



# Bhagalpur National College, Bhagalpur

(A Constituent unit of Tilka Manjhi Bhagalpur University, Bhagalpur)

## PPT Presentation- **Gymnosperm: General characters and Classification**



**Gymnosperms**  
*first plants to have seeds*



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# General characters

- ❖ **Gymnosperm:** “Naked seed plants (Phanerogams).
- ❖ Characterized by naked ovules (i.e. ovary without ovules).
- ❖ Unlike Angiosperm, in Gymnosperm the seeds are not enclosed in fruit. Hence, they are first land plants to have seeds.
- ❖ Originated in Paleozoic era (541- 252 years ago).
- ❖ Dominant in Cretaceous periods of Mesozoic era.
- ❖ Many primitive gymnosperms are extinct (Cycadofilicales, Cordaitales, Bennettiales) .
- ❖ Examples of some Gymnosperms – Cycas, Pinus, Gnetum, Epedra, taxus, Ginkgo, Cedrus, Welwitschi, Podocarpus, Abies, Araucaria, etc.



**Cycas**



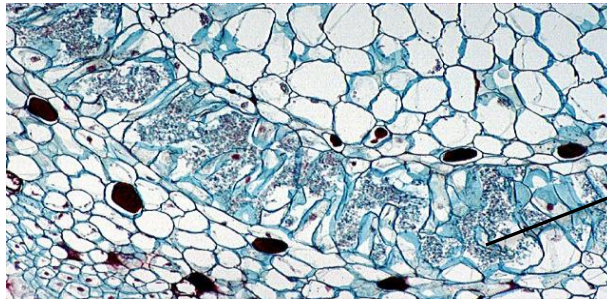
**Ginkgo**



**Pinus**

# Morphological Characters

- Plant body is sporophytic, differentiated into- root, stem and leaves.
- They usually show xerophytic characters.
- Root shows symbiotic association with blue green algae (e.g. coralloid root in Cycas), or fungi (mycorrhiza in Pinus).



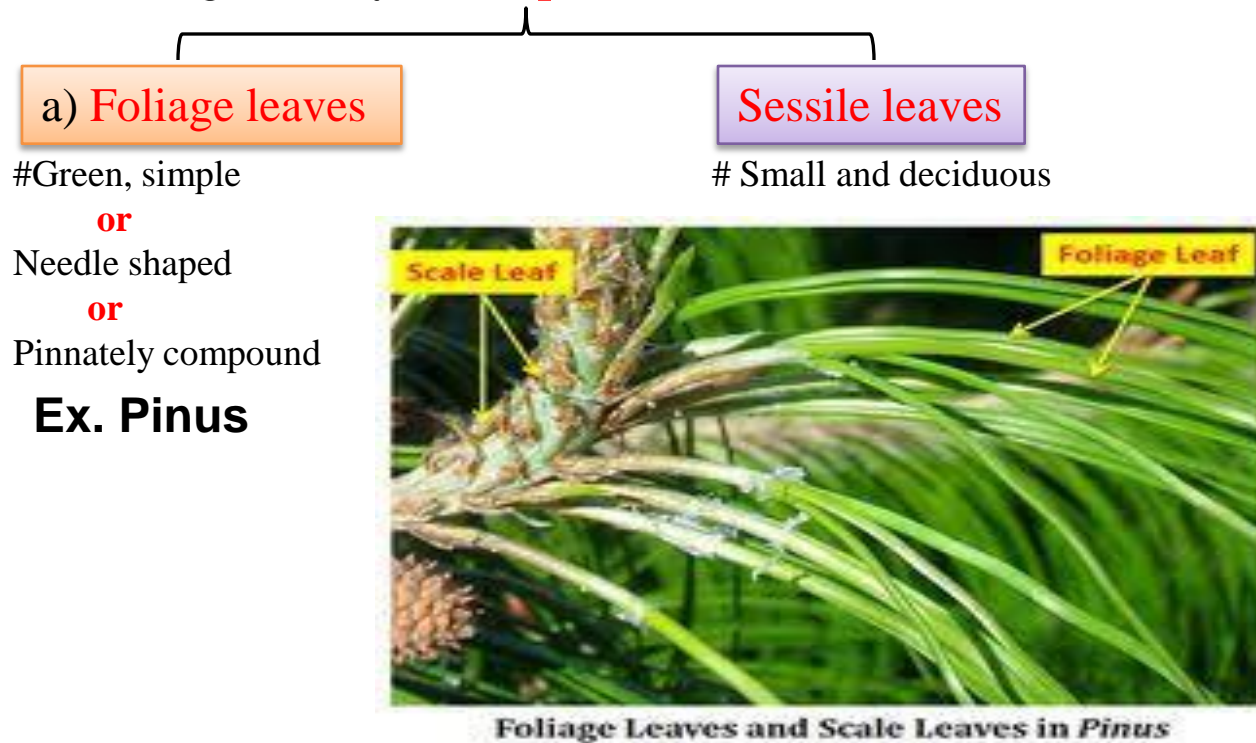
Coralloid root section showing algal zone

