Chapter 9

KINGDOM PLANTAE

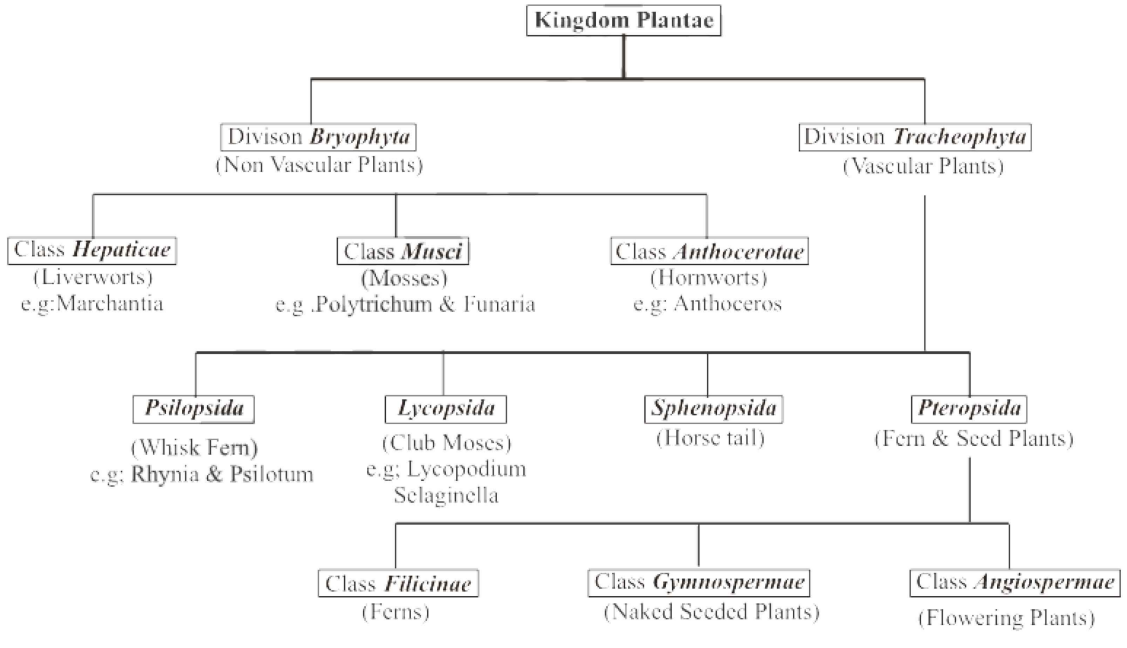
PHYLOGENETIC SYSTEM OF CLASSIFICATION:

Classification of animals and plants based on similarities and dissimilarities of relationship among living things and their organ is called phylogenetic system of classification.

Kingdom of Plantae:

The members of kingdom plantae are, ***eukaryotic***, ***autotrophic***, ***multicellular non-motile*** organisms that develop from ***embryo*** and has ***cellulose cell wall***. About 3,60,000 species of plants are known.

Outline of Classification of Kingdom Plantae:



Q.1 Give Characters of division Bryophyta.

Ans. **BRYOPHYTA** (***Non-vascular***)

These are the ***first land green plants*** that ***evolved from algae***. These have following characters:

(1) **Shade Loving (Amphibian Plants):** These live on moist, damp, shady places and are thus called ***amphibians plants*** as **they cannot live away from water and require water for fertilization**.

(2) **Without Xylem and Phloem (*Non-vascular*):** Conducting tissue and supporting tissue are absent i.e., no xylem and phloem. Absorption of H_2O and mineral salts are occurred by diffusion. Transportation of food also takes place by diffusion.

(3) **Cuticle:** Plant body may be covered with cuticle to reduce transpiration or cuticle may be thin or absent.

(4) **Alternation of Generation:** These have ***hetromorphic*** alternation of generation i.e., gametophyte and sporophyte generation alternate with each other and both generations are morphologically distinct from each other.

(5) **Gametophyte Dominant:** Dominant generation is gametophyte (i.e., ***plant body is gametophyte***) which may be ***thalloid*** (no distinction between root stem and leaves) as in liverworts (***Marchantia*** مارکینشیا) or differentiated into stem, leave and water absorbing and anchoring organs ***Rhizoids*** (as in Mosses like ***Funaria***).

(6) **Reduced Sporophyte:** The sporophyte is reduced which partly or totally *dependent on gametophyte* for its food and water absorption and anchoring organs Rhizoids.

(7) **Homosporous:** The sporophyte stage is diploid and produces *haploid (n) spores* by meiosis. All spores are of one kind and thus these plants are homosporous.

(8) **Spores Develop into Gametophyte:** The haploid spores develop into haploid gametophyte generation.

(9) **Antheridia and Archegonia:** *Sex organs* are multicellular and are of two types, male sex organs are called Antheridia while female sex organs are called archegonia. The antheridia or archegonia may develop either in same gametophyte or different gametophyte.

(10) **Sterile Covering:** Sex organs are protected by sterile (non fertile) covering of cells.

(11) **Antherozoids and Egg:** In antheridium male gametes (antherozoids) (n) are produced which are motile and produced in large number, while in archegonium a single female gamete (egg) develops (n).

(12) **Water for Fertilization:** They require water for fertilization. Fertilization takes place with in archegonium to form diploid zygote. The zygote develops with in archegonium by mitosis to form diploid embryo. The diploid embryo develops into diploid sporophyte.

(13) Attachment of Sporophyte: The sporophyte remain attached at the top of gametophyte.

Q.2 Give Characters of Bryophyte by which they adapted on Land.

Ans. **CHARACTERISTICS OF BRYOPHYTE**

Following are the characters of bryophytes by which they adapted on land.

(1) Compact Body: A multicellular compact plant body to ***conserve water*** and reduce surface exposed to dry conditions. Moreover a layer of cuticle developed to further reduce evaporation of water from surface.

(2) Photosynthetic Tissue: Development of photosynthetic tissue in special chamber for absorption of CO_2.

(3) Rhizoids: Development of hair like Rhizoids for absorption of water and to anchor the plant.

(4) Heterogamy: Development of heterogamy i.e. fusion of different types of gametes, motile sperm and non-motile egg with large amount of stored food.

(5) Archegonia and Antheridia: Gametes are protected and develop in multicellular sex organs i.e., archegonia and antheridia.

(6) Embryo Formation: Embryo is formed and protected in archegonium.

(7) Alternation of Generation: Alternation of generation which unables the plant to produce ***better genetic combination*** for survival in changing environment.

Q.3 Classify the Bryophytes. (OR)

(a/1) Write down the features of hepaticeae (ہیپاٹی سی) / Liverworts.

(b/2) Describe the characteristics of Musci / Mosses.

(c/3) Discuss Anthocerotae (اینتھوسیراٹی) / Hornworts.

Ans. Division bryophyte is divided into three classes:

(1) *Hepaticeae* (Liverworts)

(2) *Musci* (Mosses)

(3) *Anthocerotae* (Horn worts)

(1) Class Hepaticeae (Liverworts) (i.e., Marchantia Class):

It includes 900 species.

CHARACTERS:

(i) Habitat: These are found on ***damp rocks*** and ***wet soil***.

(ii) Thallus: The plant body is gametophyte and is thalloid, ***dichotomously branched*** (divides into two branches then each branch divides in the same manner)

(iii) Rhizoids: On lower surface of thallus are hair like rhizoids by which plant is attached to soil as in Marchantia or plant body may grow upright and differentiated into false stem and leaves as in porella.

(iv) Sex organs on Upper Side: Sex organs (Antheridia and Archegonia) develop on upper side of thallus near the tips of branches. Sometime sex organs develop on special branches on gametophyte. The branching bearing antheridia are called ***antheridiophores*** and branches bearing archegonia 1are called ***archegoniophore*** as in Marchantia.

(v) Gametophyte *Dominant*: Alternation of generation takes place with gametophyte generation dominant.

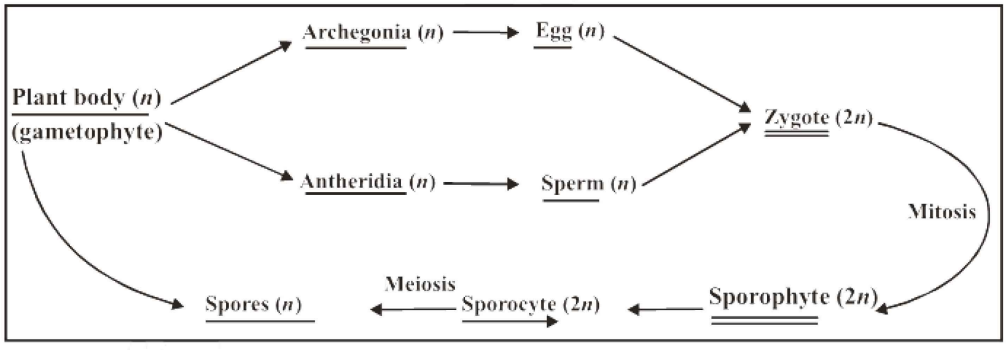


Fig. A generalized life cycle of liverworts showing alternation of generation

(2) Class Musci OR Moses (*Funaria Class)*:

These grow on damp places as well as on dry places. Water is necessary for fertilization.

CHARACTERS:

(i) Stem Like and Leaf Like Structure: Plant body is gametophyte and differentiated into stem and leaves, true roots are absent while ***rhizoids*** are present to anchor the plant and to absorb water.

(ii) ***Sex Organs on the Tip of Branches:*** *Antheridia* and *Archegonia* develop on the tip of different branches on the same plant as in Funaria or on different plants as in *Polytrichum*.

(iii) ***Paraphyses:*** Archegonia and antheridia develop in clusters and are protected by ***sterile hairs*** called ***paraphyses***.

(iv) ***Spores Develop into Protonema:*** Alternation of generation is similar to Marchantia but unlike Marchantia the spores develop into ***protonema*** or alga like stage in moss plant.

(v) ***Protonema Develops into Gametophyte:*** Gametophyte develops from bud developed on protonema stage.

