PLUS 2

NOTES

Chapter Wise



BOTANY

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Chapter 1

SEXUAL REPRODUCTION IN FLOWERING PLANTS

A flower is a modified shoot for the sexual reproduction of flowering plant

Stamen, Microsporangium and Pollengrain

Androecium

Androecium is composed of **Stamen**. Stamen has two parts - the long and a slender stock called the **filament** and terminal bilobed structure called **anther.**

Anther is bilobed, each lobe have two theca (dithecous) Anther is four-sided tertragonal structure consisting of **four microsporangia** located at the corners two in each lobe. When anther is young sporogenous tissue occupy the centre of each microsporangium. At maturity pollensacsa are packed with the **pollen grains**

Structure of microsporangia

Circular in outline, surrounded by four wall layers – the ***epidermis, endothecium, middle layers and the tapetum.*** Outer three layers perform the function of protection and help in dehiscence of anther to release the pollen, the innermost layer is **tapetum that nourishes the developing pollen grains.**

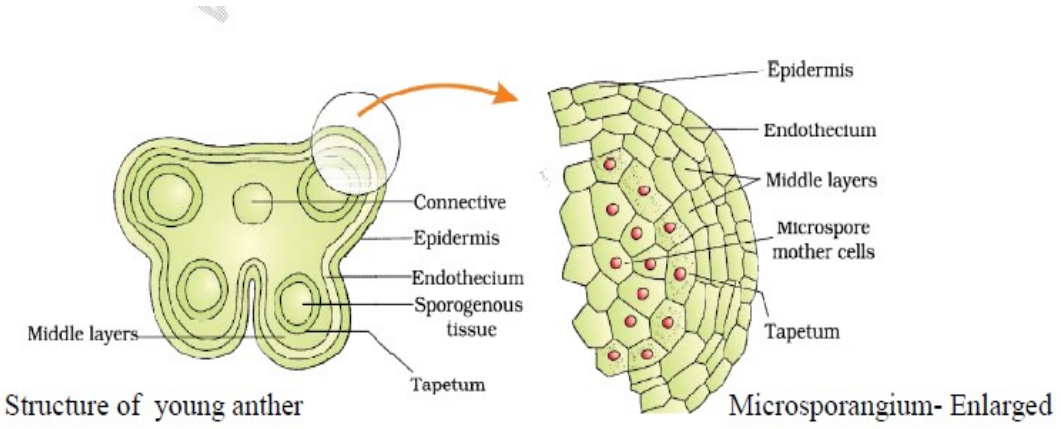


Figure : (a) Transverse section of a young anther; (b) Enlarged view of one microsporangyum showing wall layers; (c) A mature dehisced anther

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Structure of pollen grains

The pollengrain represent the male gametophyte. Spherical shape with 2 layered wall.

1. Exine
2. Intine

Hard outer layer is called **exine** and inner layer is **intine.** Exine made up of **sporopollenin** It can withstand high temperature and strong acids and alkali, no enzyme that degrades sporopollenin is so far known Pollengrains has prominent apertures called **germpores** where sporopllenin is absent . Pollen grains are well preserved a fossils because of sporopollinin. Intine is made up of cellulose and pectin. Pollen grain has two cells; **vegetative cell and generative cell.** Vegetative cell is bigger, has abundant food reserves for developing male gametes.

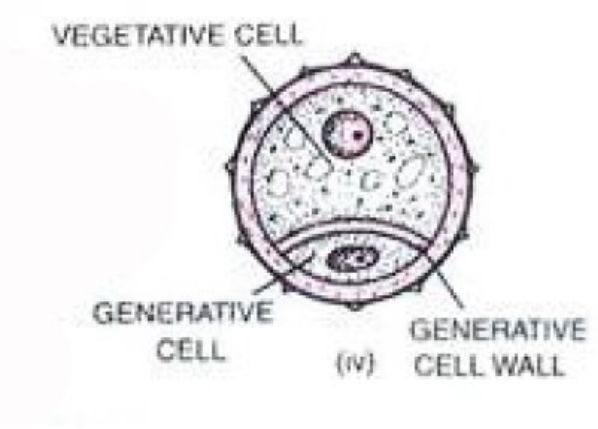


Figure : Structure of mature pollen grain

Economic importance of pollen grains

Pollengrains are rich in nutrients, used as food supplements, in the form of tablets and syrup.

It causes severe allergies and bronchial afflictions in some people. It lead to chronic respiratory disorders, asthma bronchitis eg. parthenium or carrot grass causes pollen allergy.

Pollen bank : Pollen grains of a large number of species store for years in liquid nitrogen (-196^{o}C: **Cyropreservation).** It can be used as Poland Bank in plant breeding programme.

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Pollen viability: The period for which pollen grains remain functional

Pistil,Megasporangium (ovule), Megasporogenesis, Embryo sacs

Gynoecium

Unit of gynoecium is **pistil or carpel.**

Carpel has three parts - **Ovary, Style and Stigma.**

If gynoecium has a single pistil or carpal is called **monocarpellary ovary.**

If gynoecium ha more than one pistil is called **multicarpellary ovary.**

When more than one carpel and are fused together are called **syncarpous ovary**

When carpelss are free are called **apocarpous ovary.**

Structure of ovule or megasporangium

Ovule is a small structure attached to placenta by a stalk called **funicle.** The body of ovule fuses with funicle in the region called **hilum** (hilum is the junction between ovule and funicle)

Each ovule has one or two protective envelope called **integuments.**

Integuments encircle the nucellus except at the tip where a small opening called the **micropyle.**

Opposite to the micropylar end is the **chalaza.** Enclosed within integuments is a mass of cells called **nucellus.** Nyucellus cell have reserved food materials. In the nucellus there is a single embryo sac

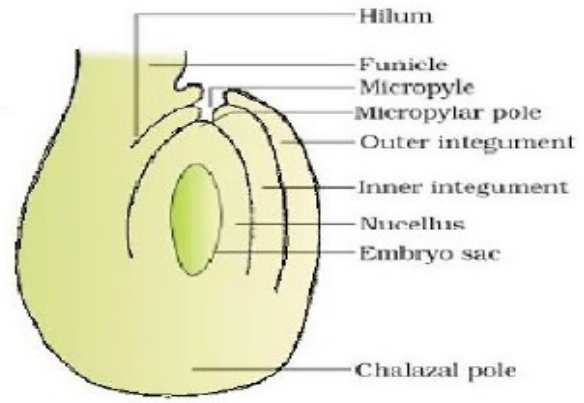


Figure : *Structure of mature ovule '*

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Megasporogenesis

The process of formation of megaspore (by meiosis) from the diploid **megaspore mother cell** (MMC) in micropylar region of nucellus. Out four megaspores one develop into functional megaspore and three degenerate.

