery and commercialization of new products obtained from biological resources.

Bioprospecting may involve biopiracy, in which indigenous knowledge of nature, originating with indigenous people, is used by others for profit, without authorization or compensation to the indigenous people themselves.

Biopiracy

Biopiracy can be defined as the manipulation of intellectual property rights laws by corporations to gain exclusive control over national genetic resources, without giving adequate recognition or remuneration to the original possessors of those resources.

Examples of biopiracy include recent patents granted by the U.S. Patent and Trademarks Office to American companies on turmeric, 'neem' and, most notably, 'basmati' rice. All three products are indigenous to the Indo-Pak subcontinent.

Green Fluorescent Protein (GFP)

The green fluorescent protein (GFP) is a protein containing 238 amino acid residues of 26.9 kDa that exhibits bright green fluorescence when exposed to blue to ultraviolet range (395 nm).

GFP refers to the protein first isolated from the jellyfish *Aequorea victoria*.

GFP is an excellent tool in biology due to its ability to form internal chromophore without requiring any accessory cofactors, gene products, enzymes or substrates other than molecular oxygen.

Cryopreservation

Cryopreservation, also known as Cryo-conservation, is a process by which protoplasts, cells, tissues, organelles, organs, extracellular matrix, enzymes or any other biological materials are subjected to preservation by cooling to very low temperature of –196°C using liquid nitrogen.

At this extreme low temperature any enzymatic or chemical activity of the biological material will be totally stopped and this leads to preservation of material in dormant status.

Later these materials can be activated by bringing to room temperature slowly for any experimental work.

Applications of Biotechnology

• This science has an invaluable outcome like **transgenic varieties** of plants e.g. transgenic cotton (Bt-cotton), rice, tomato, tobacco, cauliflower, potato and banana.

• The development of transgenics as pesticide resistant, stress resistant and disease resistant varieties of agricultural crops is the immense outcome of biotechnology.

• The synthesis of **human insulin** and blood protein in *E.coli* and utilized for insulin deficiency disorder in human is a breakthrough in biotech industries in medicine.

• The synthesis of vaccines, enzymes, antibiotics, dairy products and beverages are the products of biotech industries.

• **Biochip** based biological computer is one of the successes of biotechnology.

• Genetic engineering involves genetic manipulation, tissue culture involves aseptic cultivation of totipotent plant cell into plant clones under controlled atmospheric conditions.

• **Single cell protein** from *Spirulina* is utilized in food industries.

• Production of **secondary metabolites**, biofertilizers, biopesticides and enzymes.

• Biomass energy, biofuel, Bioremediation, phytoremediation for environmental biotechnology.

Metabolites	**Examples**
Primary	
Enzymes	Protease, lipase, peroxidase
Amino acid	Proline, leucine
Organic acid	Acetic acid, lactic acid
Vitamins	A, B, C
Secondary	
Pigments	Carotenoids, anthocyanins
Alkaloids	Morphine, codeine
Essential oil	Lemon grass oil, rose oil
Toxins	Abrin, ricin
Lectins	Concanavalin A
Drugs	Vinblastin, curcumin
Polymeric substances	Rubber, gums, cellulose

MEDICINAL PLANTS :

S. No.	**Tamil Name**	**Botanical Name**	**Drug**	**Parts used**	**Disease cured**
1	Katralai	*Aloe vera*	Anthraquinones	Leaves	Heal wounds, Skin disease, Cancer.
2	Tulsi	*Ocimum sanctum*	Essential oil	Leaves	Cold, Fever, Skin disease
3	Nannari	*Hemidesmus indicus*	Terpene	Roots	Bacterial infections, Diarrhoea

4	Nilavembu	*Andrograhis paniculata*	Terpenoids	All parts	Dengue fever, Diabetes, Chikungunya
5	Vepalai	*Wrightia tinctoria*	Flavonoids	Latex, Leaves	Psoriasis, Diarrhoea, Swellings
6	Cinjona maram	*Cinchona officinalis*	Quinine	Bark	Malaria, Pneumonia
7	Chivan Amalpodi (Sarpagandha)	*Rauwolfia serpentina*	Reserpine	Root	Blood pressure, Antidote for Snake bite
8	Thaila maram	*Eucalyptus globulus*	Essential oil	Leaves	Fever, Headache
9	Pappali	*Carica papaya*	Papain	Leaf, Seed	Dengue
10	Nithya kalyani	*Cathyranthus roseus*	Alkaloids	All parts	Leukemia, Cancer

Father of Indian Medicines

Ayurveda	**Charaka Samhita**
Yoga	**Patanjali**
Unani	**Hippocrates (BUKRATH)**
Siddha	**Agasthya**
Homeopathy	**Samuel Hahnemann**

Plant growth substances

Based on the origin and biological activities plant growth substances are grouped into three – growth regulators, phytohormones and growth inhibitors.