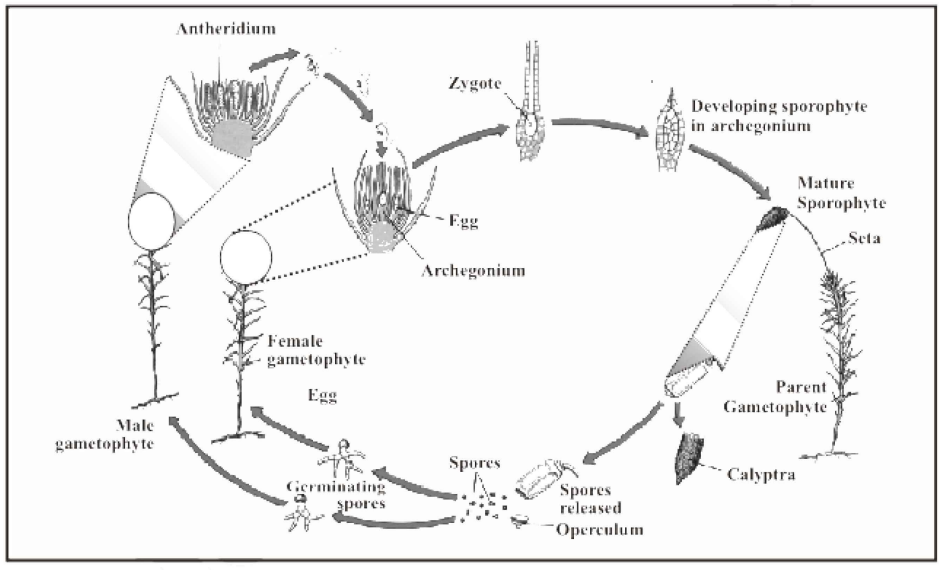


Fig. Moss life cycle

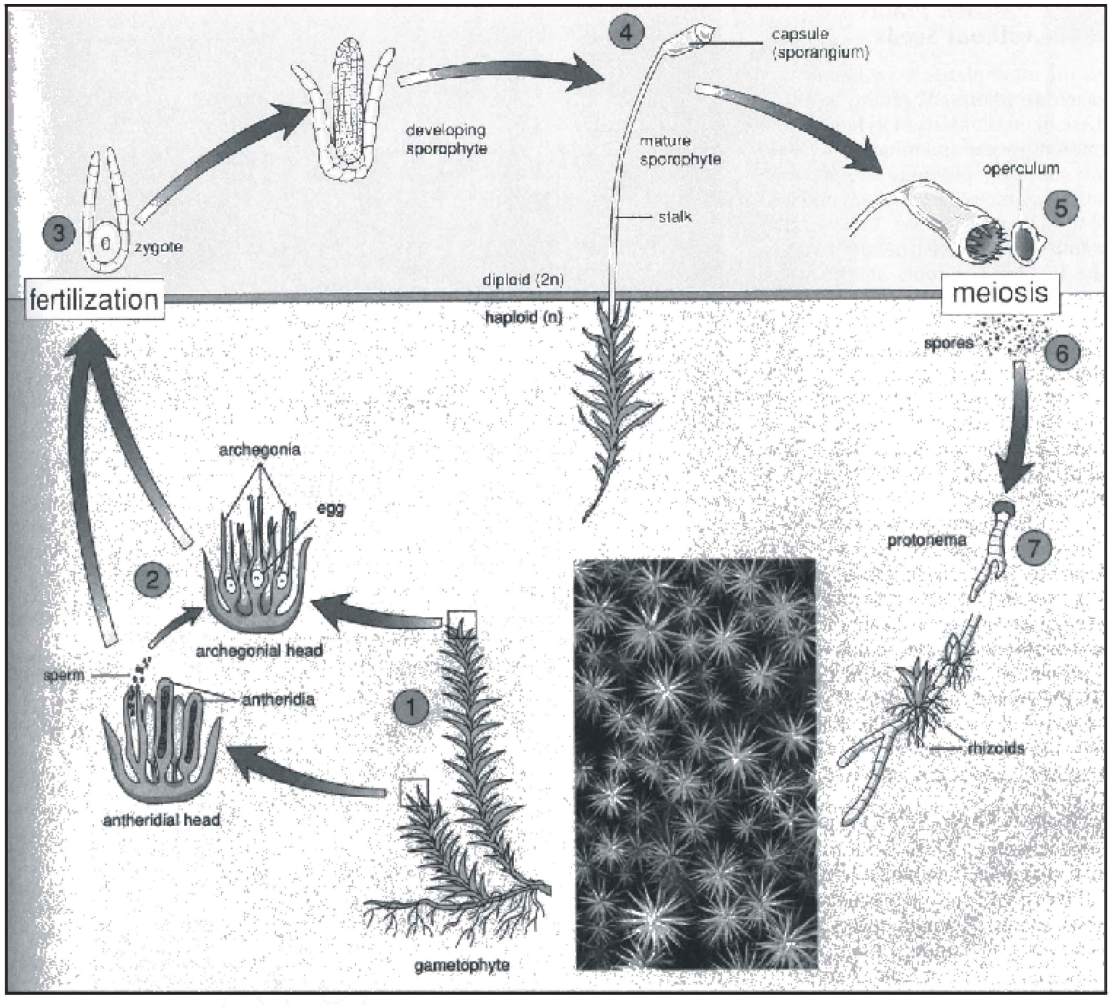


Fig: A moss bug, lacking rigid supporting tissue, bryophytes are low-profile plants they are most common in damp habitat

(3) Class Anthocerotae (*Hornworts – Anthoceros Class*):

It is *advance group* of bryophytes. The representative of this group is Anthoceros found *in hilly areas of Pakistan*.

Characteristics:

(i) ***Lobed Body:*** Gametophyte is highly lobed and ***irregular*** in outline.

(ii) ***Independent Sporophyte:*** Sporophyte (except early stage) is not dependent on gametophyte for protection and nourishment.

(iii) ***Sunken Sex Organs:*** Antheridia and archegonia are deeply sunk in gametophyte tissue.

ADVANCE CHARACTER IN SPOROPHYTE:

(iv) ***Stomata and Chloroplast in Epidermis:*** Sporophyte has stomata and chloroplast in epidermal cells and thus synthesize its own food and is independent of gametophyte.

(v) ***Waxy Cuticle:*** Sporophyte has waxy cuticle layer to reduce loss of water.

(vi) ***Meristematic Tissue:*** At the junction of foot and spore producing region there is a band of ***meristematic tissue (Power of division) that adds new cells towards spores producing region. This results increase in length of sporophyte and sporophyte continues to survive even after the death and decay of gametophyte.***

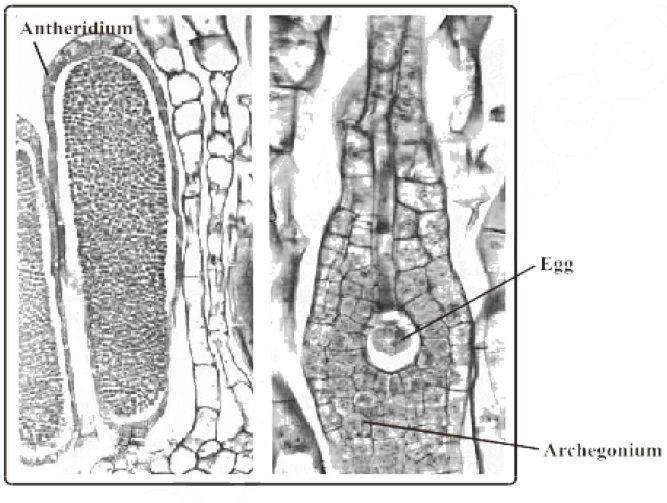


Fig. Sex Organs of Bryophytes

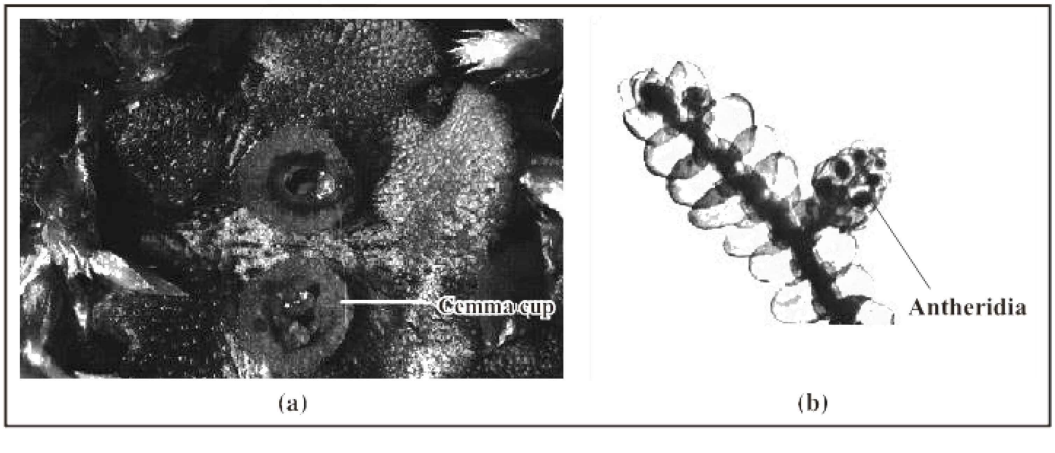


Fig. Marchantia. A typical liverwort, the gemma cups function in asexual reproduction (b) Porella, a leafy liverwort showing lateral antheridia bearing branch.

Fig. A liverworst, Marchantia bearing sex organs antheridia and archegonia on special branches called antheridiophores and archegoniaphores

Q.4 *Explain alternation of generation in Bryophytes give its importance.*

Ans. **ALTERNATION OF GENERATIONS**

In life history of plants there are two generations i.e., **Gametophyte** (gamete producing) generations and **sporophyte** (***spore producing***) generation, these two alternate with each other the phenomenon is called alternation of generation.

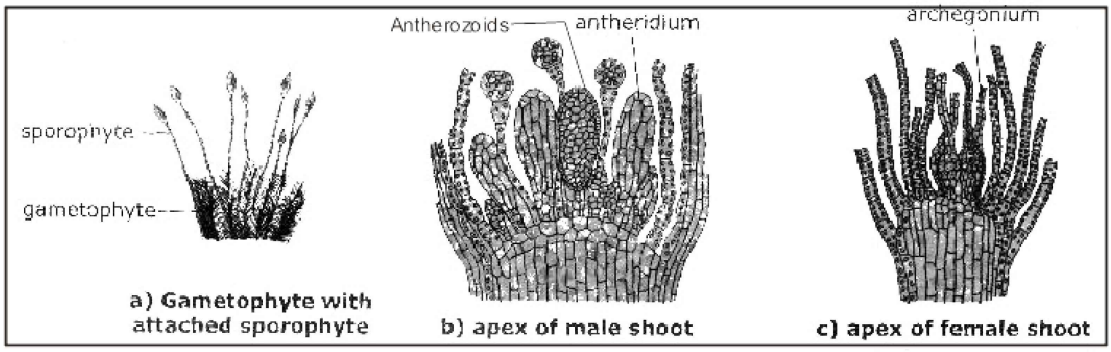


Fig. Funaria (Moss)

In bryophytes, *the dominant generation is haploid (n) i.e., plant body*. It produces gametes in sex organs.

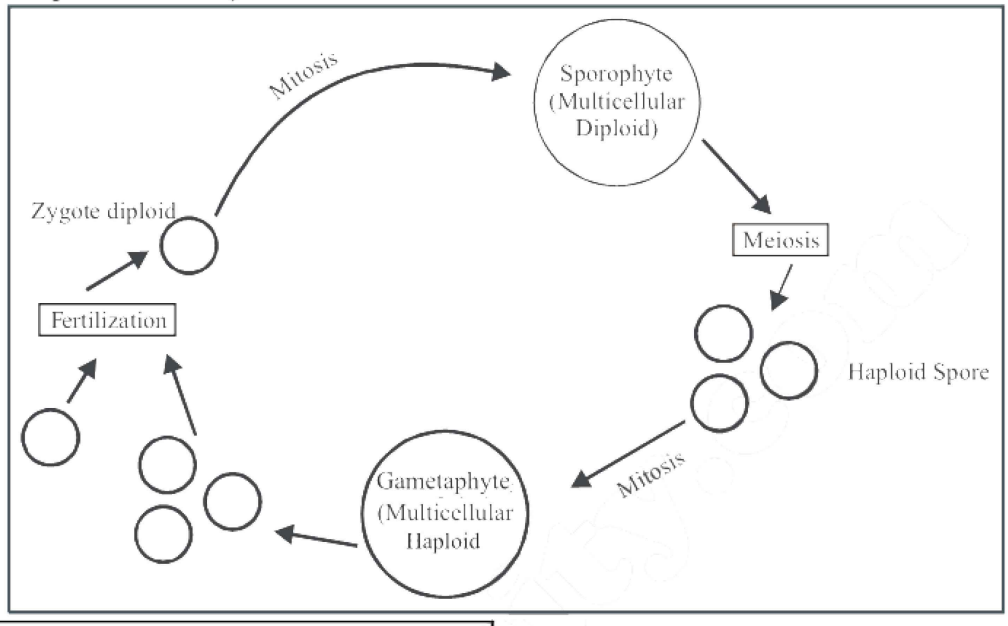
The spermatozoids or sperms are produced in **Antheridia** and eggs are produced in **archegonia**.

A haploid spermatozoid fuses with haploid egg to form diploid ***zygote or oospore***. The oospore does not develop into gametophyte but into embryo and then diploid sporophyte generation.

The sporophyte is reduced generation and consists of **foot**, **seta** (stalk) and **capsule** (sporangium).

The sporophyte produces haploid spores as a result of meosis.

The spores do not develop into sporophyte but into gametophyte stage by mitosis and complete the life cycle.



Importance of Alternation of Generation

***Spores** are formed as a result of **meiosis**.*

- ✓ *Due to **genetic recombination** variety of spores with different genetic make up are produced.*
- ✓ The spores develop into gametophytes which also have *variation in their genetic material.*
- ✓ The gametophyte with better genetic material have better chances of survival may die.
- ✓ The gametophyte with better genetic make up pass their better genes into sperms and eggs as gametes are produced by ***mitosis***.
- ✓ ***At fertilization*** there is genetic recombination of genes in oospore. From oospore or zygote sporophyte develops that produces spores by meiosis and results in variation of genetic material among spores.

Fig. Polytrichum, A hair cup moss plant

Thus alternation of generation have a survival value for bryophytes.

Q.5 Give Classification of division Tracheophytes. (OR)

(a) Write the important features of tracheophytes.

(b) What do you know about psilopsida?

(c) Give the characteristics of Lycopsida.

(d) Explain specific points of sphenopsida.

(e) Describe the important features of pteropsida.

Ans. (a) TRACHEOPHYTES

Tracheophytes are also called *green land plant* with *vascular tissue* i.e. ***xylem for conduction*** **of** ***water*** *and salts* and ***phloem for conduction of food***.

All vascular plants have *tracheids* in their xylem and thus called *tracheophytes*.

These are ***successful land plants*** with following characters. In tracheophyte plant body is *sporophyte*.

