UNIT 6: GYMNOSPERMS MORPHOLOGY, ANATOMY AND REPRODUCTION OF *CYCAS*, *PINUS* AND *GNETUM*

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Distribution

- *Cycas* is found both as cultivated or in wild state in tropical and subtropical regions of the world.
- It normally grows in well drained soil exposed to sun, such as sunny slopes of the hills, and thus exhibits many xerophyic characters.
- The genus is distributed in the Eastern Hemisphere, has several species spread over Madagascar to Japan including Australia.
- *Cycas* is the only genus of family Cycadaceae that occurs in India. It grows in Tamil Nadu, Karnataka, Kerala. Andaman and Nicobar Islands, Bengal, Bihar, Orissa, Assam and Sikkim.
- It also grows in neighbouring countries such as Nepal, Myanmar (Burma) and Srilanka.

Four species of *Cycas sp.* grow wild in India.

1. *C. beddomei* Dyer: This is found only in the hills of Cuddapah district of Tamil Nadu and eastern Andhra Pradesh.
2. *C. pectinata* GriffL*:* It Grows in the sal forests of Sikkim and Assam, Khasi hills and Manipur.
3. *C. circinalis* Linn*:* This is the most abundant, naturally occurring species. It grows in the deciduous forests of Western Ghats and on eastern side as for as Orissa
4. *C rumphil.* Miq : It is distributed on the beach forests of Andaman and Nicobar Islands. Apart from the above mentioned wild species.

Two species of *Cycas* are cultivated in India.

1. *C. revoluta* Thumb. and
2. *C. siamensis* Miq. *a*re commonly cultivated in the gardens.

COMPARATIVE STUDY OF VEGETATIVE MORPHOLOGIES OF *CYCAS*, *PINUS*, *GNETUM* SPOROPHYTES

External morphology of *Cycas*:

- A small tree, like palm or tree-fern.
- Roots are of two types:

a) Short-lived tap roots.

b) Coralloid roots. Mycorrhizic roots are absent.

- Stem is columnar unbranched and covered by armour of persistent leaf bases.
- Leaves are dimorphic.
- i) Brown scale leaves and
- ii) Large green, pinnately compound foliage leaves- arranged spirally at the top forming a crown.

Cycas circinalis

External morphology of *Pinus*:

- A tall evergreen and lofty tree.
- Roots are tap root. Tap root may persist but may be associated with adventitious roots. Roots are mycorrhizic. Coralloid roots are absent.
- Stem is erect, cylindrical and branched-branches are of two kinds.

a) branches of limited growth (dwarf shoots) and

b) branches of unlimited growth (long shoots).

- Leaves are dimorphic i.e.

i) brown scaly and

ii) needle like green, simple, foliage leaves developing in cluster at the apex of dwarf shoot.

Pinus roxburghii

External morphology of *Gnetum*:

- Shrubs or trees , majority are woody climbers with twining stems.
- Roots are normal tap roots. Mycorrhizic and coralloid roots are absent.
- Stem is cylindrical and branched-in climbers branches are of two kinds i.e. those of limited growth (dwarf shoots) and others of unlimited growth (long shoots).
- Leaves are also of two kinds:

a) the scale leaves that occur only on the long shoots ; and
b) the foliage leaves that are borne in an opposite and decussate manner on the dwarf shoots.

Gnetum montanum

COMPARATIVE STUDY OF REPRODUCTIVE MORPHOLOGIES OF *CYCAS*, *PINUS*, *GNETUM* SPOROPHYTES

Reproductive structure of *Cycas*:

Male cones:

- Male cones are compact , cylindrical or ovoid structures, large , solitary or few and apparently terminal at the growing apex of the stem.
- Each cone consist of a central axis upon which numerous microphylls are arranged in acropetal succession. Each microsporophyll is a flattened woody structure ; on the under surface (i.e. abaxial surface) of fertile portion numerous microsporangia are borne in sori. Each sorus contains 3 to 5 microsporangia.
- Each microsporangium is sessile and oval , consists of a wall of several layers of cells.
- Pollen grains i.e. microspores are many in each micro-sporangium.
- Dehiscence of microsporangium is longitudinal.

Male cone of *Cycas*

Reproductive structure of female *Cycas*:

- Female cones are not true cones but simple structures ; megasporophylls are large , generally leafy and loosely arranged spirally around the stem-apex of the female plant.
- Each megasporophyll is brown in colour and is covered with hairs and each bears 1-5 pairs of big ovules on both sides of the lower stalk-like part.
- Each megasporangium i.e. ovule consist of a massive nucellus and is surrounded by a thick

Reproductive structure of female *Cycas*:

- Single integument which is three- layered:

a) outer fleshy layer

b) middle stony layer and

c) inner fleshy layer.

- Nucellus is fused with the integument except at the micropylar region , where it forms a beak like structure called nucellar beak.
- Within the nucellar beak lies the pollen chamber.

