Q. Structure of Sporophyte.

Answer:

- The plant body of *Psilotum* is sporophytic branched rhizome system and dichotomously branched, slender, upright, green aerial systems that bears small appendages and synangia.
- Any one of the rhizome tips may turn upward and undergo several dichotomies to give rise to a green aerial shoot.
- The aerial shoots are slender, generally erect but may be pendent in epiphytes (e.g *P. flaccidum*). They are perennial and become shrubby by repeated dichotomies and sometimes attain a height up to one meter.
- The aerial axis may be cylindrical at base, furrowed in the upper parts, but somewhat flattened with three longitudinal ridges at the top.
- The basal part of the aerial axes is smooth but the distal part bears small, scaly appendages and synangia.

Q. Spore-Producing Structure of *Psilotum*

Answer:

- At maturity, many of the dichotomously branched aerial shoots become fertile and produce trilocular sporangia known as **synangia**. The mature synangium is generally a three lobed structure and each lobe of the synangium corresponds to a sporangium.

- The synangia located at the tip of very short axis, measuring 1-2 mm in diameter and closely associated with a forked, foliar appendage. At maturity, the synangium exhibits loculicidal dehiscence.

- The mode of development of each sporangium of the synangium of *Psilotum nudum* is of eusporangiate type. Each sporangium develops from

a group of superficial initial cells which divide periclinally to produce primary wall initials and primary sporogenous cells.

- A sporangial wall of four or five layers is produced through repeated periclinal and anticlinal divisions of the primary wall initials. The sporogenous tissue is produced from repeated divisions of primary sporogenous cells in various planes.

Q. SPECIAL FEATURES OF *Equisetum*.

The xerophytic features of *Equisetum* are:
(i) Ridges and furrows in the stem,

(ii) Deposition of silica in the epidermal cells,

(iii) Sunken stomata,

(iv) sclerenchymatous hypodermis,

(v) Reduced and scaly leaves, and

(vi) photosynthetic tissue in the stem.

The hydrophytic characteristics on the other hand are:

(i) we 11-developed aerating system like carinal canal, vallecular canal and central pith cavity, and (ii) reduced vascular elements.

Q. Internal structure of stem of *Equisetum*.
Answer:

- In T.S., the stem of *Equisetum* appears wavy in outline with ridges and furrows. The epidermal cell walls are thick, cuticularised and have a deposition of siliceous material.

- Stomata are distributed only in the furrows between the ridges. A hypodermal sclerenchymatous zone is present below each ridge which may extend up to stele in *E. giganteum*. The cortex is differentiated into outer and inner regions.
- The outer cortex is chlorenchymatous, while the inner cortex is made up of thin-walled parenchymatous cells. There is a large air cavity in the inner cortex corresponding to each furrow and alternating with the ridges, known as vallecular canal. These are schizolysigenous canals extending the entire length of internodes and form a distinct aerating system.
- New leaves and branches of Equisetum are produced by the apical meristem, however, most of the length of the stem are due to the activity of intercalary meristem located just above each node. The activity of intercalary meristem causes rapid elongation of the internodal region.
- The stele is ectophloic siphonestele which is surrounded by an outer endodermal layer. An inner endodermis is also present in some species of Equisetum (e.g. *E. sylvaticum*). The endodermis is followed by a single-layered pericycle.
- The vascular bundles are arranged in a ring which lies opposite to the ridges in position and alternate with the vallecular canals of the cortex. Vascular bundles are conjoint, collateral and closed. In the mature vascular bundle, protoxylum is disorganised to form a carinal cavity which lies opposite to the ridges.
- The metaxylem tracheids (scalariform or reticulate) are present on both sides of the phloem. In some species vessels with reticulate perforations are reported. The central part of the internode of aerial shoot is occupied by a large pith cavity which is formed due to rapid elongation of the internodal region.