Characteristics:

(1) These have *root*, *stem* and *true leaves*.

(2) ***Vascular system*** i.e. xylem and phloem in root, stem and leaves for conduction and support.

(3) ***Sporangia*** are protected that lead to evolution of seed.

(4) These do not require water for fertilization as sperm is transported to egg by **pollen tube**.

(5) Formation of **flowers and fruits** in angiosperms (flowering plants) for pollination and protection and dispersal of seeds.

(6) ***Heteromorphic alternation of generations*** i.e. gametophyte and sporophyte are distinct morphologically.

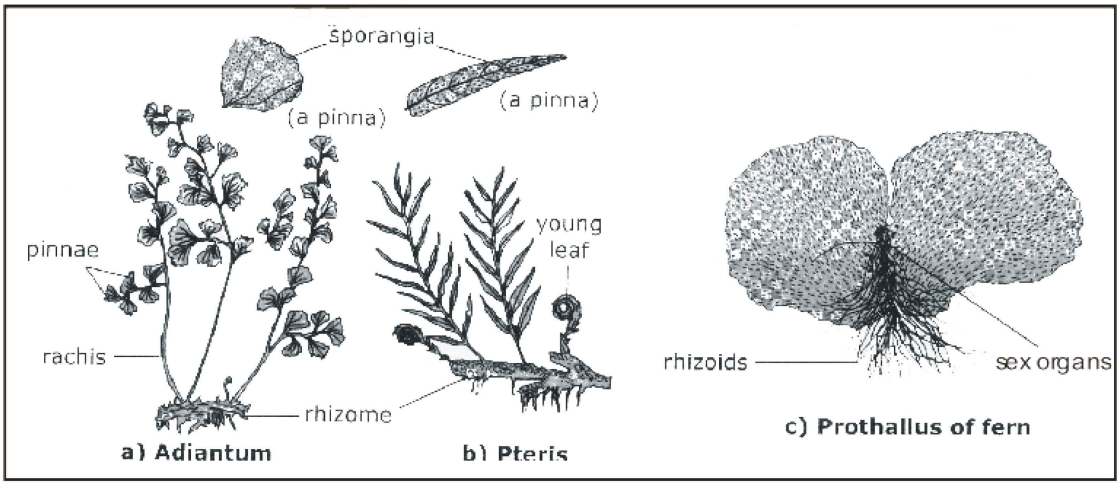


Fig. Pteridophytes

SUB-DIVISION OF TRACHEOPHYTES:

(1)	Sub division	Psilopsida	(سائی لوپ سِڈا)
(2)	Sub division	Lycopsida	(لائی کوپ سِڈا)
(3)	Sub division	Sphenopsida	(سفی ناپ سِڈا)
(4)	Sub division	Pteropsida	(ٹی راپ سِڈا)

(b/1) Sub Division Psilophyta

Psilopsida are the ***earliest primitive vascular plants***. Most of them become, extinct e.g., *Rhynia. Horneophyton, Psilophyton* and *Cooksonia*. There are only two living genera psilotum and tmesipeteris.

These have the following characters:

(i) The **sporophyte** is *rootless*.

(ii) **Stem** is differentiated into an underground stem called ***Rhizome*** and aerial stem.

(iii) The stem is ***dichotomously branched*** i.e. repeatedly divides into two branches in Y-shaped manner.

(iv) The **Rhizome** (underground stem) bears *rhizoids* for absorption of water.

(v) The **aerial branches** were leafless bear small veinless outgrowth. The branches were green to carry out photosynthesis and thus worked as leaves.

(vi) The **sporangia** developed at the tip of branches or on lateral side of branches. Thus plant body was sporophyte.

(vii) In stem **xylem and phloem** were present in the centre in the form of solid cylinder without pith. Vascular tissue was surrounded by ***wide cortex*** around which ***epidermis*** was present.

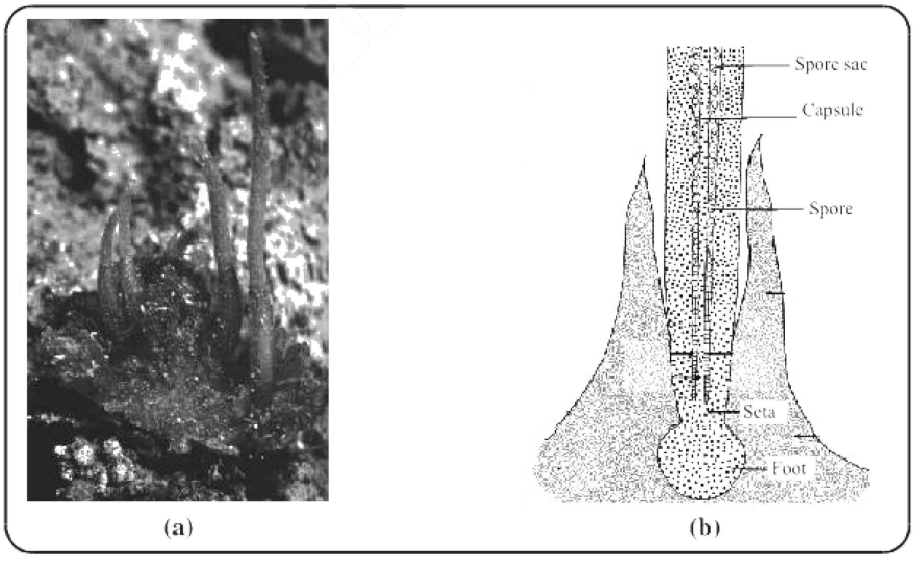


Fig. Anthoceros, a hornwort (a) gametophyte with attached horn-shaped sporophyte (b) V.S. of sporophyte.

(viii) **Gametophyte** is *thalloid*, *colourless* and *underground*. Its cells contain fungi, which provide gametophyte with food, and fungi get protection by gametophyte. This association is called mycorrhizal association e.g. in ***psilotum*** *and* ***Tmesipeteris*** (سلاٹم اور میسی پیٹیرس).

Q.6 How did Evolution of Leaf occur?

Ans. **EVOLUTION OF LEAF**

The psilopsida were leafless but have very small outgrowth on branches which were veinless and not regarded as leaves. *Lycopsida were the first plants that formed true leaves*. There are two types of leaves.

(i) **Microphylls:** These are small and have a ***single vein***. These are found in Lycopods (Lycopodium).

(ii) **Megaphylls:** These leaves have ***large blade*** or ***lamina***. ***With large number of divided veins***, these are found in fern and seed forming plants.

EVOLUTION OF MEGAPHYLLS

These leaves developed from dichotomous branching system. In primitive fern like plant about 350 million years ago. Evolution of megaphylls took place in following steps:

(a) Over Topping:

It is unequal development of various branches. In primitive fern like plant the dischotomously branched aerial portions of stem showed ***unequal branching***, i.e. some branches were small while other were long and grew ***in different planes***.

(b) Planation:

The unequal dischotomous branches became arranged in one plane. It is called planation.

(c) Fusion and Webbing:

The space between overtopped dichotomous branches were occupied by photosynthetic tissues that connected these branches. Thus a flat leaf blade or lamina was formed with dichotomously branched veins.

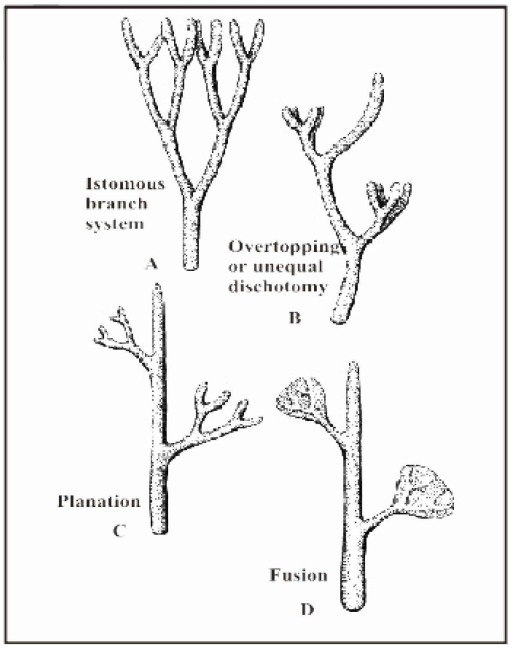


Fig. Successive evolutionary steps in the evolution of leaf

Further evolution resulted in ***reticulate venation (network)***. The process of evolution of leaf was very slow and gradual and took about 15 – 20 million years.

(b/2) Sub-Division Lycopsida

It includes *plant like* to *Lycopodium* and *Selaginella*.

These plants are also called club mosses or ***spike mosses*** due to their club/spike shaped cone or stobili and small moss like leaves. These plants are called ground as the resemble to ever green plants. These have following characters:

(i) The plant body is **sporophyte** differentiated into true root, stem and is true leaves. The leaves are single **microphylls**.

(ii) The ***leaves*** may be *spirally arranged* or opposite.

(iii) **Sporongia** develop *singly on upper side* of leaf, such leaf is called sporophyll.

(iv) The **sporophyll** may be grouped together to form cone or strobili.

(v) On the upper surface of leaf an outgrowth called **ligule** may be absent as in *Lycopodium* or present as in Selaginella.

(vi) The sporophyte may have sporangia of one kind as in *Lycopodium*. Such sporophytes are called **Homosporous** or sporangia may be of two kinds, microsporangia or male sporangia and mega sporangia or female sporangia. Such sporophytes having two types of sporangia are called **Heterosporous** as in *Selaginella*. This condition is called Homospory and Hetrospory respectively. *Heterospory is characteristics of seed forming plants*.

(vii) Gametophyte of Lycopsida is underground and has fungal association called mycorrhiza.

(c/3) Sub Division Sphenopsida OR (Horse Tail) (*Equisetum*):

The plants included in this group are called **Arthrophytes** because whole plant body consists of large number of joints.

These have following characters:

(i) ***The plant body is sporophyte*** differentiated into root, stem and leaves.

(ii) ***Leaves*** may be *broad or scale* like and are always arranged in whorls.

(iii) ***Main stem*** is not smooth but jointed (***Arthrophytes***) and had ***ridges*** *and* ***furrows***.

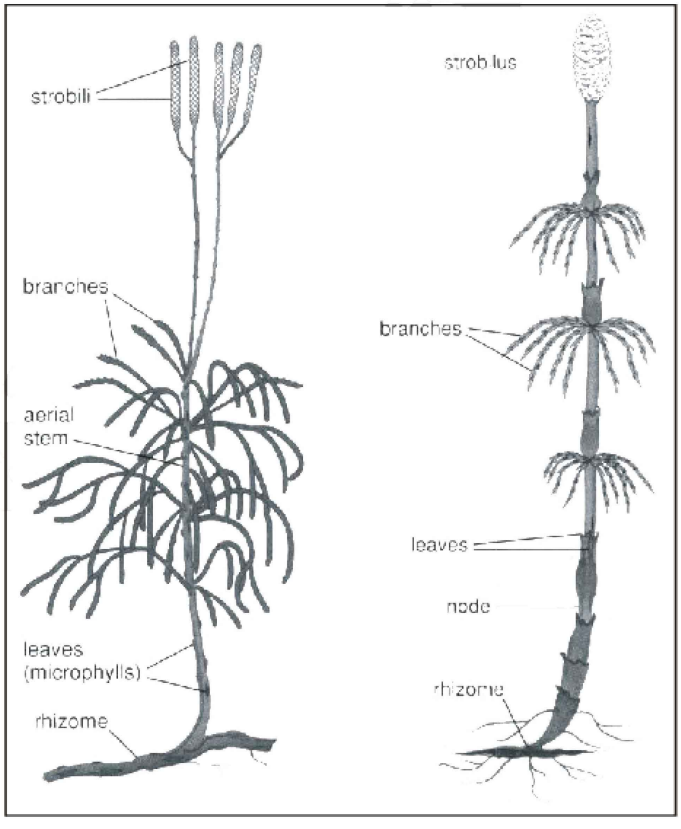
(iv) From each node there is given out whorl of branches.

(v) ***The sporangia*** develop on sporangiophore, the **sporangiophores** group together to form **cones**.

(vi) The sporangiophore has stalk and expanded disc. On the underside of disc sporangia develop.

(vii) ***Gametophyte*** is thalloid and grows on clay soil or mud e.g. Equisetum.

Fig. Representative of three of the subdivisions of vascular plants (a) club moss Lycopodium (b) horsetail, Equisetum (c) A tree fern



(d/4) Sub Division Pteropsida

It is divided into three classes.