Algal zone (Nostoc or Anabaena)

- Algae inhabiting in coralloid root of Cycas helps in N<sub>2</sub> fixation.
- Mycorrhiza helps in absorption of nutrients (Phosphorus) in plants.
- The stem is generally erect, branched and woody. However, it is unbranched in case of Cycas and underground in Zamia.



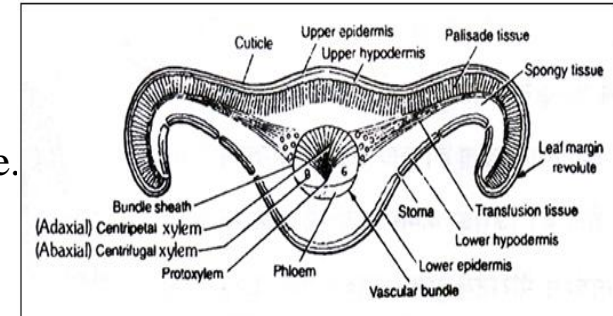
- Presence of leaf scar is a characteristic feature of gymnosperm.
- Leaves are generally dimorphic in nature.



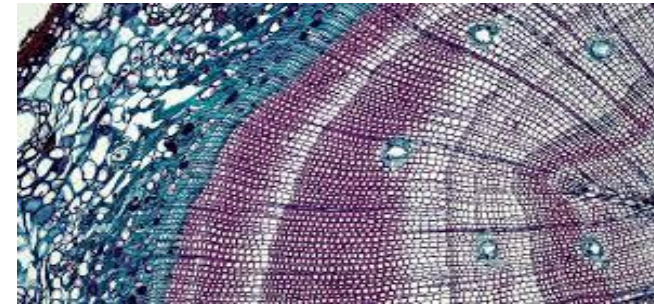
- *Cycas* shows circinate venation (young leaves curved inside). Presence of circinate venation in *Cycas* is a strong evidence for the pteridophytic origin of Gymnosperm. Therefore, *Cycas* acts as a connective link between **Pteridophyta and Gymnosperm.**

# Anatomical Characters

- The leaves of gymnosperm have very thick cuticle and sunken stomata, both indicating xerophytic character.
- Mesophyll in leaves usually differentiated into palisade and spongy tissues in *Cycas*. But is undifferentiated in *Pinus*
- Leaves do not have lateral vein.
- Lateral transfusion of nutrients takes place through transfusion tissue.
- Gymnosperm possess well developed vascular system.
- Vascular bundle is open and collateral.
- Xylem consists of tracheids and parenchyma.
- Vessel is present in Gnetum only.
- Phloem consists of tubes and phloem parenchyma.
- Companion cells are absent in Pinus.
- Stem shows secondary growth.
- The wood may be manoxylic (*Cycas*) and pycnoxylic (*Pinus*).
- Tanniferous cells are present in cortex region.
- Roots are diarch (two vascular bundles) to polyrach (many vascular bundles).



Transfusion tissue in *Cycas* leaflet



Tracheids in gymnosperm

# Reproduction in Gymnosperm

- ❖ Gymnosperms are **heterosporus** (i.e. produce two different spores).
- ❖ Megasporangia are produced on megasporophyll.
- ❖ Microsporangia are produced on microsporophyll.
- ❖ Sporophylls aggregated to form cones or strobili.
- ❖ Cones/ strobili are monosporangiate.
- ❖ Male cones in gymnosperms are short-lived; however female cones persist for many years.
- ❖ Microsporangia are found on the abaxial (lower surface) of microsporophyll.
- ❖ Microsporangial development is **eusporangiate type**.