Female cone of *Cycas circinalis*

Reproductive structure of *Pinus*:

Male cone of *Pinus*:

- Male cones are compact, oval structures measuring about 2-3cm in length; occurring singly in the axils of scale leaves of long shoots replacing thereby dwarf shoots.
- Each cone consists of a short and elongated axis upon which numerous microsporophylls are arranged spirally, a each microsporophyll is scaly, and consist of a short stalk and a leaf like expanded

Male cone of *Pinus*:

structure , the apex of which is slightly bent upwards ; on the under surface of each microsporophyll there are two microsporangia.

- Each microsporangium is sessile and oblong in shape , consisting of a wall of several layers of cells.
- Pollen grains i.e. microspores are many in each sporangium , and each is provided with two wing like projections.
- Dehiscence is longitudinal.

Male cone of *Pinus*:

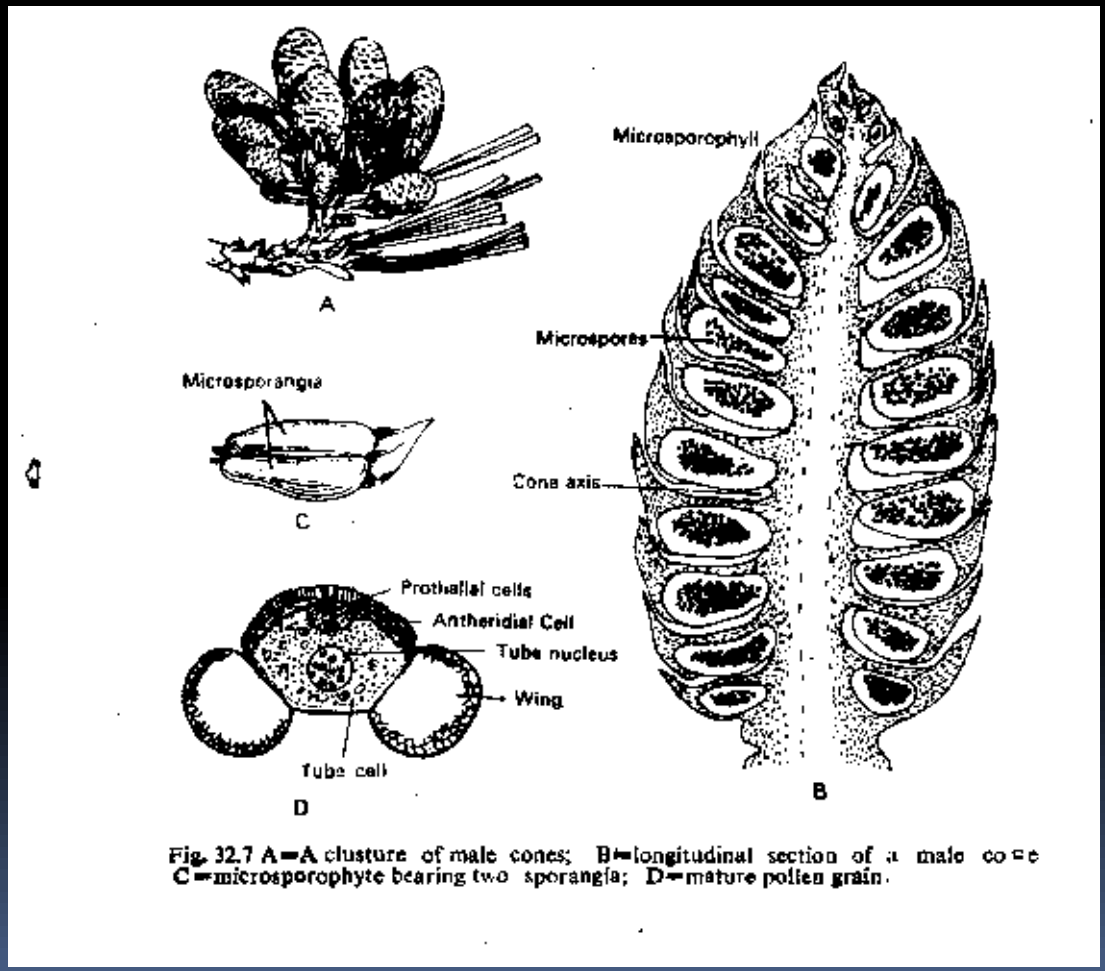


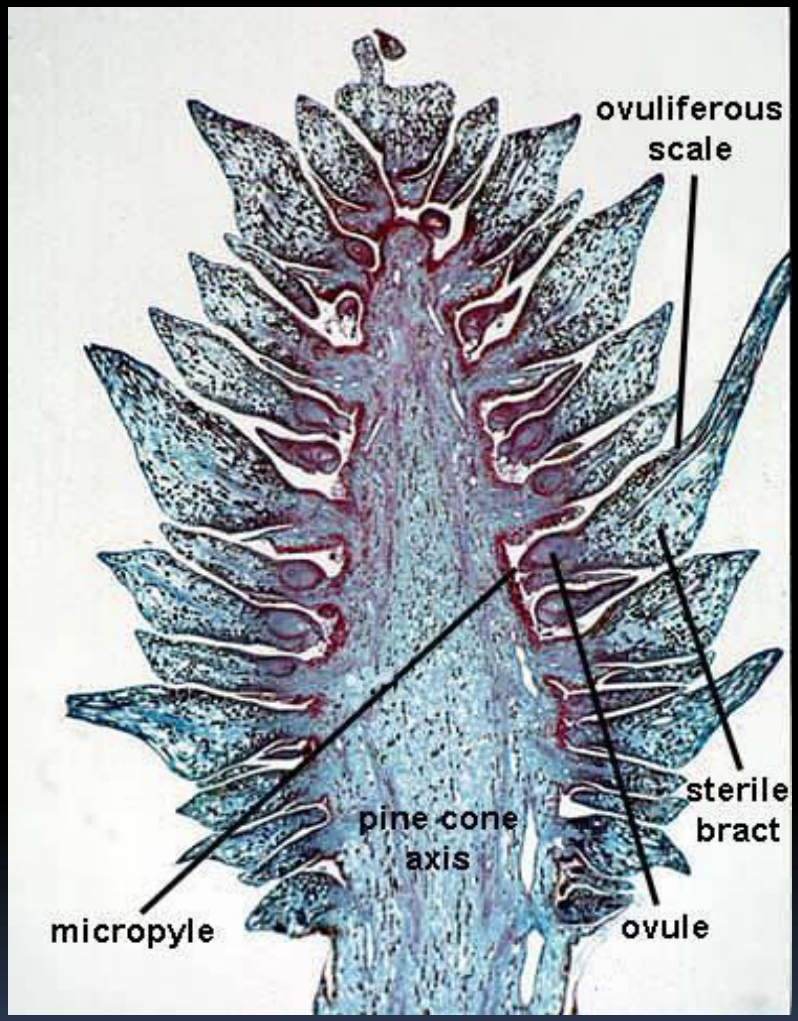
Fig. 32.7 A=A clusture of male cones; B=longitudinal section of a male cone C=microsporophyte bearing two sporangia; D=mature pollen grain.

Female cone of *Pinus*:

- Female cones form true cone like structures and are compound; these are borne in the axils of scale leaves of the long shoots taking the position of dwarf shoots.
- Each cone is hard, woody , dry and consist of a long central axis bearing spirally arranged megasporophylls.

Female cone of *Pinus*:

- Each megasporophyll is shortly- stalked and consists of a large ovuliferous scale and a bract scale attached on the lower side of the ovuliferous scale.
- Ovuliferous scale bears two inverted megasporangia on the upper surface near the base. Each ovule consist of a massive nucellus surrounded by a single integument.
- Integument is fused with the nucellus at the basal region. Nucellar beak and pollen chamber absent.



Female cone of *Pinus*:

Reproductive structure of *Gnetum*

Male reproductive structures of *Gnetum*