(i) Class Filicinae (Ferns):

1. An important character of this group is that sporangia are attached on underside of **frond** or leaves. The immature or young frond has coiled pattern of development like watch spring and it is called **circinate vernation**.
2. Ferns are mostly shade and moisture loving plants. These grow on hills and plains.
3. Some are *epiphytes*, i.e. grow on bark of tree.
4. World wide distribution, abundant in tropics.

Fig. A frond bearing sporingia attached to the underside of the leaf.

Fig. Ferns. A ostrich fern growing on a froest floor. See the coiled immature and young frondsready to uncoil.

Examples: *Dryopteris, Pteridium, Adiantum and Pteris.*

ADIANTUM (*MAIDEN HAIR FERN*):

Structure:

It grows on moist walls. Watercourse and drains. It is small herb.

Stem is short underground, called rhizome which grow horizontally in soil covered by brownish scales leaves called ramenta and persistant leaf bases. From underside of ***Rhizome*** are given out ***Fibrous adventitious*** roots. From upper side of rhizome are given out large pinnately divided leaves called **fronds**. The young leaves are in ***circinate vernation*** i.e. ***coiled form***. The ***stalk or rachis*** of leaves is black smooth and shiny hence maiden hair fern. The leaflets show ***dichotomous venation***. The groups of sporangia or ***sori*** develop on under side of bent margin of leaflets.

Life Cycle

These have *heteromorphic alternation* of generations i.e. morphologically two distinct generations.

Sporophyte:

The plant body is **diploid sporophyte** bearing groups of ***sporangia or sori*** on under side of margin of leaflets. Mature sori become black. The leaves bearing sporangia are called **sporophylls**.

Each sporangium is multicellular having stalk bearing biconvex capsule. The capsule is made of single layer of thin walled flat cells. The edge of capsule is made of ***annulus*** which occupies 3/4 of edge and made of cells with radial and inner wall thick. The second part **stomium** is made of thin walled cells. Inside the **capsule** haploid spores are formed by meiotic division of haploid spores are formed by meiotic division of diploid spore mother cells. During dry weather cells of annulus contract and stomium cells rupture to release spores. The spores fall on moist soil and germinate to form gametophyte.

Gametophyte (Prothallus):

Prothallus is small ***heart shaped*** structure. It is ***notched at anterior*** and in which lies growing point. From posterior under surface are given out ***rhizoids*** which fix the prothallus and absorb water. It is made of thin walled of many layers of cells but at the margin it is of single layer.

The ***prothallus is monoecious*** i.e. sex organs develop on the same prothallus. *Archegonia* occur near the notch and *antheridia* are scattered among Rhizoids.

Antheridium: In each antheridium large number of ***coiled; multiciliated spermetozoids*** are produced.

Archegonium: These are ***flask shaped*** having broader part **venter** and elongated part ***neck***. Venter contains egg or *oosphere*.

Fertilization: The spermatozoids (Sperms) reach the neck of archegonium by water pass through neck, unite with egg to form **zygote** or **oospore**.

Formation of Sporophyte: The diploid oospore divides by ***mitosis*** to form young sporophyte which is attached to gametophyte but later on becomes independent.

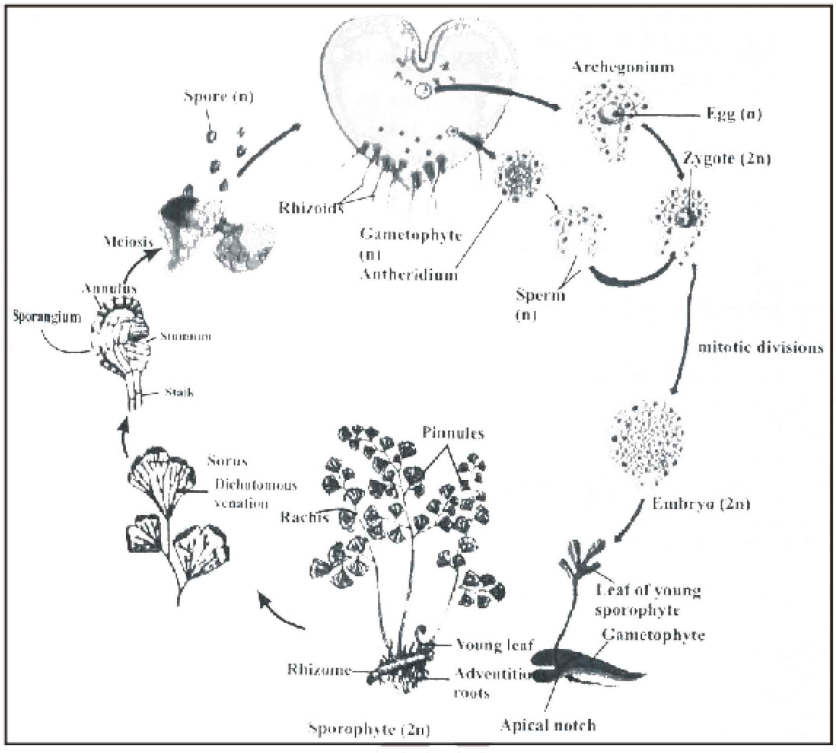


Fig. Life history of Adiantum

Q.7 How did evolution of seed occur in plants?

OR

Enumerate the evolutionary steps of seed.

Ans. **EVOLUTION OF SEED**

Seed forming plants are spermatophytes.

Among vascular plants the spermatophytes (seed forming plants) are predominant over non-seed forming plants.

The development of seed habit occurred approximately 390 million years ago but the complete seed forming plants appeared in late Devonian period about 365 million years ago.

Seed can be defined as fertilized ovule, integumented in indehisscent megasporangium. Integument is specialized protective covering around megasporangium.

Following were the steps in evolution of seed:

(i) Evolution of **heterospory**.

(ii) Retention and germination of **megaspore within Megasporangium**.

(iii) Development of **integument**, a protective layers around megasporangium.

(iv) Reduciton to a **single functional megaspore** per megasporangium.

(v) Development of **embryo sac** within megasporangium.

(vi) Modification of distal end of megasporangium for **pollen Capture**.

(i) Evolution of Hetrospory:

Bryophytes and pteridophytes (non seed vascular plants) are homosporous (except Selaginella and some other) i.e. produce one kind of spores. During evolution some plants like selaginella produced two kinds of spores and these are called Heterosporous. The smaller spores are male spores or microspores and larger spores are female spores or megaspores. Microspores developed in microsporangium while megaspore developed in megasporangium. Male spore or microspore germinates into male gametophyte or microgametophyte while female spore or megaspore develops into female gametophyte or megagametophyte.

(ii) Retention and Germination of Megaspore within Megasporangium.

In Selaginella the ***megaspore does not shed*** from megasporangium but megaspore develops into megagametophyte inside the megasporangium. In the megagametophyte egg develops.

(iii) Development of Protective layer around Megasporangium:

The branches from sporophyte surround the megasporangium containing megagametophyte. These branches fused to form a protective covering called integument around the megasporangium. This change led to ***formation of ovule***. "An ovule is an integumented indehiscent megasporangium containing megagametophyte" in other words ***ovule is an immature seed***.

(iv) Reduction of a Single Functional Megaspore per Megasporangium;

In pteridophytes normally single megaspore mother cell divides by meiosis to produce *four* ***functional megaspores*** which germinate to give rise four megagametophytes. In seed forming plants ***only one megaspore germinates*** to megagametophyte to avoid competition among four gametophytes. Remaining *three megaspore degenerate*.

(v) Development of Embryo Sac within Megasporangium:

A single megaspore retained in megasporangium germinates to form megagametophyte or embryo sac that contains egg.

(vi) Modification of Distal End of Megasporangium for Pollen Capture:

When development and evolution of seed completed then the distal end of megasporangium become modified for capturing pollen – containing sperms. It was

necessary for fertilization. The pollen after catching by tip of megasporangium develops pollen tube that contains sperm. ***The pollen tube transports the sperms to egg in embryo sac***. The ovule after fertilization change into seed and its integuments form seed coat or testa.

Advantages of Seed

(1) **Seed provides protection of developing embryo** against drying and injuries.

(2) **Seed stores food** for early developmental stages of embryo.

(3) Development of seed habit enabled in plant to live **on land** and dry environment permanently.

Q.8 Write down particular features of gymnospermae.

Ans. **CLASS GYMNOSPERMAE**

(i) **Naked Seeded:** These plants produce naked seed i.e. seed is not enclosed in fruit (Gymno = naked, spermae – seed).

(ii) **1/3 of World:** Wide spread and consists of 1/3rd of world's forest.

(iii) **Naked Ovule:** The naked ovules are born on megasporophyll.

(iv) **Heteromorphic alternation generation:** These show heteromorphic alternation of generations with independent dominant sporophyte and dependent reduced gametophyte.

(v) **Retainment of Ovule:** Female gametophyte is retained in ovule permanantly.

(vi) **Megaspore develop on megasporophyll:** The microspores develop on microsporophyll and megaspores develop on megasporophyll. The megasporophyll did not form ovary.

Example: Important genera are:

(i) *Cycas* (Sago Palm)

(ii) *Pinus* (Pines)

(iii) *Taxus* (Yew)

(iv) *Picea* (Hemlock)

(v) *Cedrus* (Deodar)

(vi) *Ginkgo*

Fig. (a) Cycas tree-habit and general organography

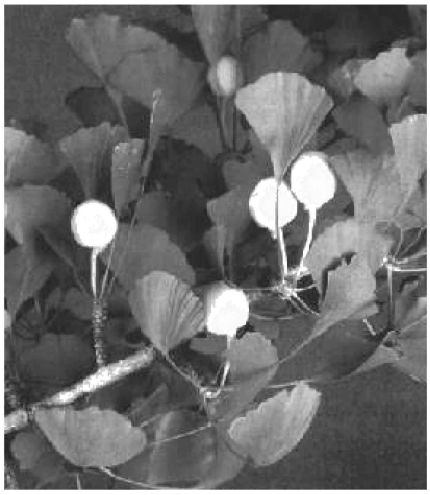


Fig. (b) Ginkgo biloba

Q.9 Discuss life cycle of Pinus / a gymnosperm.

Ans. **LIFE CYCLE OF PINUS (PINE)**

Alternation of Generation:

In Pinus the dominant diploid sporphyte (tree) generation alternates haploid inconspicuous (reduced) gametophyte generation.

Sporophyte: Pinus tree is sporophyte that produces ***microspores in microsporangia*** present on underside of ***microsporophyll***. The microsporophyll grouped together to form ***male cone***. The megaspores or ***female spores develop in megasporangium*** present on ***megasporophylls***. The megasporophyll also grouped together to form ***female cone***. The male and female cones are developed on same plant in different seasons. Due to formation of cones these plants are called ***conifers***.

MALE CONE

It consists of central axis on which microsporophylls are arranged.

Microsporophylls: On underside each microsporophyll, there are two microsporangia that contain haploid microspores.

Microspores: Each microspore has ***double wall*** containing ***nucleus*** and ***cytoplasm***. It has ***two wings*** to its lateral sides which aid in ***fertilization by wind***.

Two Sperm: The microspore's nucleus divides to form two sperms or male gametes. Microspore containing ***male gamete is called pollen grain***.

FEMALE CONE

(1) ***Central Axis:*** The female cone consists of central axis on which megasporophylls are arranged, which are ***woody***.

(2) ***Ovule:*** On the surface of each megasporophyll is a pair of ovule. In each ovule, integumented megasporangium contains single diploid megaspore mother cell. The diploid megaspore mother cell is divided by meiosis to form four haploid megaspores.

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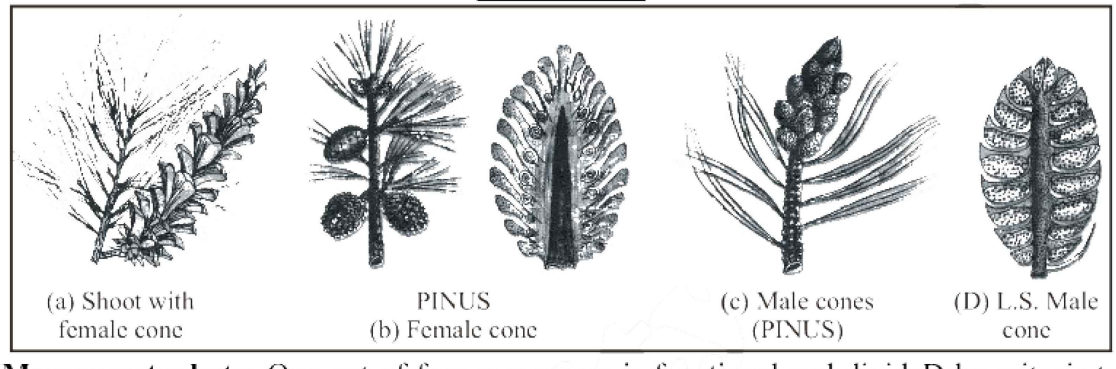


Megagametophyte: One out of four megaspore is functional and divideD by mitosis to form megagametophyte or ***female gametophyte*** or ***embryo sac***.

