Structure of Isoetales

LESSON STRUCTURE

9b.0 OBJECTIVE

This order includes two genera ***Isoetes*** and ***Stylites. Isoetes*** includes 60 to 70 species and is world wide in distribution. Nearly seven species are reported from India, such as:-

1. ***Isoetes coromandelina* :–** reported from Kerala, Tamil nadu, Andhra Pradesh Maharashtra and Gujrat Padampur and Bengal Madhya Pradesh, Uttar Pradesh, Bihar and Orissa.

2. ***Isoetes coromandelina*** Sub Sps. ***branchyglossa*** *(A. Bram)* West Bengal.

3. ***Isoetes bilaspurensis*.** (Madhya Pradesh)

4. ***Isoetes dixitii (Shande),*** (Maharashtra).

5. ***Isoetes indica*** (Pant and Srivastava.)

   (Uttar Pradesh, Madhya Pradesh and Tamilnadu.)

6. ***Isoetes panchananii*** (Pant and Srivastava)

(Madhya Pradesh and Maharashtra.)

7. ***Isoletes pantii*** Goswami and Arya

(Madhya Pradesh.)

8. ***Isoetes sahyadriensis*** Mahabala.

(Maharashtra and Tamil nadu.)

9. ***Isoetes Sampath Kumarnii*** **: L**

(Maharashtra and Tamil nadu.)

10. **Isoetes unilocularis. J. E. Smith.**

9b.1 INTRODUCTION

= Isoetes coromendelina sensu Roxp. Some worker agreed to conclude that **Stylites** may represent a divergent type of **Isoetes.** Richi Serm Alli (1977) opined that cytology seems to support the separation of **Stylites** from **Isoetes. Chromosome** number for **Isoetes** is n = 10 in **I. hystrix** (Manton 1950). The chromosome may range from 1mm to 7 to 8 μm length. Other species of **Isoetes** show haploid chromosome number like n = 11, 22, 33, 54-56 and 66 (Manton 1950; Ninan 1958)

These haploid numbers show that there is a polyploid in the genus based on the number, n - 11 Ninan (1958). In **Isoetes** both polyploidy and aneuploidy (in I. hystrix) are important in speciation.

Morphological Character

Sporophyte plant body are small ranging from 5 cm to 60 cm. in length, herbaceous and perennial. It consist of short, fleshy, upright corm-like axis - which is very specialized. On the upper surface of the axis are born densly-crowded cluster of quill-like leaves. hence called quillwort. On the basal part of the axis there are two or three deep vertical grooves that makes it two or three lobed. (In **Isoetes coromandelina** is four or five-lobed. The roots are borne on the side of the grooves. The upper leaf bearing parts is known as stem and lower parts contain roots, which is designated as rhizomorph. The vertical growth is very slow. In width it range from 0.5 to 2.5 cm. but in some forms it may reach upto 4 cm. or more.

In **Stylites**, the cylindrical axis has a limited power of vertical growth and is 7 cm. long in **S. gemmifora.** But it may reach upto height of 20 cm. in **S.**

andicola. It bifurcates dichotomously at least three times so as to form characteristic tussocks. The lower part of the axis elongates conically and on one side there is a single deep vertical grooves along which a cluster of root is found.

Roots in **Isoetes** arise from the lower portion of the fleshy axis and are unbranched rarely branched dichotomously. The roots of **stylites** are born in a single deep vertical groove on the one side of the lower half of axis. The longitudinal grooves may be two or three e.g. **S. gemmifera.**

Leaves are borne on the upper surface of the axis. Each leaf has a thickened and expanded colourless base and a tapering distal portion which is owl shaped and pointed. The leaves are 30 to 70 cm. long and are arranged in a dense spiral with phyllotaxy of 3/8, 5/13 and 8/21. A persistent more or less triangular ligule are found on the concavity. The leaf has a median unbranched vein.

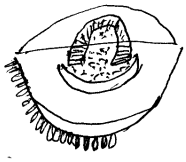
Apical growth is initiated by a group of apical cells. In **Isoetes** vegetative reproduction is rare but in **stylitess germinifera** small adventitions buds are produced.

INTERNAL STRUCTURE

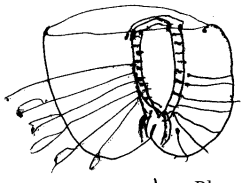
Longitudinal section of the Corm in two planes gives detailed idea of anatomical feature.