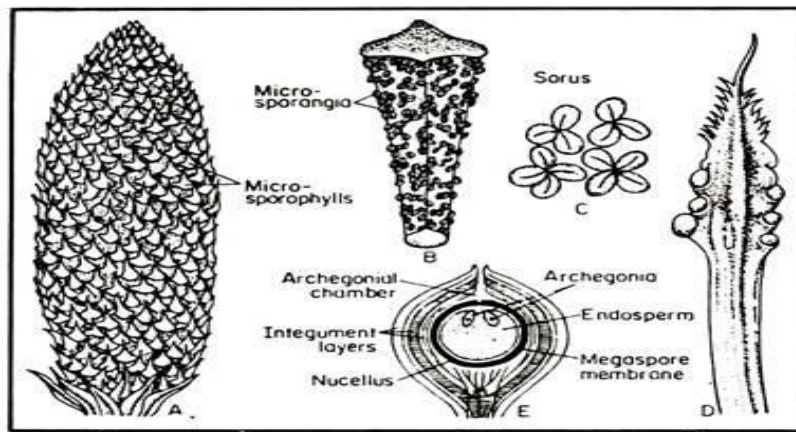


Fig 7.2 *Cycas* Sp. : A – Male cone, B – Microsporophyll, C – Sorus, D – Megasporophyll, E – V.S. through megasporangium.

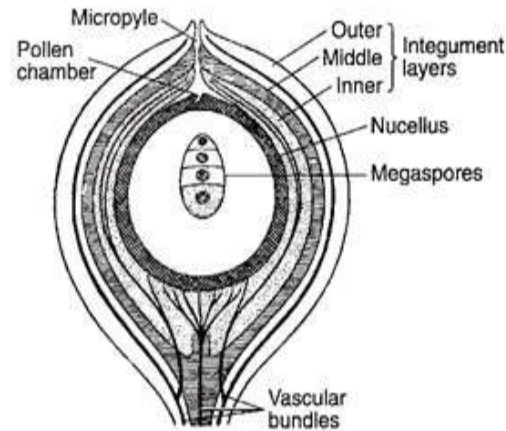


Fig. 1.19 : Vertical median section of *Cycas* ovule

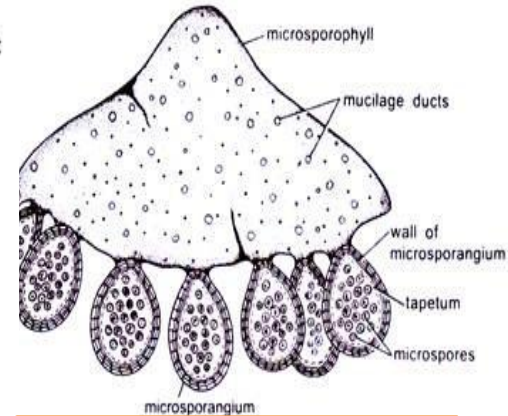


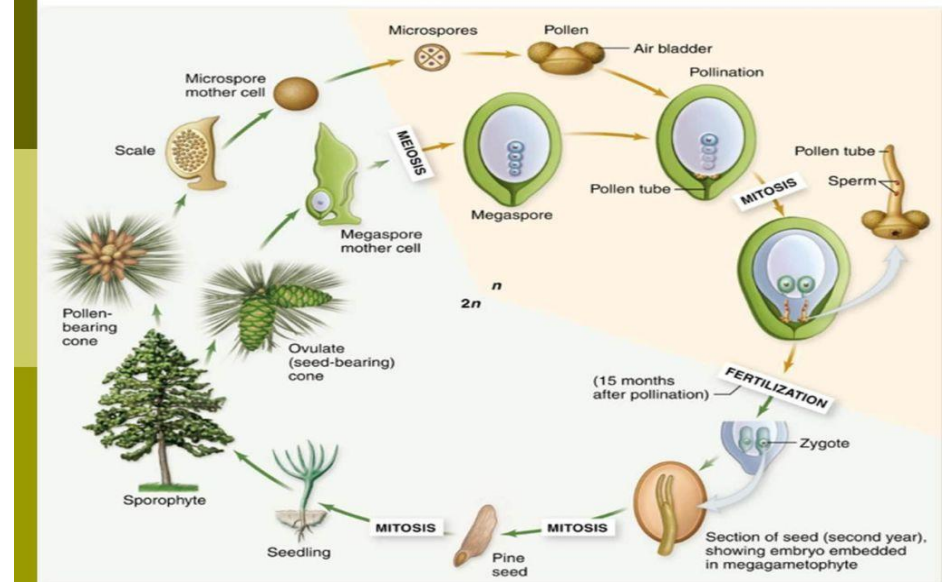
Fig 3. *Cycas* microsporophyll with microspores

- ❖ Female cone is formed by the aggregation of megasporophylls.
- ❖ The megasporophylls may be foliar as in *Cycas* or cauline (woody) as in *Pinus*.
- ❖ The megasporangium is better known as ovule.
- ❖ Ovules are **orthotropous** and **unitegmic** (ex. *Cycas*).
- ❖ Ovular integument in Gymnosperm is differentiated into three layers.