Embryo Sac: The embryo sac contains ***one to several archegonia*** that contain ***egg***.

HELP LINE

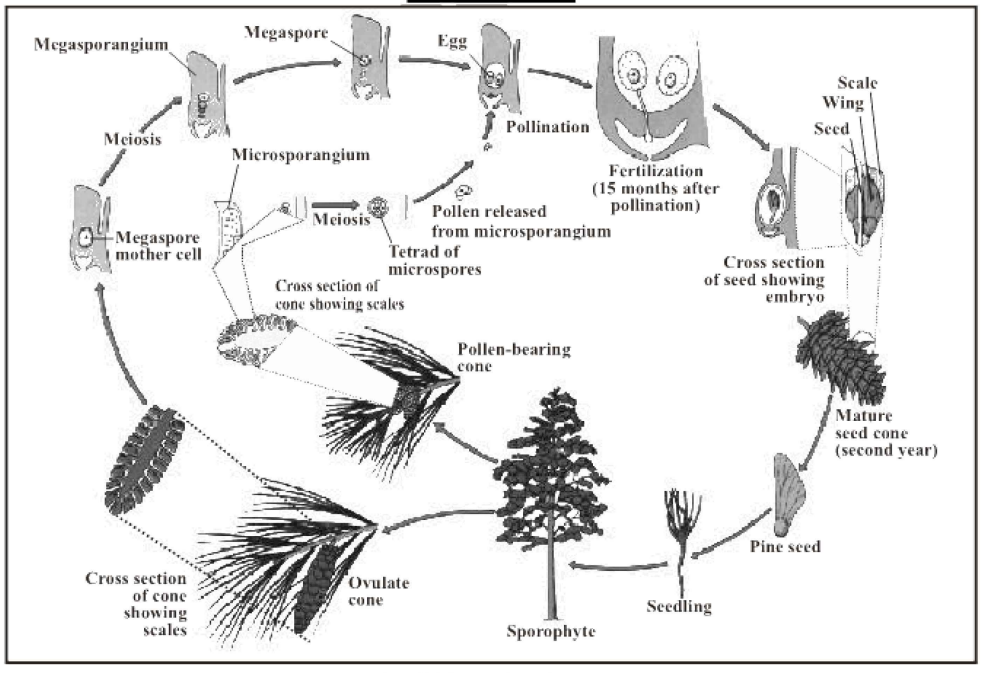


Fig. Life cycle of Pinus

Pollination by Wind: The transfer of pollen grains to ovule is called pollination and it takes place by wind. With the help of two wings the pollen grains containing sperm (male gametophyte) is carried by wind to female cone. The ***pollen grain develops pollen tube*** that passes through integumented megasporangium and reach the embryo sac.

Fertilization: The tip of the pollen tube dissolves and releases ***two sperms*** in embryo sac. One of the two sperms unites with egg to form zygote.

Zygote Formation: Many zygotes are formed in an ovule but ***only one zygote survives***.

Seed and Embryo Formation: Zygote develops into embryo. The ovules matures to form seed. On germination of seed the embryo forms a new sporophyte plant.

Q.10 (a) Give specific characteristics of angiospermae.

(b) Explain life cycle of an angiosperm.

Ans. (a) CLASS ANGIOSPERMAE (*FLOWERING PLANTS*)

These have following characters:

(i) **Enclosed Seeded:** In these plants the seed is enclosed in fruit. ***The fruit develops from wall of ovary***. The ovary is fertile leaf bearing ovule that become folded and its margins completely fused to form ovary. These are also called closed seeded plants (***Angio = Close, spermae = seed***).

(ii) ***No. of Species:*** Angiosperm constitute 2,35,000 species out of 3,60,000 known species of all plants.

(iii) ***Flowers and Fruits:*** Plant produces flowers, seed within the fruit.

(iv) ***Heterosporous:*** These are heterosporous and highly evolved.

(b) LIFE CYCLE OF ANGIOSPERMIC PLANT

(1) Sporophyte Generation:

(i) ***Diploid Body:*** The adult flowering plant is diploid sporophyte consisting of root, stem, leaves and flowers.

(ii) ***Flower:*** Flower is a reproductive part and is ***modified shoot***. Each flower consist of pedicel, thalamus or torus and floral leaves (***sepals, petals stamens*** and ***carpels***).

Modification: ***Thalamus*** *is a modified stem while stamens and carpels are modified floral leaves.* Sepals and petals are non-essential parts, as they do not take part in reproduction while stamens and carpels are essential parts of flower as they take part in reproduction.

Protective Parts of Flowers: The ***sepals*** and ***petals*** protect the essential parts of flower and also ***attract insects for pollination***.

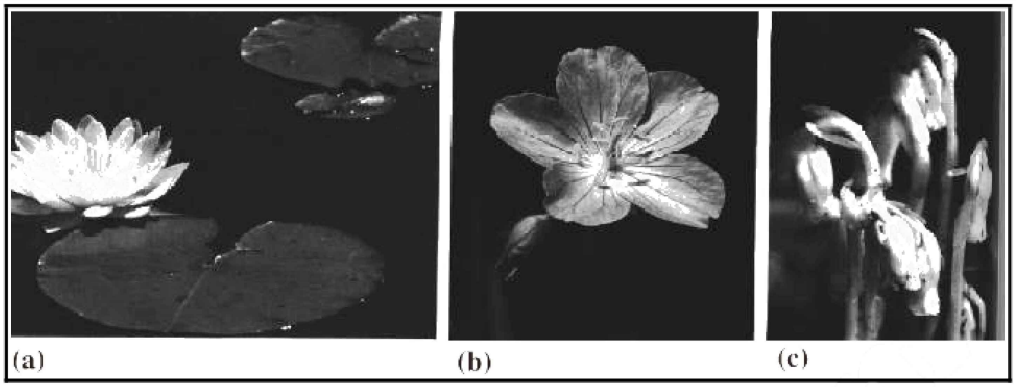


Fig. Some of the remarkable diversity of angiosperms is shown in these photographs. The species shown her eare Dicots (a) Fragrant water lily, (b) wild geranium, (c) Indian pipe (a parasite) an angiosperm that lacks chlorophyll.

(c) Reproductive Parts of Flower

(i) ***Stamen:*** It is a ***male reproductive part*** of flower and consists of ***long filament*** having bilobed ***anther*** at its tip. In anther haploid microspores are produced by ***meiosis*** inside pollen sacs.

(ii) ***Carpel:*** It is a ***female reproductive part*** of flower. The basal broader part of flower is ovary, elongated part is style and terminal broad part is ***stigma***. Inside ovary, one or more ovules are present. Ovule contains megasporangium covered by integument. In megasporangium embryo sac is surrounded by a tissue called ***nucellus***.

(d) **Pollination:** Pollen grain is transferred to stigma by insects, wind or water. It is called pollination.

(e) **Male Gametophyte:** On the stigma the pollen grain germinates to form ***pollen tube***. The nucleus of microspore first divides by mitosis to form ***two nuclei***, the tube nucleus and generative nucleus. The generative nucleus further divides by mitosis to form ***two sperms***. This germinated pollen grain containing ***two sperm is called male gametophyte***.

(f) **Female Gametophyte:** Inside the ovule a ***single functional megaspore*** divides by mitosis to form female gametophyte or ***embryo sac***. Embryo sac consists of ***seven cells*** out of which one cell is the ***egg or oosphere***.

(g) **Double Fertilization:** ***"Double fertilization a specific fertilization in angiosperms, in which two sperms are found, so sperm I fuses with egg to form zygote and sperm II fuses with a diploid nucleus to form endosperm".***

After pollination the pollen tube of male gametophyte passes through stigma style and enters ovule and reaches embryo sac.

In embryo sac two sperms are released. ***Sperm one*** unites with egg (n) to form diploid zygote. ***The zygotes divides by mitosis to form diploid embryo*** which on germination of seed develop into diploid sporophyte. In the meantime the two haploid nuclei present in embryo sac unites to form diploid fusion nucleus.

Sperm second (n) with haploid nucleus unites with diploid fusion nucleus to form triploid ***endosperm cell (3n)***. This triploid endosperm cell divides by mitosis to form a tissue called endosperm that stores food for developing embryo. ***This fusion of one sperm with egg and second sperm with diploid fusion nucleus is called double fertilization***.