Embryo sac formation (free nuclear embryo development):

The nucleus of functional megaspore divides mitotically into two nuclei that moves to opposite poles, then 4 nucleate and 8 nucleate ie., not followed immediately by cell wall formation. Later cellwalls are laid down and form embryosac. 6 of 8 nuclei forms to cells and remaining 2 nuclei move towards the centre of the embyosac and are called **polar nuclei.**

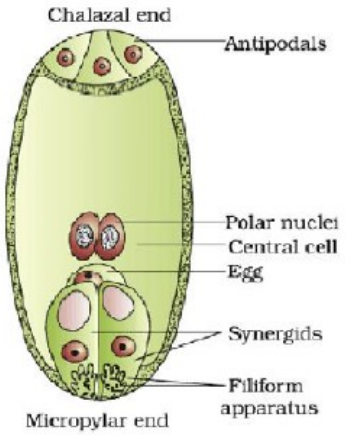


Figure : A diagrammatic representation of the mature embryo sac

Three cells at micropylar end is called **egg apparatus** . It consists of **two synertgids and one egg** cell.

Synergids have special cellular thickening called **filiform apparatus** which guide the pollen tubes into the synergids three cells at chalazal end are called egg apparatus. The large central cell has two polar nuclei. Thus angiosperm embryosac is said to be 7 **celled ans 8 nucleate .**

Pollination : Pollination is mechanism of transfer of pollen grains from the anthe to the stigma of a flower. Based on source of Pollen pollination three types :-

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1) Autogamy : Transfer of pollen grains from the anther to the stigma of the same flower . In a flower which opens and exposes anther and stigma autogamy is rare.

Autogamy requires

i) **Synchrony :** Pollen release and stigma respectively in same time
ii) anthers and stigma should lie close to each other.

In some plants eg. Viola, oxalis, commelina there are two type of flowers.

a) Chasmogamous flowers : Flowers which are similar to flowers of other species with exposed anthers and stigma.

b) Cleistogamous flowers : Flowers which do not open at all. Here another and stigma lie close to each other.

2) Geitonogamy : Transfer of pollen grains from the anther to the stigma of another flower of the same plant. This type of pollination is genetically similar to autogamy

3) Xenogamy : Transfer of pollen grains from anther to the stigma of a different plant. During pollination it brings genetically different type of pollen grains to the stigma.

Agents of pollination :

1) Wind pollinating flowers :

Pollen grains are light and non sticky, well exposed stamens, so that pollens are easily dispersed. Large feathery sigma, single over in each ovary, numerous flowers packed into inflorescence.Example:- coconut,rice,wheat,grasses,maize,datepalam.

2) Water pollinating flowers :

a) In *water hyacinth* and water lily flowers above the level of water and are pollinated by insects or wind.

b) In *Vallisneria* and *Hydrilla* the female flowers reach the surface of water by long stalk and pollen grains are released on to the surface of water and they are carried passively by water currents.

c) In *seagrasses (eg. Zostera)* female flowers remain submerged in water and the pollen grains are released inside the water.

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Characters of water pollinating flowers

1) Pollen grains are long ribbon shaped and are carried passively inside the Water

2) Protected from wetting by a mucilaginous covering

3) Flowers are unisexual and nectorless

4) Stigma is sticky and unwettable

4) Insect pollination (Entamophily)

1) Flowers are large and colourful

2) Produce rich nectar.

3) Commonly produce fragrance

4) Pollen grains are usually sticky and spiny

Pollination in Yucca: Pollination done by a special type of moth. Moth deposits its eggs in ovary and the flower in turn get pollinated by the month.

1) **Dichogamy :** Pollen release and stigma receptivity are not synchronized (either pollen released before the stigma becomes receptive (stigma becomes receptive before release of pollens)

2) **Heterostyl :** Anther and stigma are placed at different position. So pollen cannot come in contact with the stigma of the same flower.

3) **Self incompatibility :** It is a genetic mechanism that prevent self pollen of the same flower from fertilizing the egg by inhibiting Pollen tube growth in pistil.

4) **Dicliny :** Unisexual flowers

In castor and maize, male and female flowers on same plant (monoecious) prevent autogamy but not geitonogamy. In papaya (dioecious) male and female flowers are present on different plants.

Filiform apparatus

The synergid cells in embryo sac have special cellular thickenings at micropylar tip is called filiform apparatus. *It play an important role in guiding the Pollen tubes into the synergids.*

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Artificial hybridization :

It is the process of crossing different species or genera having desirable characters to combine and to produce commercially superior varieties. It is important that only desired pollen grains are used and stigma is protected from contamination (from unwanted pollens). It has two techniquet – *Emasculation and Bagging*

1) Emasculation : The process of removal of anther from the flower buds of female parent before anther dehisces. Emasculation prevent self pollination

2) Bagginng : Emasculated flower is covered with butter paper bags.

Double fertilization :

Syngamy : One of the male gamete moves to egg cell and fuse with its nuclear is called *syngamy.* It results in diploid zygote.

Triple fusion : The other male gamete move towards the two polar muclei in central cell and fuse to produce ***triploid primary endosperm nucleus (PEN)*** is called triple fusion. This two type of fusion ***syngamy and triple fusion*** takes place in embryo sac is termed as double fertilization. It is an event unique to flowering plants. The central cell after triple fusion become primary endorsperm cell (PEC) and develop into endosperm. Zygote developos into embryo.

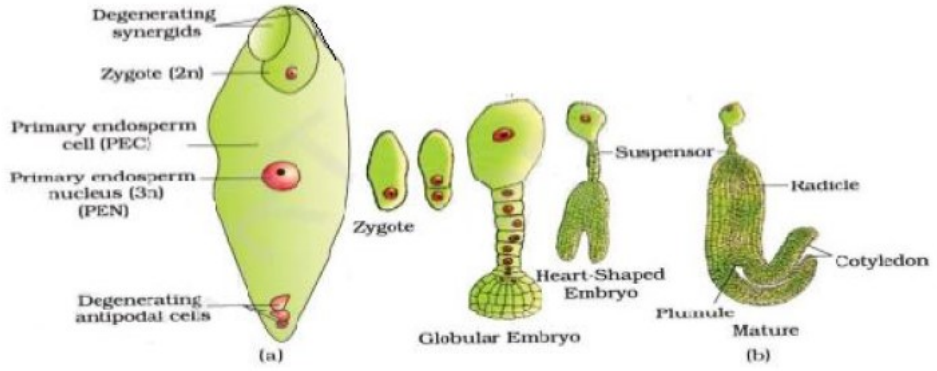
Endosperm development : PEN undergoes successive nuclear division to give rise to free nuclei is called *free nuclear endosperm.* Later cell wall formulation occurs and endosperm becomes cellular. *The coconut water from tender coconut is nothing but* ***free nuclear endosperm,*** *made up of thousands of nuclei and surrounding white kernel is the* ***cellular endorsperm***

Embryo development (embryogeny) : Embryo developes at micropylar end of the embryo sac. Endosperm provide nutrition to the developing embryo. Though early stage of embryo development are similar in monocots and dicots their seeds differ greatly.