Growth regulator

It is a hormone like synthetic organic compound. In small amounts, it modifies the growth and development either by promoting or inhibiting the growth. Eg. Naphthalene acetic acid (NAA).

Phytohormones

These are organic substances produced by the plant.

The phytohormones are broadly grouped under five major classes namely auxins, gibberellins, cytokinins, ethylene and abscisic acid.

Auxin

This hormone is present in the seed embryo, young leaves, and apical buds of the meristem.

Functions of Auxins

- Stimulation of cell elongation, cell division in cambium, differentiation of phloem and xylem, root initiation on stem cuttings, lateral root development in tissue culture
- Delaying leaf senescence
- Suppression of lateral bud growth when supplied from apical buds
- Inhibition or promotion of fruit and leaf abscission through ethylene stimulation
- Fruit setting and growth induced through auxin in some plants
- Auxin can delay fruit ripening
- In Bromeliads, the auxin hormone promotes flowering
- Stimulation of flower parts, femaleness of dioecious flowers, and production of high concentration of ethylene in flowering plants

Cytokinin

They are synthesized in roots and then transported to other parts of the plant.

Functions of Cytokinins

- Stimulation of cell division, growth of lateral buds, and apical dominance
- Stimulation of shoot initiation and bud formation in tissue culture
- Leaf cell enlargement that stimulates leaf expansion
- Enhancement of stomatal opening in some plant species
- Etioplasts converted into chloroplasts through stimulation of chlorophyll synthesis.

Ethylene

Ethylene is present in the tissues of ripening fruits, nodes of stems, senescent leaves, and flowers.

Functions of Ethylene

- Leads to release of dormancy state
- Stimulates shoot and root growth along with differentiation
- Leaf and fruit abscission
- Flower induction in Bromeliad
- Stimulation of femaleness of dioecious flowers
- Flower opening is stimulated
- Flower and leaf senescence stimulation
- Stimulation of Fruit ripening

Gibberellin

Gibberellins are present in the meristems of apical buds and roots, young leaves, and embryo.

Functions of Gibberellins

- Stimulates stem elongation
- Leads to development of seedless fruits
- Delays senescence in leaves and citrus fruits
- Ends seed dormancy in plants that require light for induction of germination

Abscisic Acid

Abscisic acid is found mostly near leaves, stems, and unripe fruit.

Functions of Abscisic Acid

- Stimulation of closing of stomata
- Inhibition of shoot growth
- Inducing seeds for synthesizing storage of proteins

Deficiency diseases, Symptoms and Cause

Name of the deficiency disease and symptoms	**Deficiency minerals**
1. Chlorosis (Overall)	Nitrogen, Potassium, Magnesium, Sulphur, Iron, Manganese, Zinc and Molybdenum.
a. Interveinal chlorosis	Magnesium, Iron, Manganese and Zinc
b. Marginal chlorosis	Potassium
2. Necrosis (Death of the tissue)	Magnesium, Potassium, Calcium, Zinc, Molybdenum and Copper.
3. Stunted growth	Nitrogen, Phosphorus, Calcium, Potassium and Sulphur.
4. Anthocyanin formation	Nitrogen, Phosphorus, Magnesium and Sulphur
5. Delayed flowering	Nitrogen, Sulphur and Molybdenum
6. Die back of shoot, Reclamation disease, Exanthema in citrus (gums on bark)	Copper
7. Hooked leaf tip	Calcium
8. Little Leaf	Zinc
9. Brown heart of turnip and Internal cork of apple	Boron
10. Whiptail of cauliflower and cabbage	Molybdenum
11. Curled leaf margin	Potassium
12. Seed dormancy	Gibberellic acid

POINTS TO REMEMBER :

- Grey water is reusable waste water from residential, commercial and industrial bathroom sinks, bath tub, shower drains and washing of clothes.
- **Dr. Verghese Kurein**, was the founder of National Dairy Development Board (NDDB) and was called the **Architect of India's Modern Dairy Industry** and the **Father of White Revolution.**
- NDDB designed and implemented the world's largest dairy development programme called **OPERATION FLOOD.**
- The Central Marine Fisheries Research Institute (CMFRI) was established by the Government of India in 1947 at Cochin, Kerala State.
- The Central Institute of Brackish Water Aquaculture (CIBA) was established in 1987 with its headquarters at Chennai.
- Bee-keeping industry is one of the important activities of Khadi and Village Industries Commission (KVIC).
- World Health Day – 7^{th} April
- World Malaria Day – 25^{th} April
- World AIDS Day – 1^{st} December
- World Anti -Tuberculosis Day – 24^{th} March
- When we cut onion, we get tears in the eyes with irritation, because of the presence of a chemical, propanethial s-oxide in onion.
- The Ripening of fruits is controlled by Ethylene.
- **World Food Day, October-16** is celebrated by the Food and Agriculture Organization of the United Nations (FAO).