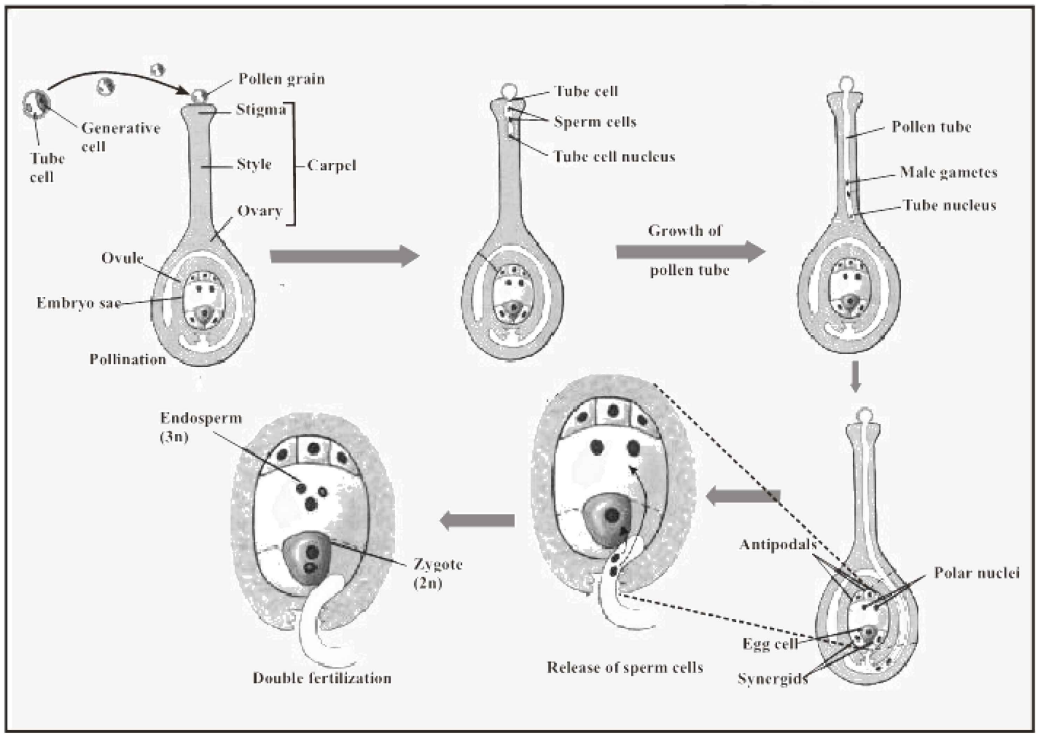


Fig. Life Cycle of on angiospermic plants

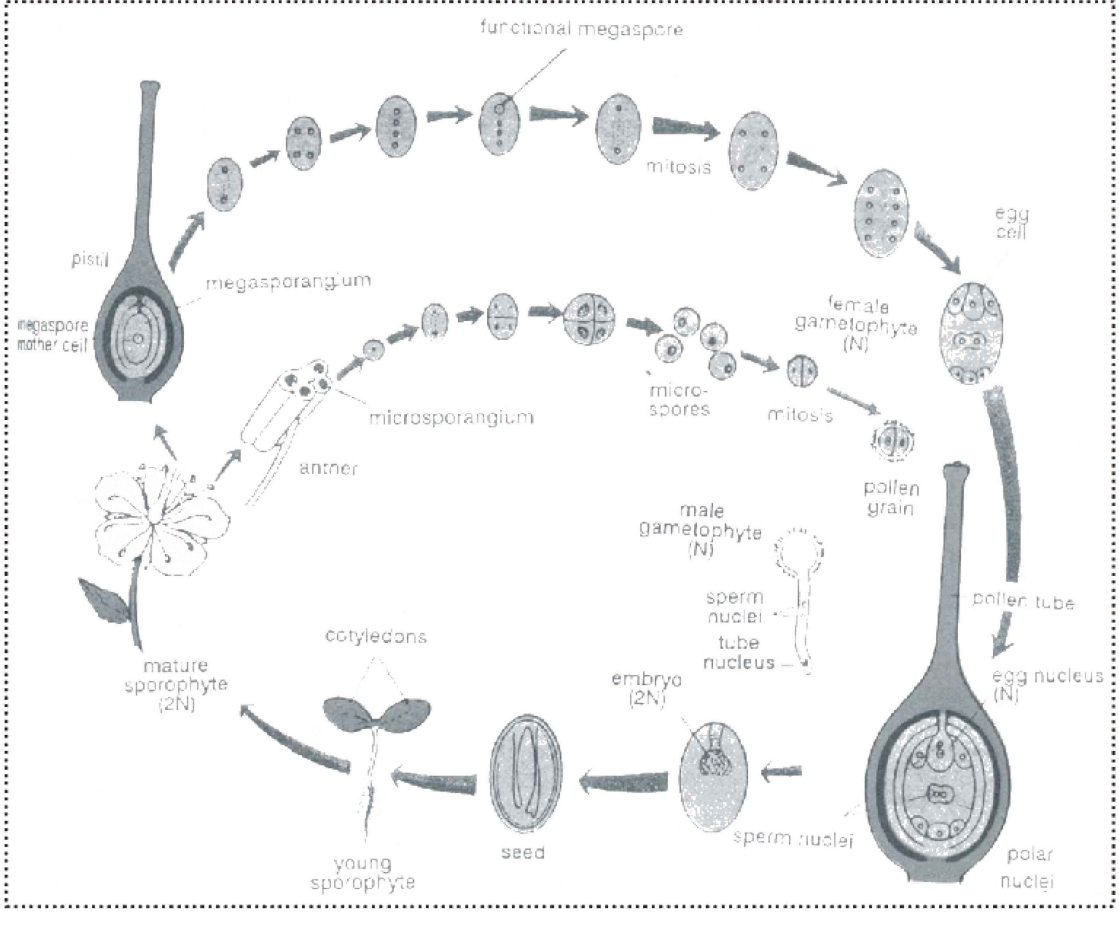
(h) **Formation of Seed and Fruit:** After formation of endosperm and embryo the ***ovule increases in size to form seed***. Its Integumen to become hard and dry to form seed coat or testa and tegmen.

The wall of ***ovary grows*** rapidly around the seeds and matures to form ***fruit***.

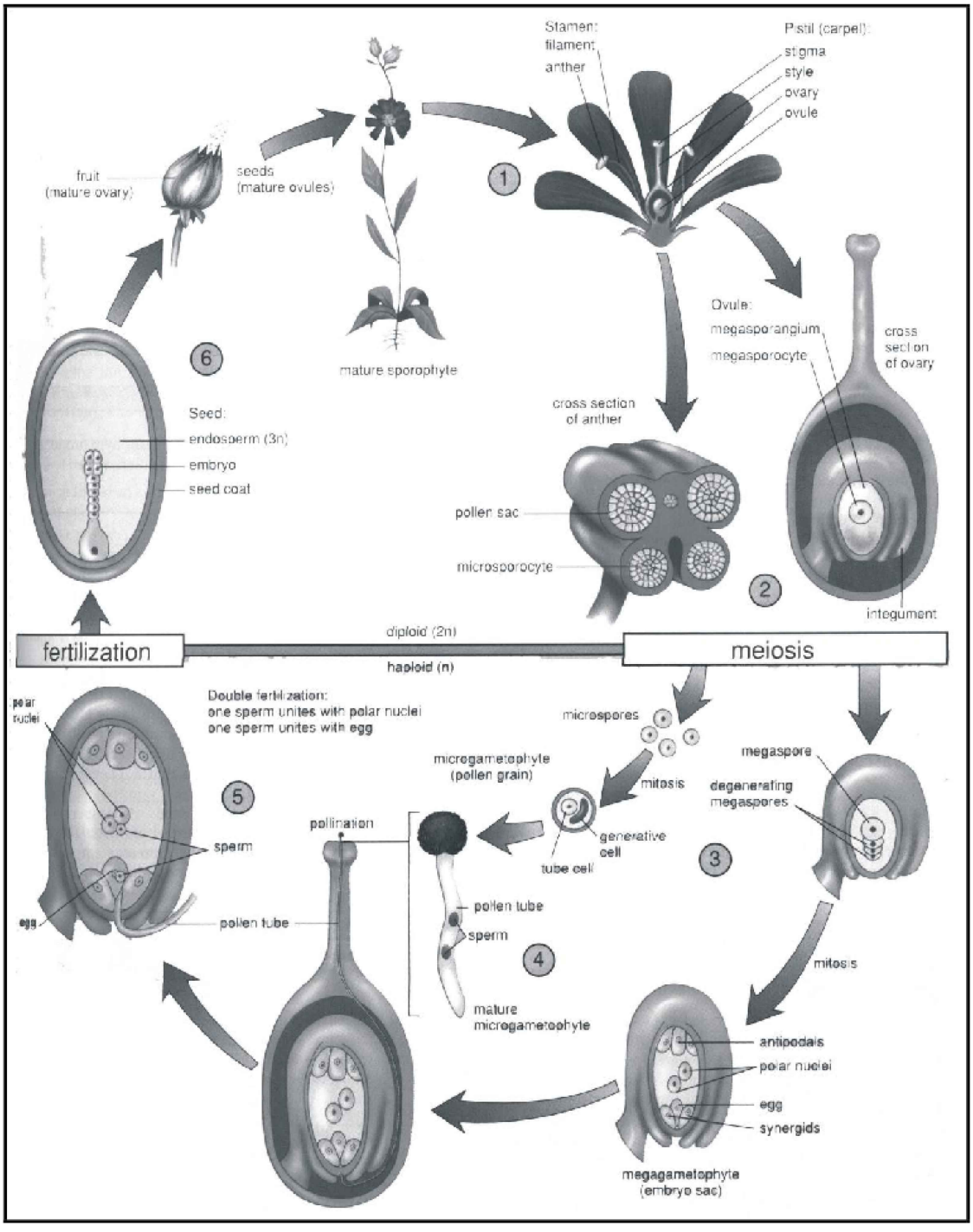
EXAMINE YOURSELF

Q.	*Brief sporophyte of angiosperm. (See A)*
Q.	*What are protective parts of flower? (See B)*
Q.	*Which are reproductive parts of flower? (See C)*
Q.	*What is pollination? (See D)*
Q.	*Brief male gametophyte of angiosperm. (See E)*
Q.	*What do you know about female gametophyte of angiosperm? (See F)*
Q.	*Write a short note on double fertilization. (See G)*
Q.	*What do you know about formation of seed and fruit? (See H)*

THINKING ROOM



FOR CONCEPT


Stamen:
filament
anther
Pistil (carpel):
stigma
style
ovary
ovule
fruit
(mature ovary)
seeds
(mature ovules)
1
mature sporophyte
Ovule:
megasporangium
megasporocyte
cross
section
of ovary
6
Seed:
endosperm (3n)
embryo
seed coat
cross section
of anther
pollen sac
microsporocyte
2
integument
fertilization
diploid (2n)
haploid (n)
meiosis
Double fertilization:
one sperm unites with polar nuclei
one sperm unites with egg
polar
nuclei
microspores
megaspore
microgametophyte
(pollen grain)
mitosis
degenerating
megaspores
5
pollination
generative
cell
tube cell
3
sperm
egg
pollen tube
pollen tube
sperm
4
mature
microgametophyte
mitosis
antipodals
polar nuclei
egg
synergids
megagametophyte
(embryo sac)

Q.11 Differentiate between Monocot and Dicot.

Ans. **DICOT AND MONOCOT**

Sr.	Dicot	Monocot
1.	**Seed:** Plants with two cotyledons in their seeds are called dicotyledenous or dicot e.g. pea and gram.	Plants with single cotyledon in their seeds are called monocot e.g. corn, wheat, grasses.
2.	**Number of Sepals and Petals** These have 4 to 5 sepals and petals or multiple of these numbers.	These have 3 sepals or petals or multiple of these numbers.
3.	**Vascular Tissue:** The vascular bundles are in form of ***ring*** in the cortex of stem.	Vascular bundles are ***scattered*** in the cortex of stem.
4.	**Leaf Venation:** Leaf venation is ***reticulate*** i.e., veins form net work in lamina.	Leaf venation run ***parallel*** in the lamina.
5.	**Presence or Absence of Wood.** These may be ***herbaceous*** (without wood) or ***woody***.	These are always herbacous without wood.
6.	**Symmetry of Flower** Symmetry of flower may be regular or irregular.	Symmetry of flower may be regular or irregular.
7.	**Primary and Secondary Wood** Due to presence of cambium between xylem and phloem ***secondary wood*** is present.	Due to absence of cambium between xylem and phloem only primary tissue is present.
8.	**Primary Growth and Secondary Growth:** Primary as well as secondary growth takes place increase in length is due to division of cells of tip of shoot and root is called primary growth. Due to division of cells of cambium increase in diameter takes place which is called secondary growth.	Only primary growth takes place, cambium is absent, therefore, no secondary growth.

Q.12 Give Characters, Economic Importance and Familiar Plants of Family Rosaceae (Rose Family).

Ans. ROSE FAMILY (ROSACEAE) GENERA AND SPECIES:

In world = 100 genera and 2000 species.

In Pakistan = 29 genera and 213 species.

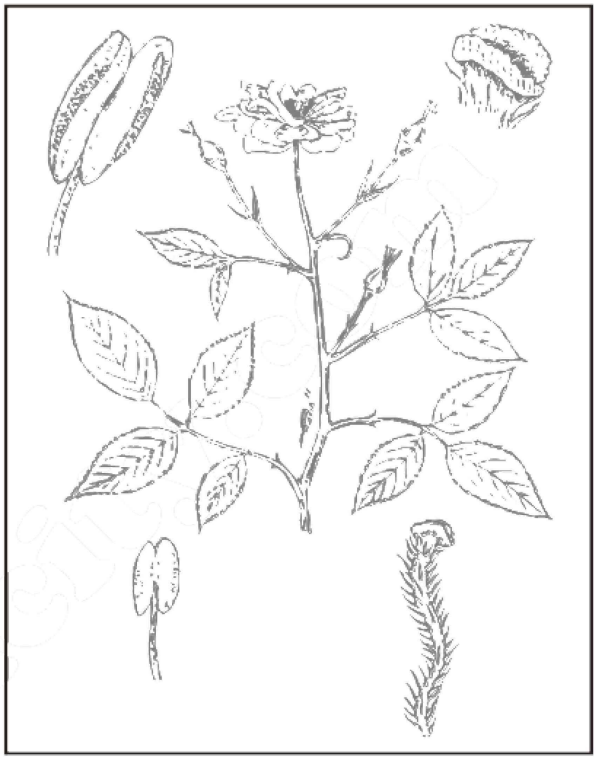


Fig. Rosaceae A-twig; bB-young stamen; B1-englarged open anther, showing pollen in it; C-ctyle hairy and stigma bilabiate; C1-enlarged bilabiat stigma.

Vegetative Characters:

(1) Plant may be *herb, shrub* or *tree*.

(2) *Stem* have usually *spines*.

(3) *Leaves* alternate, rarely opposite, simple or compound.

(4) A pair of stipule may be present at base of leaf the ***stipules*** sometimes adnate to petiole (attached).

FLORAL CHARACTERS:

Inflorescence: ***Solitary*** or may be ***racamose cymore cluster***.

Flower: Bisexual ***actinomorphic***, often ***perigynous***, usually showy scented.

Calyx: ***Sepals 5***, rarely 4, united at the base.

Corolla: ***Petals 5*** or multiple of five and are free (***Polypetalous***), large and showy.

Androecium: Stamen numerous, sometimes 5 or 10.

Gynoecium: I-numerous, ***separate (apocarpous)*** or ***united (Synacarpous)***, ovary generally superior, sometime inferior.

Placentation: Basal when carpel is ***single*** or ***apocarpous*** and axile when many carpels are syncarpous (fused).

Familiar Plants:

(i)	*Pyrus – pears*	*(ii)*	*Rosa (Rose)*	*(iii)*	*Malus (apple)*
(iv)	*Fragaria (Strawberry)*	*(v)*	*Almond*	*(vi)*	*Apricot*

Q.13 Write down economic importance of rosaceae.

Ans. ECONOMIC IMPORTANCE:

It provides us fruits.

(i) ***Decoration:*** It is used in decoration purposes e.g., rose.

(ii) ***Ornamental:*** Cultivated in garden for ornamental purpose in parks and gardens.

(iii) ***Sticks:*** The branches of crataegus is used to make walking sticks.