Four stages of embryo development : *Pro embryo, Globulr embryo, Heart shaped embryo and Mature embryo.*

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Strucure of Dicot embryo

A *Dicot embryo* consists of an *emgryonal axis and two cotyledons, the portion of embryonal axis* above cotyledons is the epicotyl and portion below the level of cotyledon is ***hypocotyl.*** Epicotyl ende in ***plumule*** or stem tip and ***hypocotyl*** **end in the** radical or root tip. Root tip is covered with root cap.

Strucure of Dicot embryo

Monocot embryo has 1 cotyledon called ***scutellum*** At lower end of embryonal Axis (hypocoty) has radicle and root cap enclosed in an undifferentiated sheath called ***coleorrhiza,*** the portion of embryonal axis (epicotyl) has shoot apex and a few leaf primordial enclosed in a hollow foliar structure called ***coleoptile***

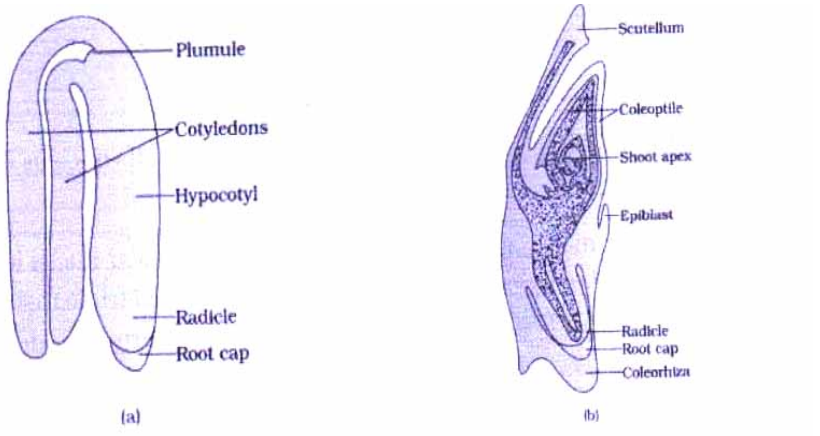


Figure (a) A typical dicot embryo ; (b) L.S. of an embryo of grass

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Seed : Seed consists of seed coats, cotyledons and an embryonal axis. Cotyledons store food reserves as in legumes.

Seeds two types :-

1. **Non albuminous or ex-albuminous seeds : Seeds** have no residual endorsperm as it is completely consumed during embryo development. Example :- pea, groundnut
2. **Albuminous seeds :** Seeds have no resaidual endosperm as it is not completely used during embryo development. Example : wheat, barley, maize, barley etyc.

Perisprem : In some seeds such as black pepper and beet *remnants of nucellus* are present is called perisperm

Pericarp.: The wall of the ovary develops into the wall of fruit called pericarp.

Flesh fruits (pericarp fleshy) Eg. Guava, Orange, mango etc.,

Dry fruits (pericarp dry) – Eg. Groundnut, Mustard etc.

False fruits : Fruit develop from the parts of the flower other than ovary. eg. Apple, strawberry, cashew etc

True fruits : Fruit develop only from the from the ovary are called true fruits, Eg. Mango

Parthenocarpic fruits : Fruit develop without fertilization. Example – Banana.

Seeds Viability : The ability of a seed to germinate and produce seedling.

1. *Lupinus arcticus :* It is the oldest plant species excavated from Arctic Tundra region have viable seeds of 10000 years of dormancy.
2. *Phoenix dactylifera.:* Plant species of date palm have the records of 2000 years of viable seed discovered during archaeological excavation at King Herod's Palace near the Dead Sea. .

Apomixis : It is a a modified form ofreproduction in which *seeds are formed without fertilization.* It is a form of a sexual reproduction that mimics sexual reproduction. It overcome the problems of hybrid seeds. Example family asteraceae and grasses.

Polyembryony: The presence of more than one embryo in the seed

*Eg.*Citrus and Mango.

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CHAPTER 2
BIOTECHNOLOGY: PRINCIPLES AND PROCESSES

1.PRINCIPLES OF BIOTECHNOLOGY

1. Genetic engineering
2. Maintenance of a sterile condition

2.Techniques of Genetic engineering

1. Creation of rDNA
2. Use of gene cloning
3. Gene transfer

3. Steps in creating G M O

1. **Identification of D N A with desirable genes**
2. **Introduction of identified D N A in to the host cell**
3. **Maintenance of the introduced D N A in the host & transfer of the D N A to its progeny**

Tools of r D N A Technology

1. Cell culture with desired DNA
2. Restriction enzymes
3. D N A Polymerase
4. Ligases
5. Vector
6. **Host cell / organism**

r D N A was constructed by Stanley Cohen and Herbert Boyer. They cut the piece of D N A from a plasmid carrying antibiotic resistance gene in the bacterium ***Samonella typhimurium*** and linked in to the plasmid of E coli. This r D N A was introduced into E coli and made to multiply making a number of replicas

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Restriction endonucleases (molecular scissors)

Restriction endonucleases was isolated from *Haemophilus influenza* – Hind II

Hind II always cut the D N A molecule at a particular point with six base pairs called recognition sequence , which is a palindrome (the sequence of base pairs read the same on both the D N A strands , when the orientation of reading is kept the same ie 5⟹ 3' direction or 3'⟹ 5'direction.

↓

Eg . 5'-GAATTC-3'

3'-CTTAAG-5'

↑

Naming of the RestrictionEnzyme

Eg : Eco R I (Esceheria coli Ry 13)

E – First letter indicates Genus name

Co- Stand for first and second letter of species name

R-Stand for Strain

I- The Order in which the enzyme were isolated.