# Pollination and Fertilization

- ✓ All gymnosperms are wind pollinated (Anemophily).
- ✓ Microspores (Pollen grains) are liberated at various stages of the male gametophyte.
- ✓ Pollens deposited in wet pollen chamber.
- ✓ Fertilization is siphonogamous (through pollen tube).
- ✓ The pollen tube function as sperm carrier.
- ✓ Male gametes are non-motile except in Cycas and Ginkgo.
- ✓ Number of archegonia in the female gametophytes varies.
- ✓ There are several archegonia in Cycas whereas only one in Pinus.
- ✓ Archegonium has single gg and venter canal cell.
- ✓ Archegonium in Gnetum is represented by ovum only.
- ✓ Nek canal cells are absent in gymnosperm.

## Gymnosperm Reproduction



- ✓ Embryo development is meroblastic (i.e. embryo develops from some part of zygote).
- ✓ Endosperm development takes place before fertilization. Hence, endosperm is haploid in nature.
- ✓ Double fertilization or triple fusion is absent in gymnosperm.
- ✓ Polyembryony (development of many embryo) is very common in Gymnosperms.
- ✓ Polyembryony results from **a) fertilization of more than one egg or by b) Division of zygote (Cleavage polyembryony).**



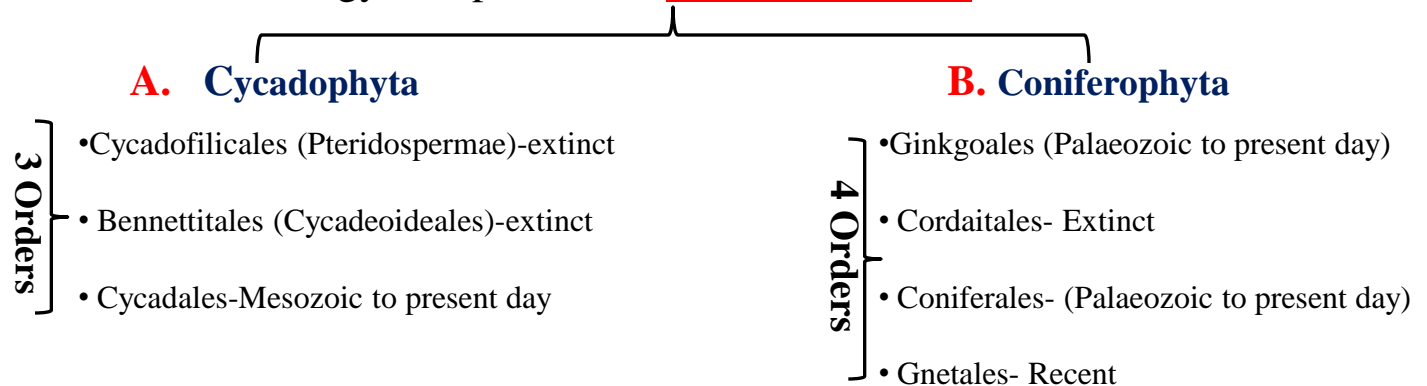
# Classification of Gymnosperm

- From time to time suggestions have been made for splitting the Gymnosperm into a number of major groups taxonomically equivalent one to another and to the angiosperms.
- **Coulter and Chamberlain (1910)** divided the gymnosperms into seven orders. Some of the orders are quite extinct and not found in present day.

- **These orders are as follows:**

1. Cycadofilicales- Extinct
2. Bennettitales- Extinct
3. Cycadales-Mesozoic to present day
4. Cordaitales- Extinct
5. Ginkgoales- Palaeozoic to present day
6. Coniferales- Palaeozoic to present day
7. Gnetales- Recent

- **Chamberlain (1934)** however, divided the gymnosperms into **two large groups-**





- Prof. B. Sahni (1920) divided the gymnosperms into **two large groups** and gave them the terms:-

### 1. Phyllosperrmae

- They comprise of the **Pteridosperms** and the **Cycadophyta** (Cycadales and Bennettitales).