(iv) ***Tobacco Pipes:*** Wood of pyrus pastia is used for making tobacco pipes.

(v) ***Gulkund:*** Petals of rose are used in making gulkund.

(vi) ***Ark:*** Ark gulab is used for curing eyes diseases.

(vii) ***Perfumes:*** Rose oil is used as perfumes.

Q.14 Give Characters, Economic Importance and familiar plants of family Solanaceae (Potato Family).

Ans. SOLANACEAE (*POTATO FAMILY*)

GENERA:

In world = 90 genera and 2000 species.

SPECIES:

In Pakistan = 14 genera and 52 species.

VEGETATIVE CHARACTERS:

It is called *potato family*. These may be *herbs, shrubs* and sometimes *tree* and vines. Leaves are alternate and rarely become opposite in floral region, petiolate or rarely sessiles.

FLORAL CHARACTERS:

Inflorescence: Axillary cyme, ***combination of cymes***, sometimes ***helicoid*** or ***umbellate*** cyme.

Flowers: Bisexual, ***actinomorphic*** or weakly ***zygomorphic***, hypogynous and ***pentamerous***.

Calyx: Sepals 5, united (***gamosepalous***) persistent.

Corolla: Petals 5, united (***Gamopetalous***) persistent.

Androecium: Stamen 5, epipetalous (attached to petals) ***didynamous*** i.e. arranged in two whorls of 4 and 2 each.

Gynoecium: Bicapiallary (two carpels) syncarpous (fused), ovary obliguely placed, bilocular or 4 locular by false septa.

Placentation: Axile.

Familiar Plants:

(1) *Solanum tuberosum* (potato)

(2) *Solanum molangena.*

(3) *Capsicum annum* (chilli)

(4) *Lycopersicum esculentum* (Tomato)

(5) *Solanum nigrum* (mako).

(6) *Atropa belladona.*

(7) *Nicotiana tobacum* (Tobacco)

(8) *Dature alba.*

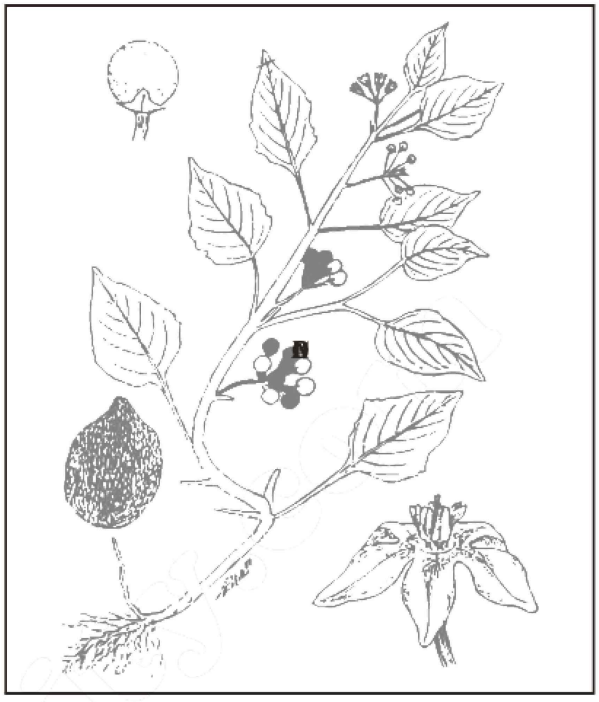


Fig. Solanaceae: Solanum nigrum, A- twig, B-Flower C-fruit, D-seed

Q.15 Discuss economic importance of solanaceae.

Ans. ECONOMIC IMPORTANCE OF SOLANACEAE:

(1) Vegetables: It is used as vegetable like *tomato, bringal, potato, chilly.*

(2) Vitamins: It is a rich source of vitamin C and A e.g. chilly and simla mirch.

(3) Drugs: From Tobacco nicotine is obtained and used in drugs.

(4) Cigarretes: Dried leaves of tobacco are used to make cigarretes.

(5) Medicines: (i) *Atropa belladona* and datura are used in medicine.
(ii) Ak – Mako is used as medicine.

(6) Ornamentals: Cultivated in gardens for ornamental purposes.

Q.16 (a) Discuss general and floral characteristics of Fabaceae / pea family / papilionaceae.

Ans. FAMILY FABACEAE / PEA FAMILY:

Genera = 400
Species = 9000

This family is found all over the world, but common in warm temperate regions. In Pakistan, 82 genera and 587 species are present.

FLORAL FEATURES:

Calyx: Sepals 5, gamasepalous to form hairy tube.

Corolla: Papillionaceous, petals 5, the upper petal is large called standard or vexillum two lateral petals united to form boat shaped structure called keel or carina.

Androecium: Stamen 10, diadelphus (united by their filaments into two groups 9 stamen united to form sheath around the pistil and 10^{th} is free.

Gynoecium: Carpel with one locule, ovary superior with long style which is bent.

Placentation: Marginal.

Fruit: Legume or pod.

Familiar Plants:

(i) *Lathyrus odoratus* (sweet pea) (لیتھائرس اوڈوریٹس)

(ii) *Arachis hypogea* (Mong Phalli). (اریکس ہائپوجیا)

(iii) *Cicer arietinum* (channa). (سائیسر اری ٹی نم)

(iv) *Dalbergia sisso* (shesham) (دلبرجیا سیسو)

(v) *Medicageo sativa* (Alfa Alfa). (میڈی کے گوسٹائیوا)

(vi) *Pisum sativum* (edible pea). (پائزم سٹی وم)

Q.16 (b) What do you know about the importance of Fabaceae Family?

Ans. (1) Protein and Oils: It is a source of high protein and oils i.e. pulses like *gram, pea,* kidney *bean* etc.

(2) Fodders: It is used as fodder of cattle like horse, cow sheep etc. e.g. *Medicago sativa* (Alfa Alfa), Trifolium.

(3) Edible Seeds: Seeds of Arachis hypogea (مونگ پھلی) are edible and also used for extraction of oil (تیل نکالا) used as vegetable oil after hydrogenation.

(4) Dye: From Indigofera *tinctoria* indigo dye is obtained and from *Butea monosperma* yellow dye is achieved.

(5) Furniture and Fuels: Many tree provide ***timber*** for making furniture and fuel e.g. Dalbergia and Butea.

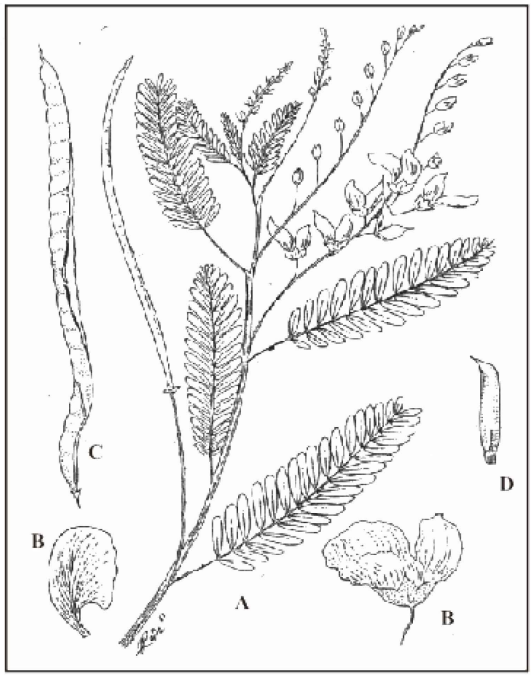


Fig. Fabaceae (Papilionaceae): Sesbania sesbar; A-twing; B-flower; B1 standard verillium; C-fruit a legume; D- carpel.

(6) Medicines: These are used as medicines e.g. *Glycyrrhiza glabra* for cough and cold *Clitoria* ternatea for snake bite.

(7) Ornamental Plants: (زیبائشی پودے) Used as ornamental plants e.g., ***Lathyrus butea*** and Clitoria.

Q.17 Give characteristics, Economic Importance and Familiar Plants of Family Caesalpiniacea Cassia Family. (OR) Write down an account on Cassia Family.

Ans. **CASSIA FAMILY**

Genera and Species:

In World = 152 genera and 2300 species

In Pakistan = 16 genera and 60 species.

Vegetative Characters:

Mostly trees or shrubs, sometimes ***climbers*** stem, erect, woody, herbaceous or climbing leaves compound, pinnately divided rarely simple.

FLORAL CHARACTERS:

Inflorescence:

Racemose: Axillary or terminal racemose or panicle or spike rarely cymose.

Flower: Bisexual, zygomorphic rarely actionomorphic, perigynous.

Calyx: Sepals 5, coloured, free, or connate at base.

Corolla: Petals 5 polypetalous.

Androecium: 10 stamens or fewer or numerous. Free or united.

Gynoecium: Carpel 1, ovary superior, unilocular, stigma simple.

Placentation: Marginal.

Fruits: Legume (پھلی).

Familiar Plants:

(i) *Tamarindus indica* (Imli). (ٹیمارنڈس انڈیکا)

(ii) *Cassi fistula* (Amaltas). (کیشیا فسٹولا)

(iii) *Bauhinia verigata* (Kachnar) (باؤنیا ویری گیٹا)

ECONOMIC IMPORTANCE:

(1) **Medicine:** It is used as medicine e.g. leaves of *Cassia alata* are used ***to cure ring worm*** and skin diseases, Cassia *senna* and C. obovata leaves yield drug senna which is ***laxative*** oil of *Cynometra cauliflora* is used for sin diseases.

(2) **Vegetables:** Bauhinia variegata (Kachnar) is used as vegetable.

(3) ***Tataric Acid:*** Tamarindus indica (Imli) is edible and is rich source of tataric acid.

(4) The bark of tamarindus and bauhinia are used in ***tanneries***.

(5) The wood of Haematoxylon yields haematoxylin ***dye***.

(6) Grown as ***ornamental plants*** i.e., Kachnar.

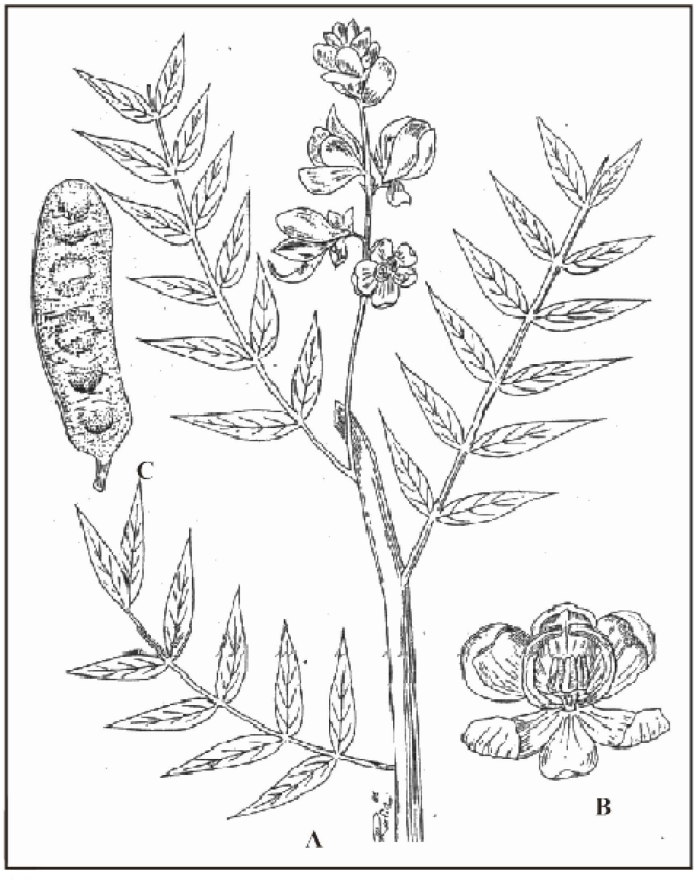


Fig. Caesalpiniaceae: Cassia senna; A twig, B-flower; C- fruit

Q.18 Give Characters, Economic Importance and familiar plants of family Mimosaceae (Acacia Family).

Ans. **MIMOSACEAE**

GENERA AND SPECIES:

In World = 56 genera and 2800 species.

In Pakistan = 4 genera and 18 species.

VEGETATIVE CHARACTERISTICS:

Habit and Habitat: Mostly trees or shrubs, rarely herbs or climbers mostly xerophyte stem, woody, leaves, compound, pinnately divided, alternate, stipulate, stipules modified into thorns.

FLORAL CHARACTERS:

Inflorescence:

Umbel: Spike like or head or umbel rarely raceamose or globose umbel.

Flower: Bisexual, actionmorphic, hypogynous or slightly. Perigynous bracteate.