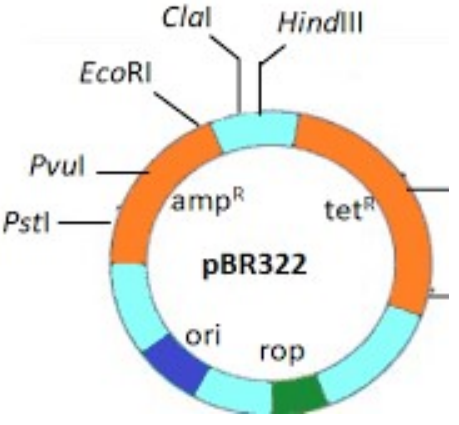
Cloning Vectors

Eg 1. pBR 322

Ori- orgin of replication

Pst 1,EcoR 1,Hind III ,Bam H 1 ,Sal1

Pvu II, Pvu 1-Restriction site



amp R & tet R - Selectable markers r e

replication of plasmid.

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2.Ti plasmid of Agrobacterium tumifaciens.

Processes of r D N A technology

1. Isolation of D N A
2. Fragmentation of D N A by restriction endonucleases
3. Amplification gene interested by Polymerase Chain Reaction (P C R)
4. Ligation of D N A fragment into a vector using D N A ligase
5. Transfer of r D N A into the host
6. Culturing the host cell on a suitable medium on a large scale
7. Extraction of desired product
8. Downstream processing

Separation of D N A fragments – Gel electrophoresis
Amplification of D N A -Polymerase chain reaction
Purification of D N A - Downstream processing

Methods of r D N A into the host

1. Microinjection –Recombinant D N A directly injected into the nucleus of animal cell
2. Gene gum method or Biolistics –The plant cells are bombarded with high velocity micro particles of gold or tungsten coated with D N A
3. Disarmed pathogens – These vectors are allowed to infect the cell to transfer recombinant D N A

Gel Electrophoresis

4. Restriction endonucleases cut the D N A fragment. These fragments can be separated by a technique known as Gel electrophoresis.
5. Gel used – Agarose gel from sea weeds
6. DNA fragments being positively charged are separated by forcing them to move through the matrixs towards the anode under the electric field
7. The DNA fragments separate according to their size
8. Dye- Ethidum bromide
9. Visualized by exposure to U V radiations as orange red band

Elution: Extraction of separated bands of DNA from the Gel

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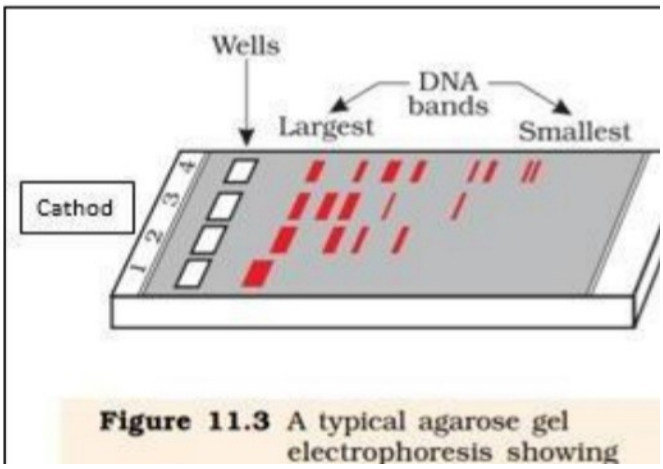


Figure 11.3 A typical agarose gel electrophoresis showing

Polymerase Chain Reaction (P C R)

Gene Amplification – Synthesis of multiple copies of 'gene of interest'

Tools

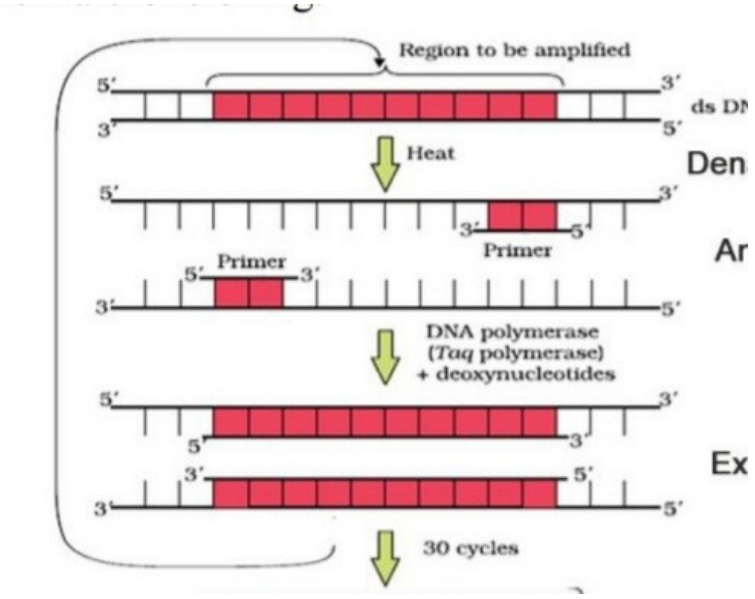
Two set of primers – Chemically synthesised oligo nucleotides complementary to D N A. Enzyme- Thermostable DNA polymerase (Taq polymerase) extracted from the bacterium thermus aquaticus.

Steps

1. Denaturation – Heating the target DNA (Gene of interest) 94^{o} c . The strands separate and act as template.
2. Annealing – The temperature slowly lowered about about 52^{o} c and two primers anneal with 3' end of template DNA
3. Extension of Primer -The Taq polymerase helps in the extension of primers by adding oligonucleotides.

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Bioreactor

Bioreactor are vessels in which raw materials are biologically converted into specific products in a large scale

It provides optimum growth conditions

It has an agitator system

A foam control system

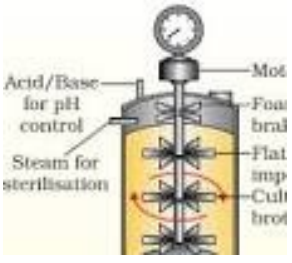
A PH control system

An oxygen delivering system and

A temperature control system

Stirring type Bioreactor

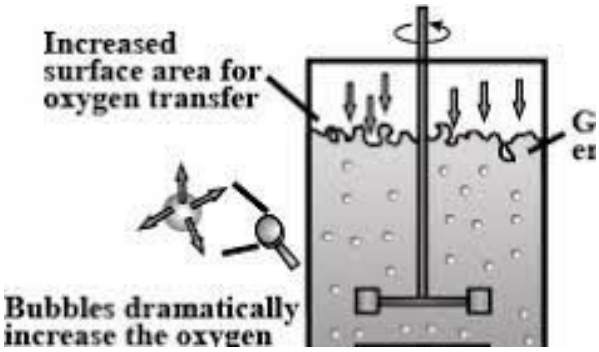
1. Simple stirred tank Bioreactor – Oxygen moves through a delivery system
2. Sparged stirred tank Boireactor – The surface area of culture medium is increased by bubbling the sterile air into the system



Simple Stirred Tank Boireactor

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Sparged Stirred Tank Boireactor

Downstream Processing

The process in which a product is subjected to series of processes before being marketed as a finished product

Steps

Separation ⟹ Purification ⟹ Addition of Preservatives ⟹ Clinical Trial

⇩

Quality Control Test

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CHAPTER 3

BIOTECHNOLOGY AND ITS APPLICATIONS

1. Application of biotechnology in Agriculture

Genetically Modified Organism (GMO) are plants bacteria fungi and animals whose gene have been altered by manipulation.

