



**First CBZ – Botany**

**Second Semester**

**Paper II**

**Basics of Vascular Plants and Phytogeography**



## Unit 2: Lesson 2: Occurrence , Morphology, anatomy, reproduction and life history *Cycas*

# CYCAS

## Structure, Reproduction & Life-Cycle

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# Systematic Position

- GYMNOSPERMAE
  - Division: CYCADOPHYTA
  - Class: CYCADOPSIDA
  - Order: CYCADALES
  - Family: CYCADACEAE
  - Genus: CYCAS
- (Greek word Kycas = Cocopalm)





# Distribution & Occurrence

- Includes 20 Species
- Occurs wild or cultivated in tropical and sub-tropical regions
  - South of Eastern Hemisphere
  - e.g. S. Japan, India, China, N. Australia, E. Coasts of Africa, Myanmar, Bangladesh, Mauritius, Nepal, etc.
- 6 species Indian – 4 wild & 2 cultivated
  - *C. circinalis*, *rumphii*, *pectinata* & *beddomei*
  - *C. revoluta* & *C. siamensis*



# Sporophytic Plant Body

- Plants are low and palm-like, height 4-8 feet
- Tallest species, *C. media* – upto 20 feet high
- Stem unbranched, columnar and covered with persistent leaf bases
- Leaf segment remains circinnately involute within the bud – leaves dimorphic
- Female reproductive structures – the megasporophylls are not aggregated in cones
- Ovules (2 or more) borne on the lower margins in ascending order





# External Morphology

- Stem – Cycas plant shows tuberous stem when young, becoming columnar and unbranched later
- Leaf – Shoot apex is protected by a rosette of brown scale leaves
- Plant grows very slowly adding a new crown of leaves every 1 or 2 years, alternating with crown of scale leaves



# External Morphology

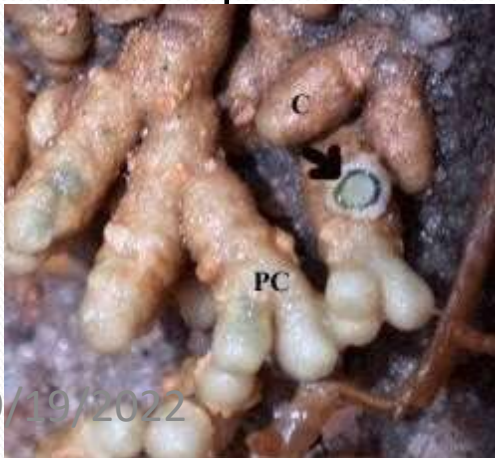
- The pinnately compound megaphyllous leaves have 80-100 pairs of leaflets arranged on the rachis
- Circinnate ptyxis of young leaves is a fern like character
- Leaf base is rhomboidal in shape and attaches the leaf transversely to the stem
- The leaflets are thick , leathery in texture, ovate or lanceolate in shape & photosynthetic in function.





# External Morphology

- Scale leaves are very small, rough and dry, triangular in shape and brown in colour, thickly coated in ramenta
- Root is of two types-normal and coralloid.
- Normal tap-roots grow from the radicle deep inside the soil giving out lateral branches
- Some of the lateral roots grow apogeotropically towards the surface of soil and branch dichotomously
- These roots are short, thick and swollen at the tips.

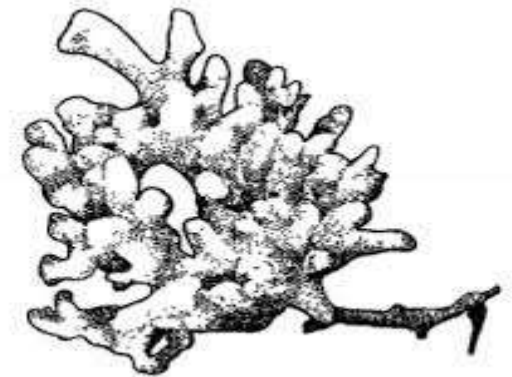


**Cluster of  
coralloid roots**



# External Morphology

- The much branched mass appears like a coral on the soil surface hence called coralloid roots
- Do not bear root caps
- The cluster has lenticel like apertures
- Become infested by  $N_2$  fixed blue-green algae (cyanobacteria); bacteria & diatoms e.g. Nostoc punctiforme, Anabaena cycadacaerum
- Symbiotic relationship thus established



. Cycas. Coralloid root-external features.