- Male cones are compact, slender axis like structures,upto 6cm.in length, either solitary and axillary or in cluster at the shoot apex.
- Each cone consist of as tout axis bearing at the base two opposite and connate bracts- a little above , on the cone axis, whorls of circular bracts called “cupules” are present one above the other.

Male reproductive structures of *Gnetum*

- In the axil of each collar , male flowers i.e. microsporophylls are arranged in definite rings , usually 3-6 in number ; above the male flowers , there is a single ring of abortive female flowers.
- Each microsporophyll or male flower consist of a stalk bearing two microsporangia , the stalk is invested at the base by a sheath-like perianth.

Male reproductive structures of *Gnetum*

- Each micro sporangium is oval and consist of a wall of single layer of cells and pollen grains are many, simple and without wings.
- Dehiscence is apical.

Male reproductive structures of *Gnetum*

Female reproductive structure of *Gnetum*

- Female cones are compact , slender axis like structures , either solitary and axillary or in cluster at the shoot apex.
- Each cone consist of a stout axis bearing at the base two opposite and connate bracts-a little above this and on the cone axis whorls of circular bracts calles collars are present one above the other. In the axil of each collar , 4 to10 female flowers or ovules are developed in a single ring.

Female reproductive structure of *Gnetum*

- Each female flower is stalked and consists of an ovule with a massive nucellus surrounded by envelops. The outer envelope often called perianth, is thick and fleshy ; the middle envelope is actually known as outer integument- this is very thin ; the inner envelope is fused with the nucellus in the basal part and narrows above to form a micropylar tube or so called-style. Nucellar beak is absent but a pollen chamber has been noted in various species.

Female reproductive structure of *Gnetum*