Advantages of GMOs

1. Increased tolerance against abiotic stress.
2. Reduced dependence of crops on chemical pesticide.
3. Reduced post harvest losses
4. Enhanced nutritional value of food (Vitamin A enriched golden rice)
5. Increased efficiency of mineral usage by plants .

2) Production of pest resistant plant

A) Bt cotton

Soil bacterium *Bacillus thuringiensis* produce crystal protein (Cry protein) that are toxic to the larvae of insects. The Cry protein exist as inactive Protoxin and get converted in to active toxin when ingested by the insect, as the alkaline PH of the gut solubilise the crystal. The active toxin binds to the surface of epithelial cell of midgut and create pores and leading to the death of insects.

B) Protection against Nematodes

A nematode ***Meloidegyne incognitina*** infect tobacco plant and reduce the yield it can be prevented by using RNA interference (RNAi)

The specific genes from the parasite are introduced into the plant using Agrobacterium as the vector, which produce both sense and antisense RNA in the host cell.

Since these two RNA are complementary, they form double stranded RNA. The ds RNA molecule binds to m RNA and prevent translation of m RNA of the pathogen. This phenomenon is called RNA ***silencing of m RNA.***

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3) Application of biotechnology in medicine

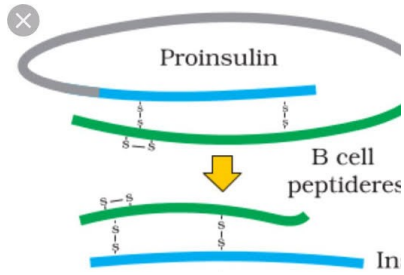
Genetically Engineered (Humulin)

Human insulin consist of two short Polypeptide chains chain A and chain B inked by disulphide bridges.

Insulin is secreted as prohormone which has to be processed before it becomes a mature and functional hormone.

The ***Prohormone*** contains another polypeptide called C-peptide which is removed during maturation.

In 1983 Ell Lilly an American company, prepared two DNA sequences coding for chains A and B of human insulin and introduced the into the plasmids of E cell to produce insulin. The two chains produced where extracted and combined by creating this ***disulphide bridges.***



Maturation of proinsulin into insulin

2. Gene therapy

In this method, genes are inserted into the cells and tissues of an individual to correct certain diseases like cancer, hemophilia

The first clinical gene therapy was given in 1990 to a four year old girl with AdenosineDeaminase (ADA) deficiency.

For gene therapy Lymphocytes where grown in a culture and functional ADA cDNA is then introduced into these lymphocytes.

These Lymphocytes are then transferred into the body of the patient. Thepatient request periodic infusion of such genetically engineered lymphocytes.

3. Molecular Diagnosis

Techniques ….

1. Polymerase chain reaction (PCR)
2. RDNA Technology
3. ELISA (Enzyme Linked Immuno Sorbent Assay)

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Principle of ELISA -

1. Antigen antibody reaction

Application of PCR

1. To detect HIV
2. To detect mutation in gene

Transgenic Animal

1. Transgenic animals are used for testing the safety of vaccines.
2. To test the toxicity of drugs.
3. Normal physiology and development
4. Study of diseases.
5. Biological products.

GEAC Genetic Engineering Approval Committee

Biopiracy

The use of bioresources by multinational companies and other organizations without proper authorization and compensation to the countries concerned.

Biopatent

It is the right given to a person or organization for a new discovery, no any person or organization can sell your product without your permission. Eg: Basmati rice grown in India is distinct for its unique flavor and aroma but an American company got patent rights on Basmati through the US patent and trade mark office.

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CHAPTER 4

ORGANISMS AND POPULATIONS

Population:

Ti is a group of similar individuals living together sharing or competing for similar resources and potentially inbree, in a particular geographical area in a particular time.

Population size (density) (N)

Total number of individuals present per unit area or volume at a given time.

Population attributes

A population has certain attributes.

1) **Birth rate:** It is the rate of productionof new individuals in a population by birth per unit time.
2) **Death rate:** It is the rate of loss of individuals from a population per unit time by death
3) **Age Pyramid**

A population at any given time is composed of different age groups, ie, pre-reproductive, reproductive and post-reproductive if age distribution is plotted for the population the resulting structure is called an age pyramid. For human age pyramid shows males and females in a diagram shape of the pyramid reflect the growth status of the population whether it is growing stable or declining. Base of the pyramid show the prereproductive age group and above that reproductive and at the top post reproductive age group.

Age pyramids are of three types

1) Expanding pyramid

If pre-reproductive age group is more than reproductive it shows an expanding population.

2) Stable pyramid

If pre reproductive age is no more than reproductive it is shows stable population.

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3) Declining pyramid

If pre-reproductive ages is less than reproductive age group it shows a declining population.