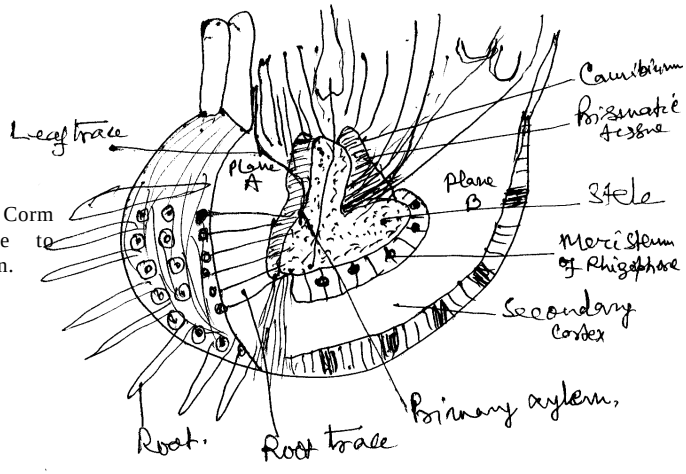
(a) In a plane at right angles to the basal groove and through each lobe.

(b) In the plane along the externally seen basal groove.

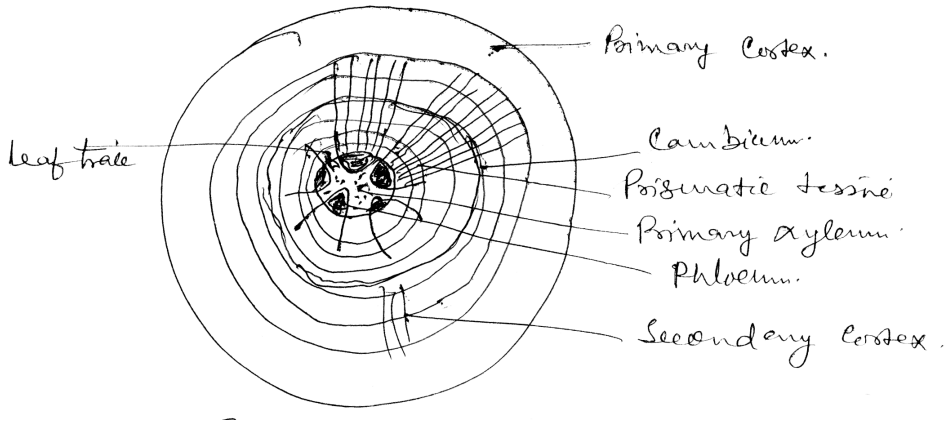


Cross section of (Plane B) the Corm in opposite vertical plane to correspond with thehalf section.





Three dimensional sketch of corm showing the relationship ofthe roots of the rhizophore to the main axis and essential details of internal structure.



Sector diagram of T. S. of Corm of Isoetes.

In the centre of the corm is stele. Stele is protostele with superparenchymatized layer of pith. The secondary growth is by cambium which is composed of two parts.

(a) A lateral meristem which surrounds the upper portion of the vascular cylinder and encloses the sides of the lower root bearing portion of the corm. Towards the inner side the cambium produces radially arranged-secondary Vascular Tissue (Prismatic tissue of Russoul). This tissue has been interpreted as secondary xylem (Stokey 1909), as secondary phloem (West and Takeda 1915, Krantrachue and Evert 1977), as secondary tissue containing both tracheids and sieve elements (Scatt and Hells 1900) and as tissue composed of (a) occasional tracheids (b) considerable unmodified parenchyma and (c) specialized Parenchyma cell which are concerned with conduction (Weber 1922).

(b) A basal meristem which is continuous with the lateral meristem arranged to form a ribbon.

The secondary growth in **Stylites** is essentially similar to **Isoetes** except it is less active (Rauh and Falk 1959).