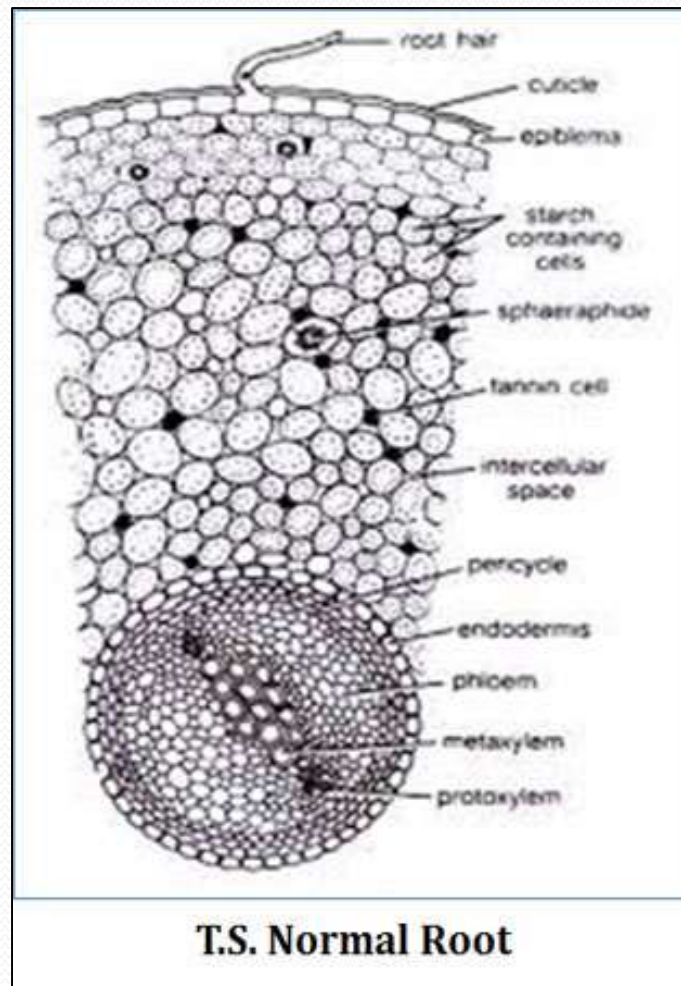
# Anatomy

## Root

- Young root shows typical structure like that of a dicotyledonous root
- Outermost layer, epiblema, encloses the parenchymatous cortex interspersed with tannin cells and mucilage canals
- Endodermis with casparian thickenings
- Pericycle is multilayered with thin cells having starch grains
- Vascular tissue within is typically radial
- Roots usually diarch to tetraarch, rarely polyarch
- Vessels absent in vascular tissue
- Pith reduced or absent



## *Cycas revoluta* T.S normal root (young)



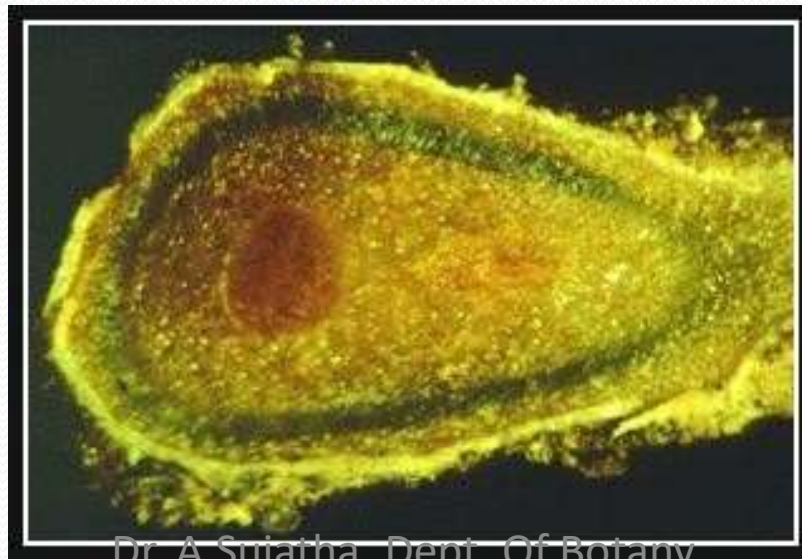
# Anatomy – Root

- Older roots show secondary growth
- Cambial ring is initiated between xylem & phloem and completed by differentiation in inner layer of pericycle adjacent to protoxylem elements
- These cambial cells are meristematic and add secondary xylem on the inside and secondary phloem towards cortex
- Alongside phellogen (cork cambium) develops in outermost layer of cortex below the epidermis
- This produces dead cork cells (phellem) towards outer side and living secondary cortex cells (phelloderm) on the inside.
- Lenticels are developed in old roots