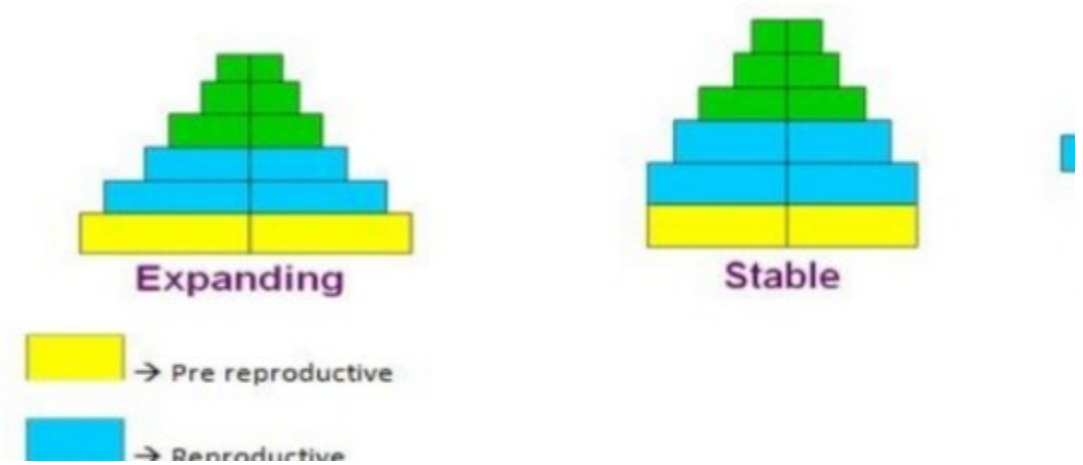


Figure: Representation of age pyramids for human population.

Population growth: It is the number of individuals added in a population per unit time due to birth and immigration over the rate of death and emigration.

It depends on 4 factors –

1) Mortality 2) Natality 3) Immigration 4) Emigration

Natality (B): Number of births in a given period and added to the initial density.

Mortality (D): Number of death in the population during a given period.

Immigration (I): Number of individuals of the same species that have come into the habitat from elsewhere.

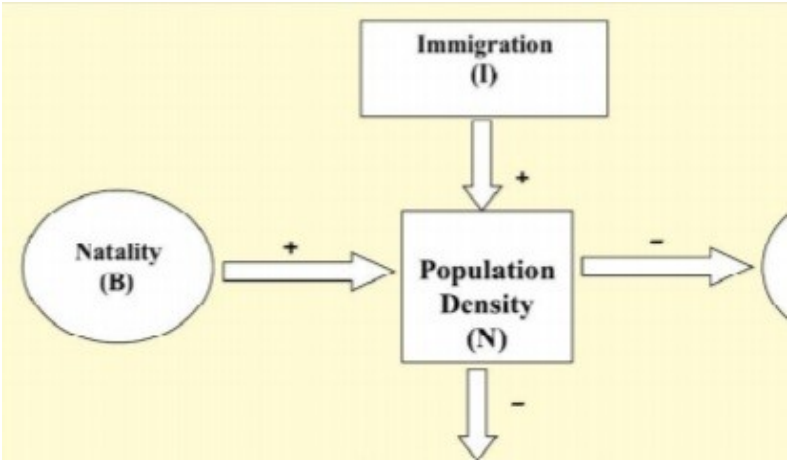
Emigration (E) : Number of individuals of the population which left the habitat and gone elsewhere during the time period

Population growth equation

N t+1 = Nt +](B+I) – (D+E)]

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Change in population size = (Births + Immigration) – (Death+ Emigration)

= (B+I) - (D+E)

Carrying capacity: The maximum number of individuals of a population which can be provided with all the necessary resources for their healthy living.

Population growth forms or models:

Graphic patterns of a population growth plotted against time are called population growth forms.

Two models of population growth:

1) Exponential growth
2) Logistic growth.

Exponential growth: When resource in a habitat is unlimited each species has the ability to fully develops its potential to grow as Darwin observed population grow in an exponential or geometric fashion. If we plot population density N in relation to time t we get equation is

dN /dt=rN.

Logistic growth

Population growing in a habitat with limited resources show initially a lag phase then phases of acceleration and deceleration and finally an asymptote when population density reaches the *carrying capacity (K)*. When we plot N in relation to time t result in a sigmoid curve. This population growth is called Verhulst-pearl Logistic growth and the question is

dN/dt=rN[K-N/K]

N = population density at time t,

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r is intrinsic rate of natural increase,

K is carrying capacity.

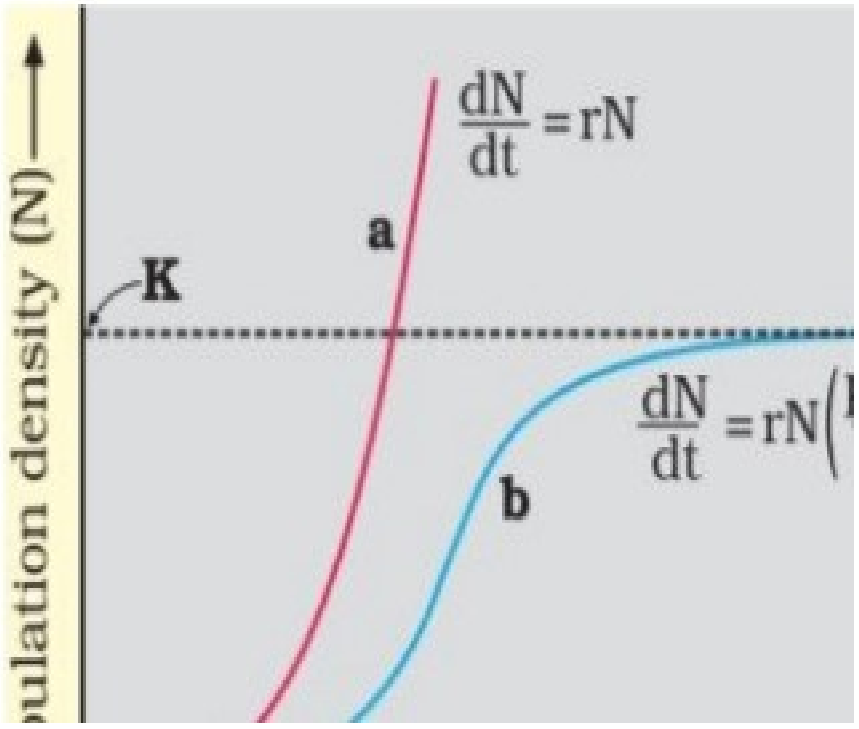


Figure: Population growth curve a when response are not limiting the growth, plot is exponential, b when responses are limiting the growth, plot is logistic, K is carrying capacity

Population interactions

Important types of population interactions are:-

Species A	Species B	Name of Interaction
+	+	Mutualism
-	-	Competition
+	-	Predation
+	-	Parasitism
+	0	Commensalism
-	0	Amensalism

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Figure : Population interactions

1) Predation (+ -)

Predation is food relation between two organism in which one animal captures and feeds on another species. Species which eat the other is called the Predator, the species consumed is called the prey.

Role of Predators

Predation is a conduit for energy – transfer. P

redation help in maintaining species diversity by reducing the intensity of competition among Prey species.

Predation keeps the prey population under control in agriculture Biological control methods adopted for pest control are based on the ability of the Predator to regulate prey population.