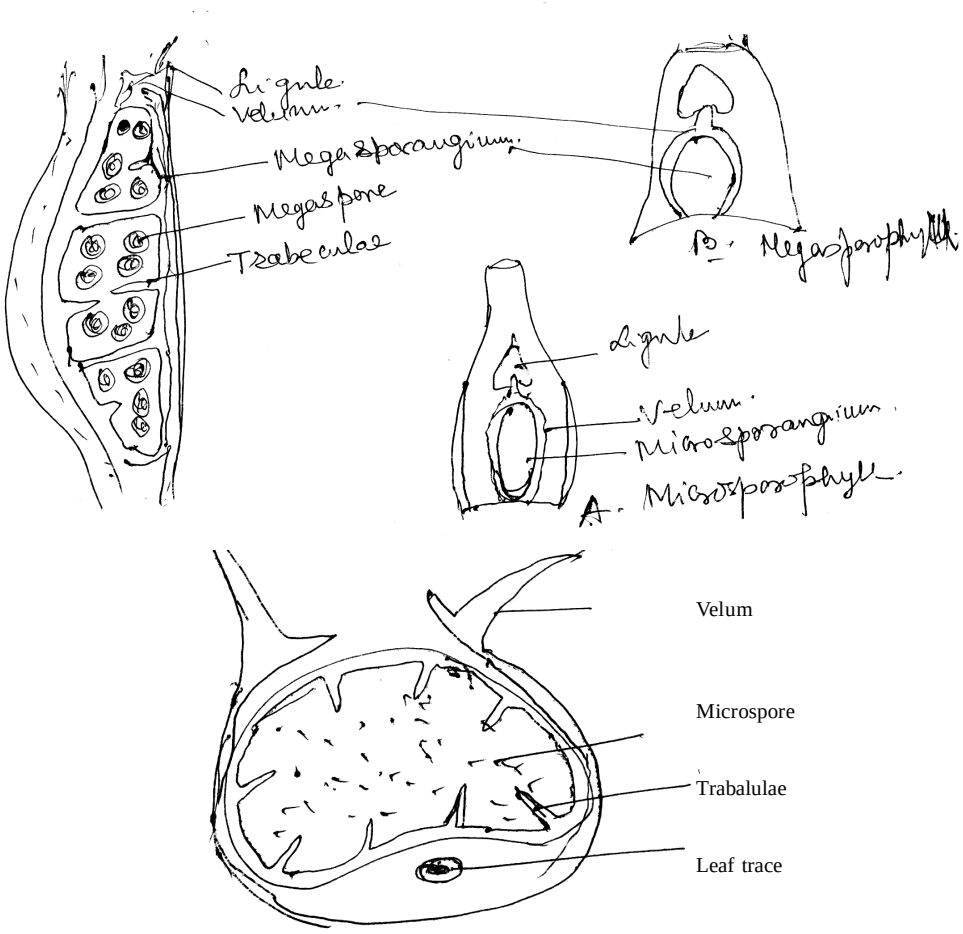
Leaf : Cross section reveals semicircular or more or less rhombic. Mesophyll cells undifferentiated. The stomata are situated over the air cavities. The vascular bundle is small and collateral.

The ligule remain situated on the adaxial side of the leaf base consist of only of Parenchyma. Its base thickens and penetrate or little into the leaf as glossopodium. The morphological nature of the corm and axis is still not clear. It has been described as an erect rhizome as a stock, as a stem combined with a

stigmarian type of rhizomorph, as an upper leaf bearing part, the stem and a lower root bearing part, the rhizomorph (Scott and Hill 1900), Stokey 1909, Lang 1914, West and Takeda 1913, Osbron 1922, Steward 1947, Bhjambie 1962, 1971 and Pnolillio 1963).

9b.2 SPORE PRODUCING ORGANS

Every leaf in both genera is potentially a sporophyll because each bears sporangium, normal or abortive. The sporophyte are heterosporous. The development of sporangium is of eusporangiate type. The mature sporangia are of two kinds : microsporangia and megasporangia but they are much alike in size and appearance. The microsporangia bear numerous (1,50,000 to 2,50,000) small Microspore. Megasporangia bear 50 to 500 large megaspore. In **Isoetes indica** Pant and Srivastava (1962) observed 703 to 2345 megaspore and the megaspore and polymorphic that is large, medium and small. Dimorphic are found in **Isoetes ceromendolina** and **Isoetes dixitii.** In the megaspore mother cells of I. **Coromandelina** there is no chromosome reduction.



Cross Section of Microsporophyll and Microsporangium of Isoetes. (rough diagram)

The spores are of two kinds which differ in size, in the number produced per sporangium. The spores shows monolete markings. In **I. indica** megaspore occur in the same sporangium (Goswami and Arya 1968) and - occasionally the microspore are trilete (Pant and Srivastava 1962)

The Microspores are produced in bilateral tetrads. Monolete are 20 to 45 mm in length. The laesura is 1/4 to nearly equal to sore length. They are ashy to browhish in colour, ridged-longitudinally. The surface is spinose papillate, denticulate, muricate, echinate, cristate, tuberculae or smooth.

The megaspores are produced in tetrahedral tetrads and bear the usual triradiate mark (trilete). The laesura is 3/4 to equal to radius of the spore. They are white, grey or black in colour and the surface is tuberculate, echinate, cristate or reticulate, with equatorial ridge. The megaspores are 250 to 900 mm in diameter.