# Anatomy – Root

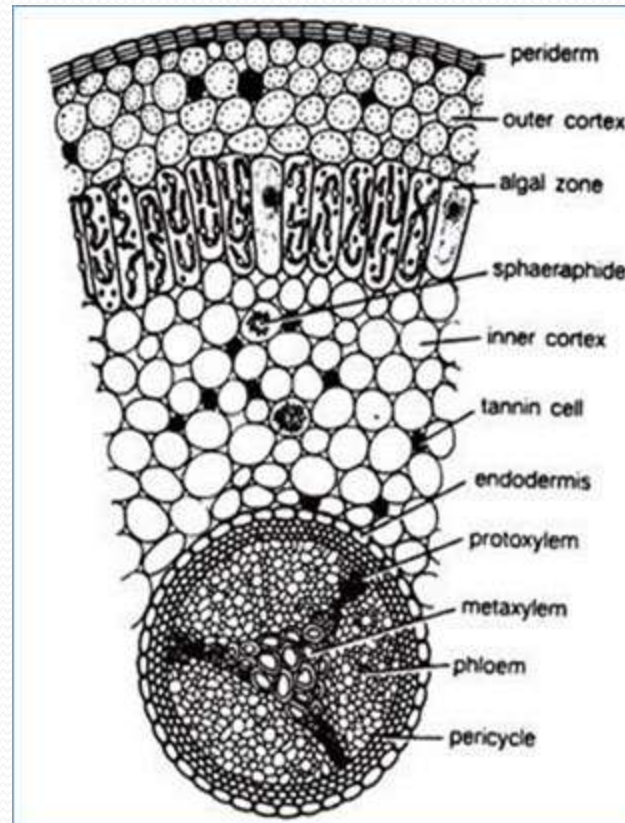
## Coralloid Roots

- Has additional algal zone in the cortex
- Cells of algal zone palisade like and form the middle cortex





## T.S Corolloid root



**T.S. Coralloid Root**

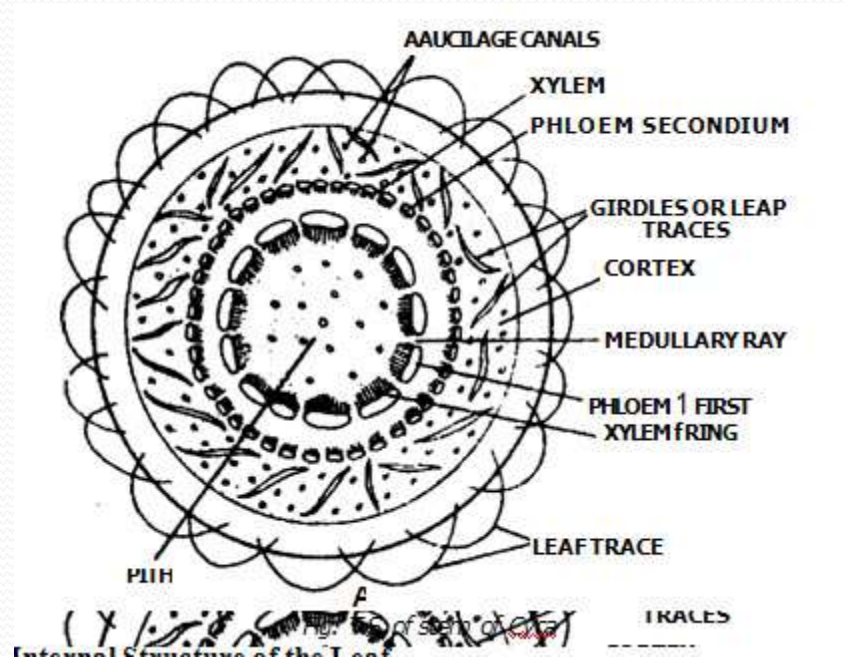
# Anatomy – Stem

## Stem

- Show irregular outline due to the presence of leaf bases, therefore epidermis is not a continuous layer
- Broad cortex is traversed by simple and girdle leaf traces
- Numerous mucilage canals, starch grains also present
- Narrow zone of vascular tissue having open, endarch vascular bundles arranged in a ring and separated from each other by wide medullary rays