Prey defense mechanism

Defence mechanisms in animals

Some insect and frogs are cryptically coloured camouflaged. Some species are poisonous to avoid the predator.

The ***monarch butterfly*** is distasteful to its Predator due to poisonous chemical present in its body.

Defence mechanisms in plants

Morphological defense mechanisms in plants

Thorns in Cactuts and Acasia protects from browsing animals chemicals defence in plants. ***Calotropis produce poisonous cardiac glycosides*** against herbivores, nicotine, caffeine quinine, strychnine are chemical substances produced as chemical defence against gracious and browsers.

2) Competition (- -)

It is interaction between two or more organism for same resources both suffer in competition. Competition occur in closely related species and when resources are limited. In competition fitness of one species are significantly lower in presence of another species.

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Competition two types

1) Interspecific competition: Competition of different species.

2) Intraspecific competition: Competition between individuals of the same species because all members of the species have a of food, habitat, mate etc. Competition effect herbivores and plants more adversely than carnivores.

Competitive release

A specious may have restricted distribution due to the presence of a competitively superior species and when superior species is removed from the area other species expand its distribution is called ***competitive release***. It is confirmed by Connel's field experiment with barnacles.

Gause's competitive exclusion principle:

Two closely related species competing for the same resources cannot coexist indefinitely and the competitive inferior will be eliminated eventually. Eg. *Abington tortoise became extinct in Galapagoes islands within a decade by introduction of goats Goats were better Browsers than tortoise.*

Species facing competition might evolve mechanism that promote coexistence rather than exclusion is called ***resource partitioning***. When two species compete for same resources they *avoid competition by choosing different times for feeding, foraging is* called resource partitioning. **Mac Arthur** show this by five closely related species of warblers live in same tree.

3) Parasitism (+ -)

It is negative interaction between two different species in which one organism (parasite) derives food from the other (host) parasite is beneficial and the host is harmed.

Adaptations of parasite

1) Loss of unnecessary sense organs,

2) Adhesive organs to cling on to host

3) Loss of digestive system

4) High reproductive capacity..

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Parasite reduce the survival growth and Reproduction of the host, reduce the population density of host render the host more vulnerable to the date predation by making physically weak.

Parasites two types

1) Ectoparasite

2) Endoparasites

Ectoparasite live on the surface of the host eg. lice on humans, ticks on dogs, endoparasite live inside the body of the host.

Brood parasitism

Brood parasite lay eggsin the nest of the other birds for incubation, hatching and rearing of young ones. ***eg. Cuckoo lays egg in the nest of crow.***

4) Commensalism (+ 0)

Interaction in which one species benefits and the other is neither harmed nor benefited

Examples

1) Epiphytes: Plants growing on other plants for accommodation eg. Vanda.

2) Barnacles and whale

3) Cattle egret and grazing cattle

4) Sea anemone and clown fish.

5) Mutualism (+ +)

Interaction in which both species are benefited, both live together on each other.

Examples

1) Lichens: Symbiotic association of Algae and Fungi

2) Mycorrhiza is an association of fungus with the roots of higher plants eg. *Pinus*

3) Plant animal relationship: Plant take the help of animals for pollination animals help plant in the dispersal of fruits and seeds plants offer fees or rewards in form of pollen grains and nectar should be safeguard against cheaters.

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Plant pollinator relationship

In many species of **fig trees**, there is a tight one-to-one relationship with the pollinator species of **wasp.** The wasp pollinates the fig inflorescence while searching for suitable egg-laying sites. In return for the flower of pollination the fig offers the wasp some of its developing seeds, as food for the developing wasp larvae.

Orchid – pollinator interaction: **Ophrys** is a Mediterranean Orchid employs ***sexual deceit*** to get pollination by a species of bee. One Petal of its flower has resemblance to female bee and it attracted and pseudo copulates with the Orchid flower then pollen grains are dust from the flower and pseudocopulate with another flower, transfer pollen grains to it and pollinates the flower. If female bee colour pattern change the Orchid flower co evolves to maintain the ***resemblance it is an example of co-evolution operates in nature.***

6) **Amensalim:- (- 0)**

Interaction between two different species in which one species is harmed and the other is neither benefited nor harmed. Eg. Pencillium secretes penicillin which kill bacteria but mould is not affected.

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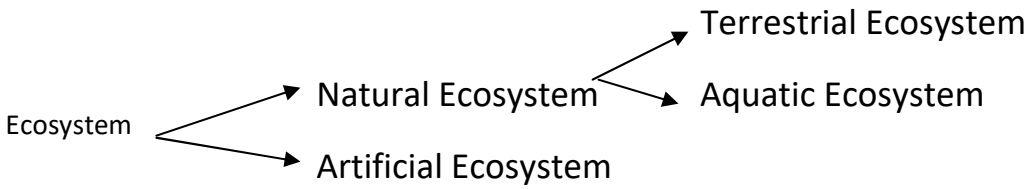
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CHAPTER 5

Ecosystem

Ecosystem is a basic functional unit in which living organism interact with each other and with their surrounding environment.

Classification of Ecosystem



Stratification

The vertical distribution of different species occupying different level is called stratification

Eg: In forest ecosystem, trees occupy top vertical strata, shrubs the second and herbs occupy the bottom layers.

Functions of Ecosystem

i productivity

ii Decomposition

iii Energy flow

iv Nutrient cycling

1. Productivity : Rate of biomass produced per unit area during a given period.

There are two type of productivity

i Primary productivity

ii Secondary productivity

Primary productivity: The amount of biomass produced per unit area over a time period by plants during photosynthesis.

Primary productivity can be divided in to

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a) Cross primary productivity (GPP)
b) Net primary productivity (NPP)

GPP:-The rate of total production of organic matter by plant during photosynthesis.

NPP:-The balance biomass remaining after utilizing in their respiration by plant

NPP = GPP – R

Secondary Productivity:- Rate of formation of new organic matter by consumer.

2. Decomposition:- Break down of complex organic matter present in detritus in to inorganic substance like CO2, H2O and nutrients by decomposers

Detritus:- It is the dead remains of plant such as leaves, bank, flower and dead remains of animals

Detritivores:- The organism which break docun detritus



Fragmentation:- Break down of detitus in to small particles by detritivores like earth worm.

Leaching:- Water soluble morganic nutrials go down in to the soil horizon and get precipitated.

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Catabolism:- Emymatic degradation of detritus in to simples morganic substance.

Humification:- Formation of dark coloured substance from detritus is known as humification.