Calyx: Sepals 5, gamasepalous, toothed.

Corolla: Petals 5 or polypetalous or gamapetalous.

Androecium: Stamen 5 – numerous, free adnate to petals.

Gynoecium: Carpel 10, unilocular ovary, superior ovules many.

Placentation: Marginal.

Fruit: Legume.

Familiar Plants:

(i) *Acacia nilotica* (Kikar) (اکے شیا نیلاٹیکا)

(ii) *Albizzia lebbek* (Beric) (البز یالیبک)

(iii) *Mimosa pudica* (touch me not). (مائموسا پوڈی کا)

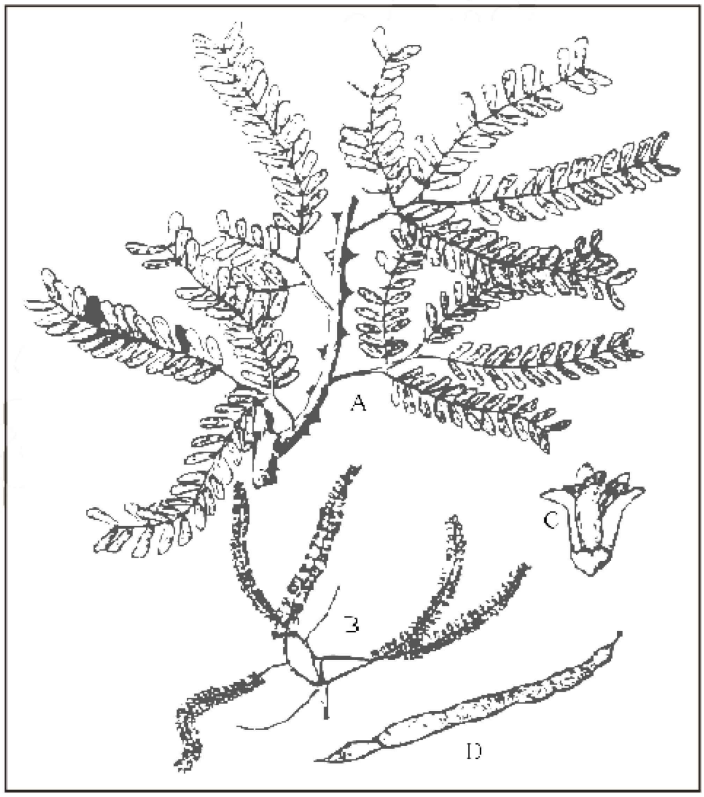


Fig. Mimosaceae: Prospsis cineraria; A-twig, B-inflorescences; C-flower; D-fruits

Economic Importance:

(1) Wood of *Acacia* and *Albizza* is used for construction purposes, making furnitures and used as fuel. Wood of Albizza is used in cabinet work and railway carriage.

(2) From *Acacia nilotica* gum is obtained.

(3) From *Acacia catechue* a dye katria is obtained.

(4) Tender leaves of a *nilotica* are used as blood purifier.

(5) Cultivated for ornamental purposes.

Q.19 Give Characters, Economic Importance and familiar plants of family Poaceae (Graminae) Grass Family.

Ans. **POACEAE**

In World = 600 generals and 10,000 species.

In Pakistan = 158 genera and 492 species.

Vegetative Characters:

Stem: Annual or perennial herbs stem jointed and hollow nodes, leaves are solitary, sometimes crowded at the base of stem, alternate, ***exstipulate ligulate***, sessile, leaf base form sheath around stem, simple.

FLORAL CHARACTERS:

Inflorescence: Mostly spikelets arranged variously in groups.

Rachila: Each spikelets consists of bracts arranged along axis called rachilla.

Glumes: Two lower empty bracts of rachilla called glumes, two bracts other than glumes called lemma palea enclosing flower.

Floret: The whole structure consisting of lemma, palea and flower is called floret.

Awns: The glume bears stiff bristles called awns.

Flower: Usually bisexual, sometimes unisexual, in-conspicuous, sessile bracteate, incomplete, zygomorphic hypogynous.

Perianth: (Sepals and Petals) absent or representaed by 2 – 3 scales called lodicules.

Androecium: Stamens 1 – 6 usually 3.

Gynoecium: Carples 3 united, free, stigma feathery.

Grainy Fruit: Grains or ***caryopsis*** fruit in which wall of ovary is dry and fused with ***testa***.

Familiar Plants:

(i) ***Triticum vulgare*** (wheat). (ٹری ٹیکم ولگیر)

(ii) ***Zea mays*** (corn). (زی میز)

(iii) ***Avena sativa*** (Oat) (اوینا سٹیوا)

(iv) *Oryza sativa (Rice)* (اوریزا سٹیوا)

(v) *Saccharum officinarum* (sugarcane) (سیکرم افسیچیرم)

(vi) Bambosa (Bamboo) (بمبوسہ)

Fig. Poaccae (Gramineae): Chloris barbata; A-Habit; B-Spikelet; C-gulumes; D-fertile lamma, E-flower, F-Fruit;

ECONOMIC IMPORTANCE

(1) **Foods:** This family is of great importance for both man and animals. It provides food e.g. ***cereals, millets*** are food of man and many ***fodder crops*** are food of animals e.g. ***wheat, oat, corn barley*** and ***rye plants*** etc.

(2) **Fodder:** Dry stem and leaves of cereals crops are used as fodder of animals.

(3) **Sugar:** Sugar is obtained from the juice of sugarcane.

(4) **Lawns:** Grasses are used in lawn.

(5) **Ornamental:** Cultivated as ornamental purposes.

(6) **Making material:** Bambosa (Bamboo) is used as building material in huts, making ***boats carts*** and ***pipes, mats, basket, hats***. Its leaves are given to horse as cure of cough and cold.

(7) **Aromatic Oil:** Aromatic oil is extracted form lemon grass used in ***perfumes***.

(8) Alcohol: Ethyl alcohol and ***beverages*** are prepared from cereals.

(9) Ropes: Fibers of ***Saccharum munja*** are used in making ropes.

HELP LINE

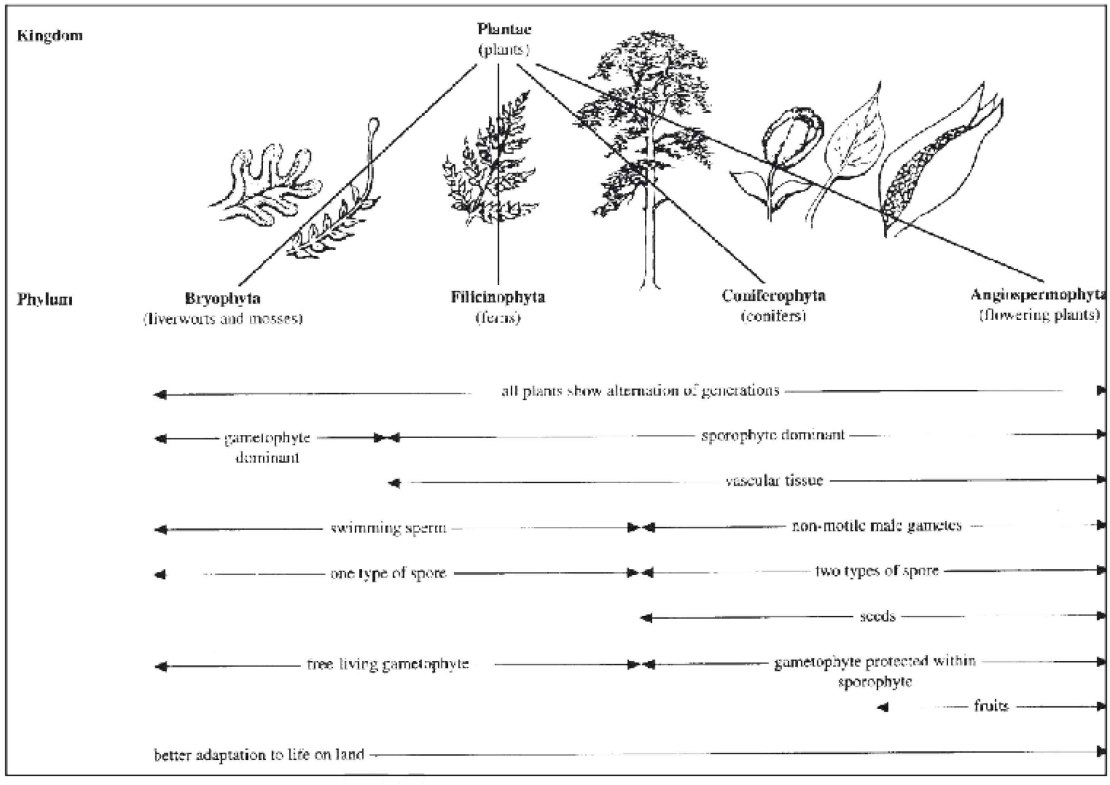


Fig. Classification of plants and some of the main trends in plant evolution

IMPORTANT DEFINITIONS

Alternation of Generation: "The alternate occurrence of sporophyte and gametophyte generations in a plant is called alternation of generation

Antheridium: The male sex organ of the lower plants. (OR) A multicellular sperm producing organ with jacket of sterile cells.

Antherozoid: A motile male gamete produced by lower plants and some gymnosperms.

Archegonium: A multicellular egg producing structure with a jacket of sterile cells. (OR) The female sex organ of the lower plants.

Axis: The stem and root (if present) of plant.

Axil: The upper angle formed by the junction of leaf with the stem.

Cambium: A zone of dividing cells between xylem and phloem.

Evolution: Descent with modification.

Egg: A large non flagellated female gamete is called egg.

Foot: The absorbing organ of the embryonic sporophyte in liverworts, mosses and vascular cryptogams.

Gamete: A sex cell i.e. sperm or egg.

Heterospory: The production of more than one type of spore by a species. (OR) Production of microspores that grow into male gametophytes and megaspores that develop into female gametophytes.

Ligule: An outgrowth from the upper side of the microphyll in Selaginella.

Microspore: Smaller male haploid spore producing a male gametophyte. (also called pollen grain).

Megaspore: The non motile female haploid spore having reserve food for gametophyte.

Microsporophyll: A leaf bearing one or more microsporangia is called microsporophyll.

Megasporophyll: A leaf bearing one or more megasporangia is called megasporophyll.

Microphyllous Leaves: A typical leaf of lower plants which is relatively small with single leaf. (OR) ***Macrophyllous Leaves:*** Trace (Vein) or megaphyllous.

Megasporphyllous Leaves: The typical leaves of lower plants and seed plants which are relatively large with many veins.

Node: Point of attachment of a leaf or branch is known as node.

Ovule: A megasporangium covered by an integument.

Phloem: A vascular tissue which conducts food is called phloem.

Reproduction: Replication or multiplication of individuals is called reproduction.

Seed: The structure that develops from the fertilized ovule, having an embryo which is surrounded by protective coat.

Sperm: The motile male gamete is called sperm.

Sporophyll: A modified leaf that bears sporangia. (OR) A leaf bearing one or more sporangia.

Sporangium: A structure containing spores.

Spore Mother Cell: The cell that gives rise four spores by meiosis.

Sporophyte: The spore producing diploid generation in the life cycle of a plant.

Spore: Asexual unicellular reproductive unit is called spore.

Strobilus: A group of closely packed sporophylls bearing sporangia arranged around a central axis.

Vein: Xylem and phloem strand in a leaf.

Zoospore: A motile asexual reproductive cell is called zoospore.

Zygote: The diploid cell produced by the union of two gametes.

Xylem: A vascular tissue which conducts water.

Gametophyte: The gamete producing haploid generation in the life cycle of a plant.

Q.20 How sporangia are protected in vascular plants? (OR) Write a short note on the protection of sporangia in pteridophytes (club mosses and horsetails).

Ans. PROTECTION OF SPORANGIA:

The oldest vascular plants i.e. *Rhynia*, have sporangia, which were present at the tips of upright branches. These sporangia were not protected with the passage of time, due to evolution, protection of sporangia was provided by cones.

CONE FORMATION:

"Cone is closely packed structure sporophyll around a central axis bearing sporangia."

Example: Club mosses and horsetail, pteridophytes, pinus (Gymnosperm)

Club Mosses:

Sporophylls protect to sporangia in club mosses. A group of sprophylls combines together to form cone. In this way, sporangia are protected by envelope of sporophylls.

Horsetails:

Horsetails have well developed cones. Sporangia are produced on little branches. Each branch ends in a flattened head called PELTATE HEAD. Sporangia are attached just below the peltate head. Here sporangia are completely covered for protection.