Pith is large, parenchymatous having mucilage canals and starch grains

# T.S of young Stem





# Anatomy – Stem

- Old stem of *Cycas* shows secondary growth
- Wood manoxylic type with scanty xylem and wide medullary rays

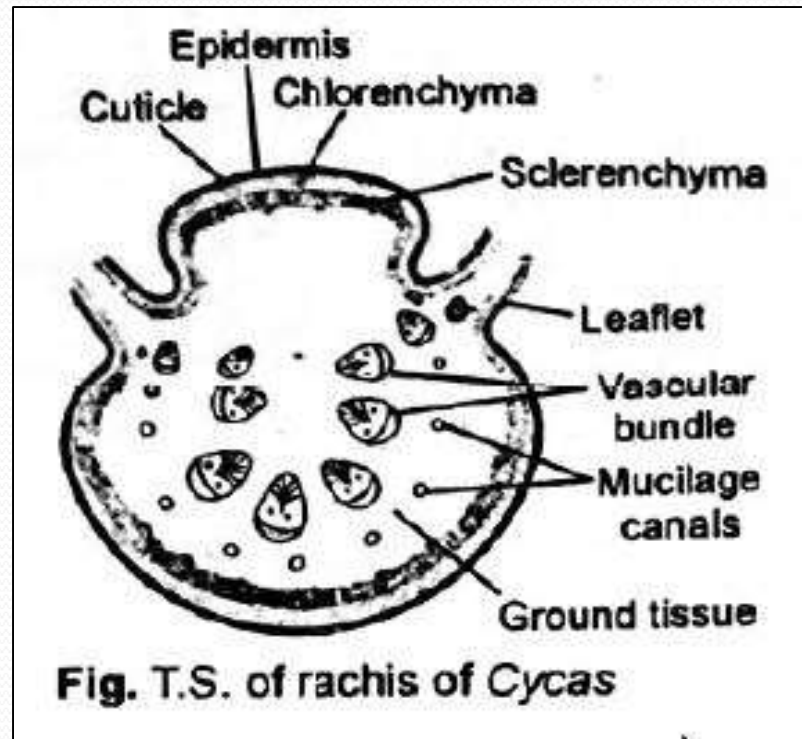


# Anatomy – Rachis

## Rachis of Cycas

- Woody and thick
- Hypodermis sclerenchymatous
- Characteristic feature is omega shaped ( $\Omega$ ) outline of the numerous vascular bundles
- Each bundle has sclerenchymatous bundle sheath and is open, collateral.