Mineralisation:- Humus is further degraded by same microbes and releases inorganic nutrients from humus.

Factors affecting Decomposition

i Climatic factors

ii Chemical composition of detritus

3. Energy flow

Energy flow is a non cydic process and unidirectional from sun to producers, consumers and decomposers

Food Chain

Flow of energy from one organism to another organism by the process of eating and being eaten.

Eg:- Grass $\rightarrow$ Goat $\rightarrow$ Man

Food chain is two types

1 Grazing food chain (GFC)
2 Detritus food chain (DFC)

GFC – Food chain that begins from producers (plants)

DFC – Transfer of energy starts with dead organic matter by decomposer.

Many food chains are interconnected to form a food web

Trophic level:- In a food chain, organisms occupy a specific place is known as Trophic level.

Standing crop:- Each tropic level has a certain mass of living material. Total amount of biomass living material present in different trophic level at a given time

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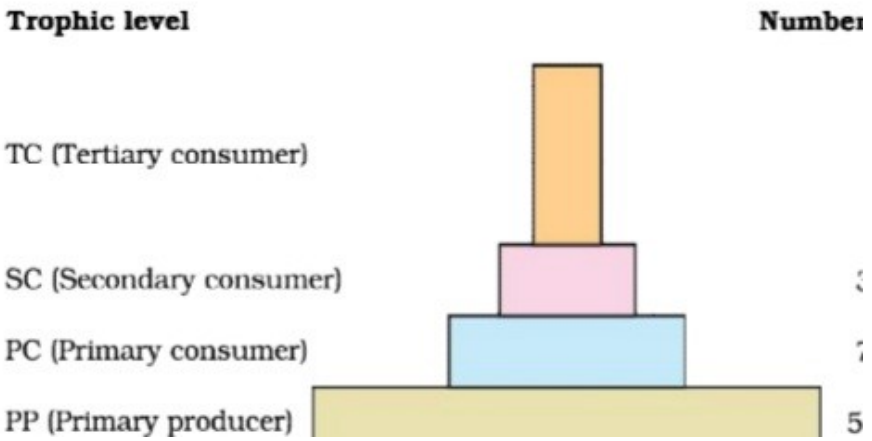
Ecological pyramids

Diagramatic representation showing the relationship between the organism at different levels of an ecosystem.

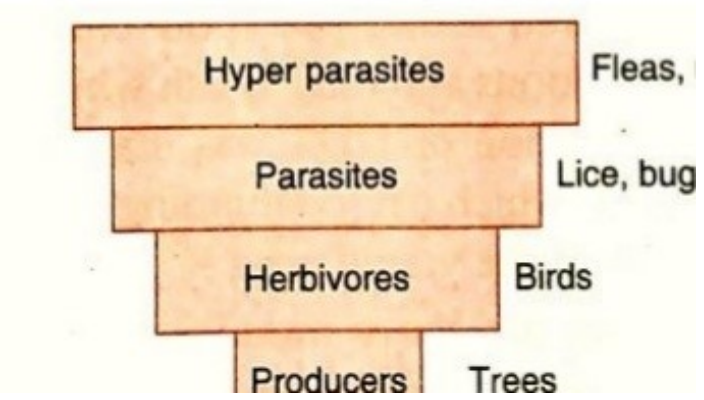
Three types of ecological pyramids are

1. **Pyramid of number**
2. It is usually upright

Represents the number of individuals at various trophic level with produces at base and various consumer at higher levels.



Pyramid of number in a single tree is ***inverted*** because number of organism in each trophic level exceeds.

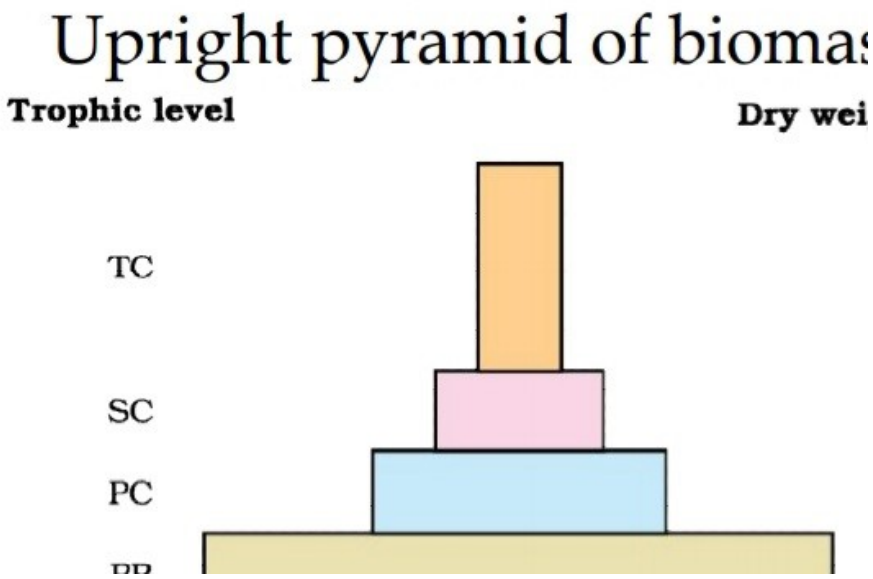


2. Pyramid of biomass

It presents the biomass of organism of each trophic level most of pyramid of biomass are upright but in sea is generally inverted because the biomass of fishes exceeds that of phytoplankton.

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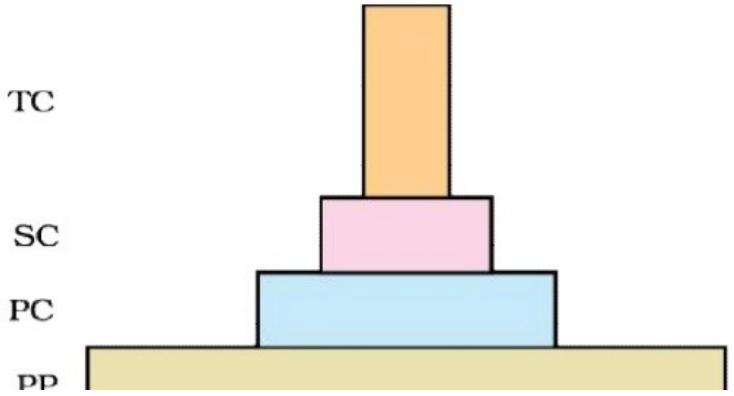
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3. <u>Pyramid of Energy</u>

The pyramid of energy is always upright, can never be inverted

The diagrammatic representation of energy used by organism of successive trophic levels in an ecosystem



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