9b.3 SPORE GERMINATION:

Spore germinates as soon as they are shed from the microsporangium. The mature microgametophyte is wholly endoscopic and consists of a small prothallial cell and one antheridium. Autherozoids are multiflagellate. The nine-celled microgametophyte is more reduced than in any other pteridophyte.

The megaspore consist of considerable amount of reserve food material and large nucleus. The archegonia are developed from the superficial cell. At maturnity, the neck canal cell and ventral canal cell disintegrate and the female gametophyte is initially endospore. No suspensor is formed and the embryogeny is exoscopic.

9B.4 EMBRYOGENY:

Affinities of Isoetales.

Isoetes and its close ally **Stylites** present many unusual features such as:-

Anchor-shaped stele in **isoetes,** in all leaves and sporophylls.

Process of secondary growth involving anomalous cambium

Large sporangia with trabeculae.

Microspore monoletes and megaspores trilet.

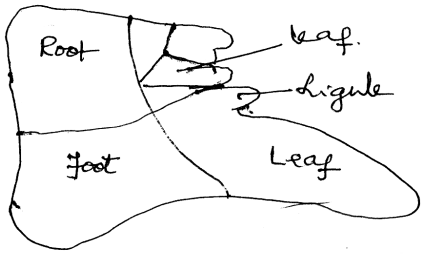
Double origin of tapetum.

But they possess lycopsidean vascular organisation; the ligulate leaves and the single sporangium on the adaxial face of the sporophylls - clearly establish their - lycopodiaceous pteridophytes. Among the lycopsida they have features in common with the lepidodendrales orders. Features of isoetales with lepidodendrales are:-

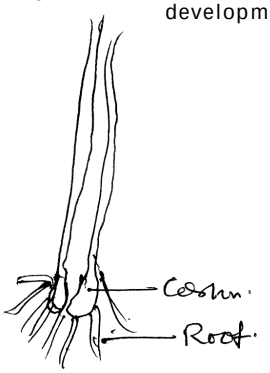
- Definite 'root system' - arrangement and organization of monoarch roots.
- Occasional dichotomy of the corm like axis.
- Helical arrangement of leaves.
- Presence of ligule.
- Form of leaf scar.
- Secondary tissue production.
- Heterospory
- Massive sporangia with trabeculae
- Reduced endosprous gametophytes.

Some morphologist regard the upper half of the corm which bears the sporophylls as representing a cone axis comparable to that of lepidostrobus.

Isoetes resembles pleuromeiales in similar stem structure ligule leaves, structure of root, trabeculae and massive sporangia, presence of monolete microspores and - trilete megaspore. On the basis of comperative morphology and paleobotanical evidences suggestse that the living genera of Isoetales represent highly reduced and - specialized derivatives of **Sigillaria** like form in lepidodendrales with intermediate forms provided by various genera of pleromeiales. The reduction series which is not phylogenetic can be traced as:-



Young embryo showing the relation of intial segmentation to subsequent organogenic development.



SIGILLARIA LIKE

Forms in lepidodendrales — pleuromeiopsis — pleuromeia — Northrostianella — Nathorsteina — Stylites — Isoetes.

9B.5 QUESTIONS FOR EXERCISE

1. Give on account of Isoetales and their affinities.
2. Describe the anatomy of stem of **Isoetes** and **Stylites.**
3. Draw a well-labeled sketch of Corm and describe its significance with morphological nature of corm-like axis.
4. Describe the spore producing organ of Isoetales / Isoetes.
5. Discuss Prathallus structure of Isoetales.
6. Give an account of embryogeny of Isoetales.

9b.6 SUGGESTED BOOKS FOR ADVANCED AND DETAILES STRUDIES.

1. Studies in Paleobotany by H. N Andrws.
2. Morphology of Vascular Plants by D. W. Bierhorst.
3. Primitive land plants by f.O. Bower.
4. Size and form in plants by F. O. Bower.
5. Morphology and evolution of fossil plants by T. Delevozyas.
6. Morphology of vascular plants by A. J. Eames. (Lower group)
7. Organography of plants Part-II by Ko Goebal.
8. Studies in fossil plants by D. H. Scott.
9. Cryptogamic Botany Vol. II by G. M. Smith.
10. The biology and Morphology of Pteridophytes by N. S. Parihar.
11. Pteridophyta by K. R. Sporne
12. Pteridophyta by A. Rashid.

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