## Cycas Rachis T.S



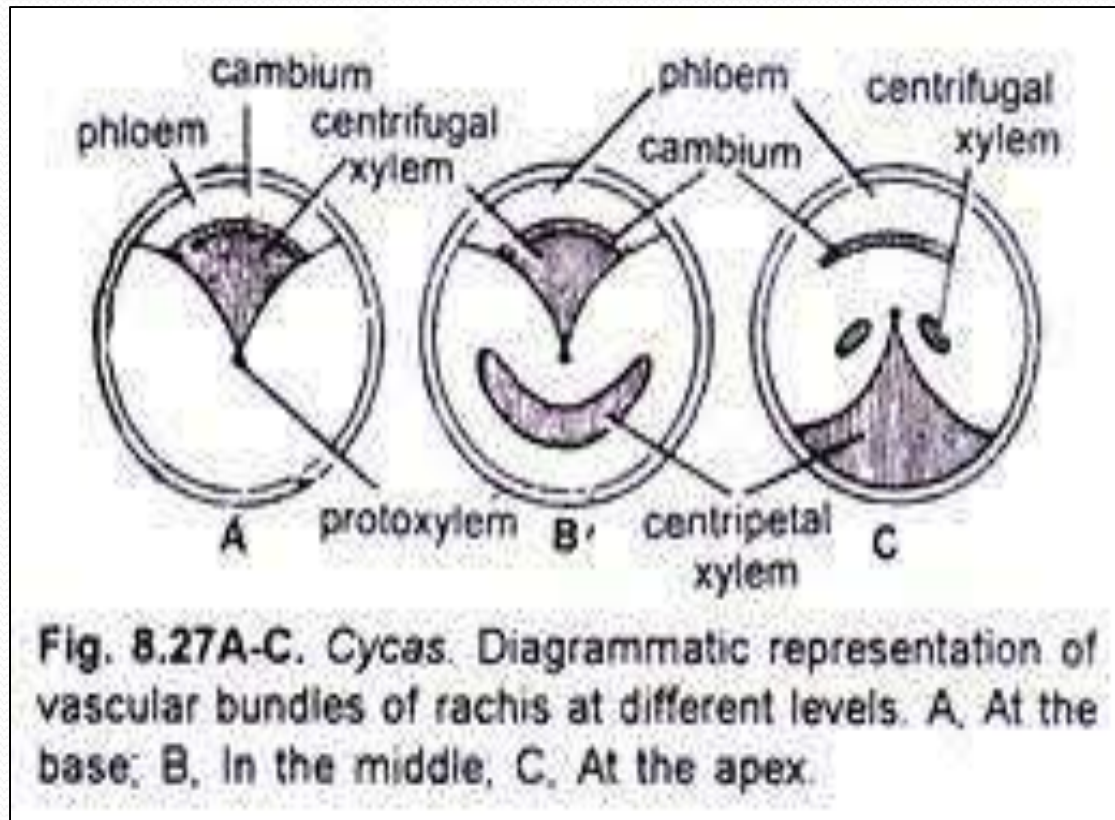


# Anatomy – Leaflet

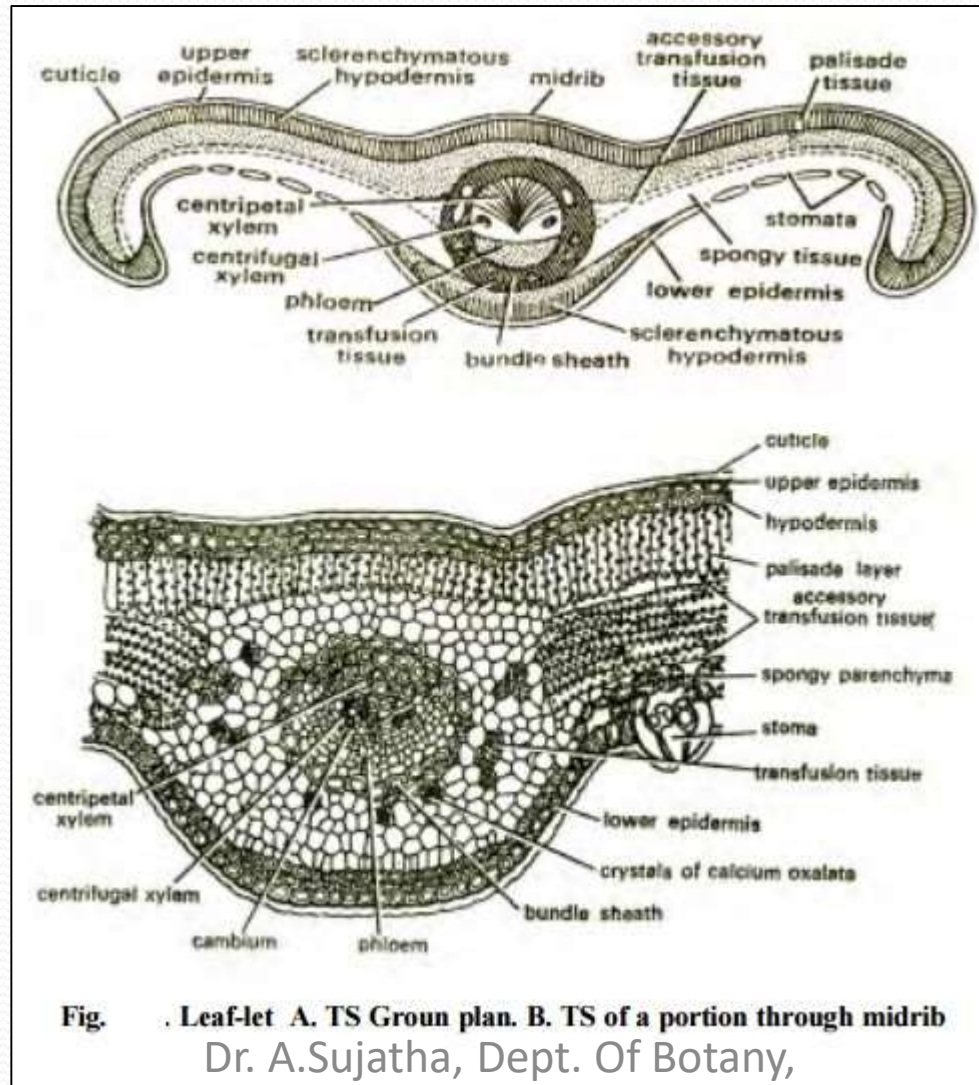
## Cycas Leaflet

- Leaflet is thickly cutinized and leathery
- Possesses all xerophytic characters
- Sunken stomata and thickened hypodermis present
- Well developed palisade layer in mesophyll
- Between the palisade and lower mesophyll layers, there are transversely running long colourless cells in 3-4 layers extending from mid-rib to near leaf margin
- These constitute the transfusion tissue
- Mid-rib bundle consists of a broad triangular centripetal xylem and two small patches of centrifugal xylem – thus dipoxyl
- Phloem abaxially placed