- The vascular bundles remain unbranched until they reach the level of node. At the nodal region, each vascular bandle trifurcates (divided into three parts).
- The middle branch of the trifurcation enters the leaf. Each lateral branch of the trifurcate bundle joins a lateral strand of an adjacent trifurcate bundle to form a vascuiar bundle of internode. Thus the vascular bundles of internode alternate with those of internodes above and below.
- In the nodal region, the xylem is extensively developed as a conspicuous circular ring. There are no vallecular or carinal canals at this level. In addition, a plate of pith tissue occurs at the node which separates one internode from another.

Q. Morphological nature of Rhizophore of *Selaginella*.

This structure arises from the prostrate axis at the point of dichotomy and elongates downward. It is a colourless, leafless, unbranched and cylindrical structure.

As soon as the free end of rhizophore touches the soil it develops a tuft of adventitious roots at its free end. It differs from root in having no root cap and from stem in having no leaves.

The following views regarding the morphological nature of the rhizophore have been proposed:

a. **Capless root hypothesis:** According to Harvey Gibson (1902), Uphof (1920), Wochok and Sussex (1974), the rhizophore is a capless root because:

It is positively geotropic, (ii) It is a leafless structure, (iii) It is almost similar in anatomy of the root, (iv) It has a monostelic stele.

b. **Leafless shoot hypothesis:** According to Worsdell (1910), Williams (1937), Cusic (1954) etc. The rhizophore is a leaf-less shoot because:

Root cap is absent, (ii) Root hairs are absent, (iii) It is exogenous in origin, (iv) It arises from the angle meristem present at branching, (v) It can develop into leafy shoot under experimental conditions.

c. **Sui-generis hypothesis:**

According to Goebel (1905), Bower (1908), the rhizophore is an organ "Suigeneris" i.e., having absolutely no parallel structure anywhere in the plant kingdom. Thus, it is altogether a new structure.

Schoult (1938) regarded rhizophore as specialized stem modified in the direction of root because of the root bearing nature.

Q. Structure of Gametophyte of *Pteris*.

Answer:

- The spores germinate after falling on a suitable substratum.
- Initially the spore wall (exine) ruptures and the inner contents come out in the form of a germ tube and subsequently by a transverse division in the germ tube forms the first rhizoid and the first prothallial cell.
- The prothallial cell divides to form a small filament having an apical terminal cell with two cutting faces.
- The apical cell further divides and a spathulate prothallus is formed first.
- Finally a mature prothallus is formed which becomes cordate, dorsiventrally flattened, aerial and photosynthetic.
- The prothallus is made up of parenchymatous cells which are single-celled thick towards the margin and many-celled thick towards the centre.

- The growing point are located in the apical notch. Rhizoids are formed over the ventral surface.
- The prothallus is monoecious, protandrous.
- Antheridia appear first and are confined to the basal central or lateral regions among the rhizoids. Archegonia develop near the apical notch.
- A superficial cell on the ventral surface of the prothallus functions as an antheridial initial.
- This divides transversely to form an outer upper cell and an inner lower cell (first ring cell).
- Due to the higher turgor pressure in the upper cell, the cross-wall between these two cells bulges down and as a result the upper cell becomes dome-shaped.
- Then the upper cell divides by an arched periclinal wall to form a dome cell and the primary androgonial cell.
- The dome cell further divides transversely forming a cover cell and a second ring cell.
- Then the cover cell and two ring cells by anticlinal divisions form a single-layered jacket of the antheridium.
- The primary androgonial cell divides repeatedly to form 20-25 androcytes and eventually each androcyte metamorphoses to form a multiflagellated coiled antherozoid.

- A mature archegonium of *Pteris* consists of a 5-6 celled projecting curved neck, a neck canal cell, a ventral canal cell and an egg.

- The antheridium at maturity absorbs water and swells.

- Due to the increase in pressure within the antheridium the cover cells split apart releasing the antherozoids in a thin film of water present on the surface of the prothallus.

- At the same time the ventral canal cell, the neck canal cell and the neck cells at the top disintegrate forming an open passage for the antherozoids to come towards the egg and, eventually, one of the antherozoids fuses with the egg to form the zygote.