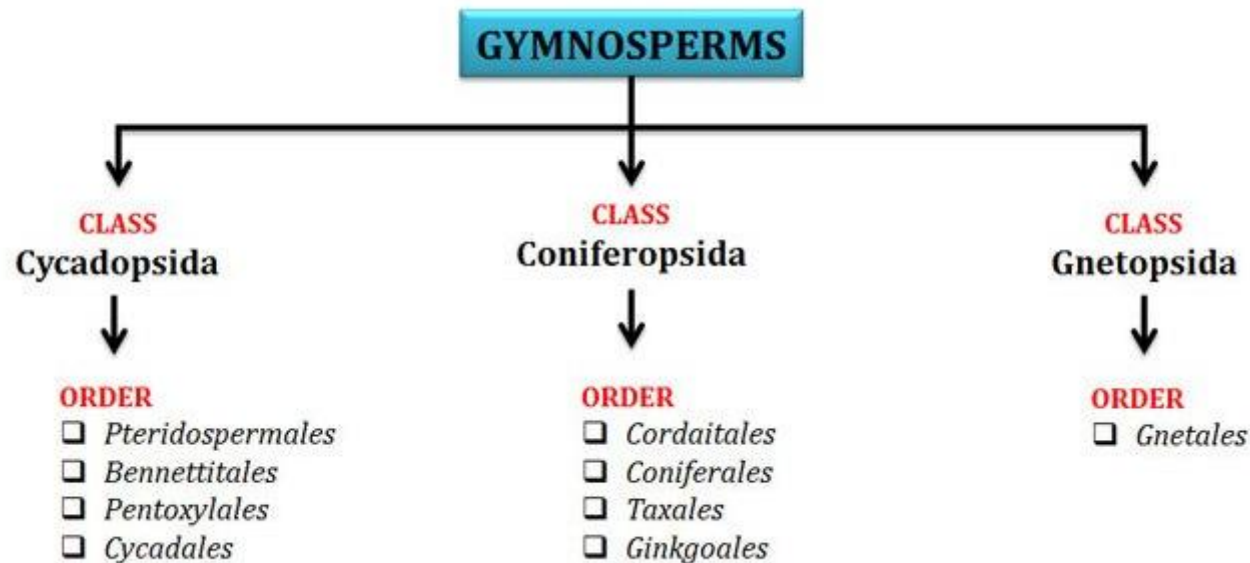
- The seeds are being inserted on the modified leaves.

### 2. Stachyospermae

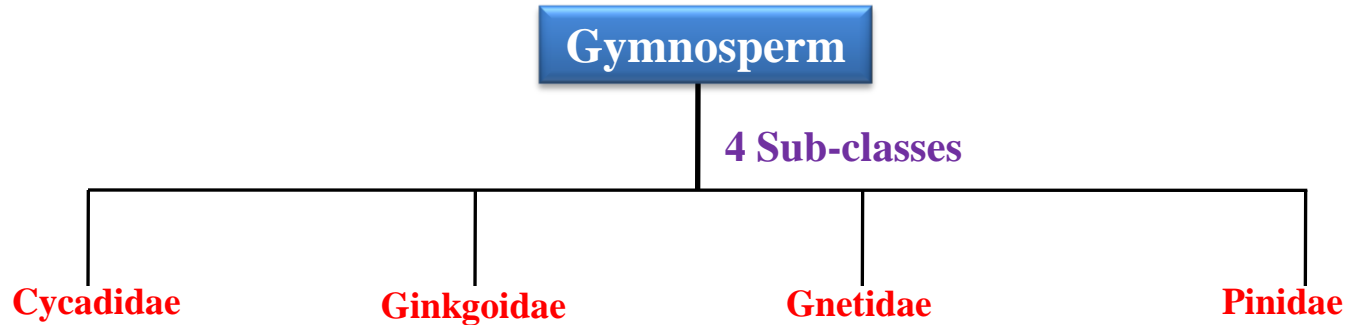
- This group includes the orders of Coniferophyta of Chamberlam.

- They are more or less microphyllous plants with seed inserted on the stems.

## • Classification of Gymnosperm by K.R.Sporne (1965)



- The most recent system of classification for gymnosperms is proposed by Christenhusz et al. (2011).
- They divided the extant gymnosperms into four sub-classes: **Cycadidae, Ginkgoidae, Gnetidae and Pinidae.**



**Thank you**



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# **Department of Botany**

## **Topic : Gymnosperm: General characters and Classification**

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