# Representation of vascular bundles of rachis in *Cycas*



# Leaf let T.S





# Reproduction – Vegetative

- Vegetative reproduction is by means of bulbils
- Develop in crevices of scale leaves and leaf bases at the basal part of an old stem
- Produces new plant on detachment



# Reproduction – Sexual



The Malaysian cycad *Cycas circinalis*. Left photo shows the "cone" of a female plant with modified leaves (sporophylls) bearing small ovules along their margins. Center photo shows a female plant with clusters of mature seeds attached to the sporophylls. Right photo shows the erect, pollen-bearing cone (strobilus) of a male plant. The individual scales (sporophylls) of the cone bear clusters of sporangia.



# Reproduction – Sexual

- Strictly dioecious plant
- Male plants are rare
- Male strobilus or cone borne singly at the apex of the trunk
- Apical shoot apex utilized in the development of male cone, hence branching sympodial
- Cone shortly stalked & large (up to 50cm length or more)





# Reproduction – Sexual

- Numerous micro-sporophylls spirally arranged around the central axis
- Each micro-sporophyll is narrow below and broad above terminating into projection – the apophysis
- Microsporangia confined to abaxial (lower) surface
- Usually present in sori – each with 2-6 sporangia
- They contain a large number of haploid microspores (pollen grains)

# Female Reproductive Structures

- Female plant do not produce definite cones
- A whorl of spirally arranged megasporophylls arise around the short apex
- Each megasporophyll resembles the foliage leaf and approximately 10-23 cms. long
- Lower petiolar part bears the naked ovules on the margins



# Ovule Structure

- Largest ovule (6cms.x4cms.) seen in *C.circinalis*
- Ovules are orthotropous, sessile, ovoid or spherical in shape and unitegmic.
- The thick integument is differentiated in three layers- outer and inner fleshy layers, middle stony.
- The integument remains fused inside with nucellar tissue except at the position where it forms the micropylar opening.
- Ovule is well supplied with vascular bundles.



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# Megasporangium

- The megaspore develops in the nucellus by meiotic division and goes on to form female gametophyte tissue.
- 2-3 archegonia are formed in this haploid tissue which is food laden.
- Egg cell in the venter of archegonia, undergoes fertilization by the motile spermatozoid forming diploid zygote.



## Pollination - Development of male gametophyte after pollination

- The pollen grains are carried by wind (Anemophily) and caught by pollination drop secreted by ovule. Pollination is direct.
- The pollination drop is dehydrated and the pollen grains are sucked into the pollen chamber.
- Pollen grains take rest for some time in the pollen chamber.

## Pollination - Development of male gametophyte after pollination

- During the germination of pollen grain the exine is ruptured and the inner intine comes out in the form a tube like structure known as pollen tube.
- At this time the generative cell divides and forms a larger, upper body cell and smaller, lower stalk cell.
- The pollen tube acts as haustorium to absorb food materials from the nucellus besides as sperm carrier.
- The body cell divides and forms two naked, top shaped, motile, multiciliated antherozoids. The cilia are in 4 – 5 spirals.
- The male gametes of *Cycas* are 180 – 210  $\mu$  in size and largest in the plant kingdom.
- The pollen tube apex is ruptured and the male gametes are released into the archegonial chamber.
- Presence of multiciliated male gametes is the fern character shown by *Cycas* male gametophyte



# Young Sporophyte – Embryo

- Embryo development is meroblastic.
- Proembryo shows upper haustorial part, middle elongating suspensors and the basal meristematic embryonal region.

# Seed

- A mature embryo is straight and has a short hypocotyl.
- Embryonal axis has plumule at one end and radicle at the other.
- Radicle is covered by coleorhiza.
- Number of cotyledons maybe 2-3..
- Nucellus is completely absorbed in the seed.
- Mature seed is large 2.5–5 cm wide and usually orange or red in colour..
- Germination is epigeal type.

9/19/2022





# THANK YOU

New flush of leaves

