Quadrant II – Transcript and Related Materials

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Module Name : Anatomy of *Cycas*

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Notes

The plant body of *Cycas* is a sporophyte, differentiated into root, stem and leaves. Roots are dimorphic with two morphologically different types of roots, normal roots and coralloid roots.

Anatomy of *Cycas*

Anatomy of *Cycas* root

Normal roots:

The primary roots are tap root which are short lived and are replaced by adventitious roots. Roots are positively geotropic and helps in fixation and absorption

Anatomy of normal root of *Cycas* (T.S):

Internal structure of root resembles that of angiospermic dicot root. Anatomically the normal root of *Cycas* consists of three well defined regions, *viz.,* epiblema, cortex, stele. Epiblema is the outermost layer circular in outline and formed of thin walled cells. Inner to epiblema is cortex, composed of thin walled, rounded parenchymatous cells .with many intercellular spaces. Some

of the cells possesses tannin and starch. Multilayered cortex surrounds the stele. Stele comprises of single layered endodermis and pericycle. Stele is diarch, triarch or polyarch. Vascular bundles are radial i.e., xylem and phloem are present on different radii. The origin of xylem is exarch.

Coralloid roots: These are special types of adventitious roots developing from some of the normal roots. These roots are negatively geotropic .and are formed near the soil surface, shows dichotomous branching with rounded or blunt tips, root cap is absent.. Coralloid roots are coral like in appearance, greenish brown in colour. These roots have N_2 fixing blue green algae (Cyanobacteria) and thus helps in nitrogen fixation.

Anatomy of coralloid root of *Cycas* (T.S.):

The transverse section of coralloid root consists of three well defined regions *viz.,* periderm, cortex, stele. Periderm is outermost layers and is composed of multilayerd cork and cork cambium. Perdierm surround the cortex which is wide and divisible into three zones, outer, middle and inner cortex. Outer and inner cortex are made up of thin walled parenchymatous cells, while the middle cortex is the algal zone. The cells of algal zone are thin walled, radially elongated and contain algal filaments, belonging to the species of *Nostoc* and *Anabaena* of Cyanophyceae. These endophye fix nitrogen. Innermost layer of cortex surround the stele. Stele is triarch, the stele is bounded by an endodermis which is followed by pericycle. Secondary growth is absent.

***Cycas* leaflet:**

A *Cycas* leaflet is differentiated into a swollen midrib portion and two lateral wings. The leaflet shows xerophytic features. The margins of leaflet in *Cycas revoluta* are curved while in *Cycas circinalis* the margins of wings are straight. The center of the leaflet is bulging due to the presence of vascular bundles.

Anatomy of *Cycas* leaflet (T.S.):

Internally *Cycas* leaflet shows five distinct regions *viz.,* Epidermis, Hypodermis, Mesophyll, Transfusion tissue and Vascular bundle. Epidermis is the outermost layer (uppermost and

lowermost) covered by thick cuticle. Stomata are restricted to the lower epidermis. Below the epidermis is the hypodermis which consists of polygonal sclerenchymatous cells 1-2 layered in thickness. The mesophyll of the leaflet is differentiated into an upper layer of palisade cells and lower spongy tissues. All the cells of mesophyll contain chloroplasts. Between the palisade and spongy cells are the cells of transfusion tissues consisting of 2-3 layers of laterally elongated parenchyma cells, extends from the vascular bundle (mid vein) up to margins of the leaflets: the cells are tracheid- like, colourless. The transfusion tissues facilitate lateral conduction of water compensating for the absence of lateral veins. The air spaces of spongy tissue communicate with the outside through stomata. A single vascular bundle is present in the midrib portion of the leaflet. The vascular bundle is conjoint, collateral and open type, it is diploxylic in nature. Below the xylem lies an arch shaped cambium and, on the lower side of the cambium is phloem. The vascular bundle is characterized by the presence of a triangular centripetal xylem and two small patches of centrifugal xylem. Each vascular bundle is surrounded by a bundle sheath.

Anatomy of *Cycas* rachis (T.S.)

The transverse section of rachis is biconvex in outline, from its two sides on the anterior side, opposite each other, two leaflets are formed. The section shows epidermis, hypodermis, and ground tissues. The vascular bundles present in the ground tissue are arranged in the form of inverted letter omega.

The outermost layer is epidermis, heavily cutinized and possesses stomata. The epidermis is followed by multilayered hypodermis. The outer layers of the hypodermis contains chlorophyll containing cells of chlorenchyma while, the inner layer are sclerenchymatous formed of thick walled cells. The ground tissue is made up of thin walled parenchymatous cells. A large number of mucilage canals lie in the peripheral region. Ground tissue encloses number of vascular bundles arranged in inverted omega shape. Each vascular bundle is conjoint, collateral and open type with cambiform cells and is surrounded by bundle sheath cells. The xylem is diploxylic *i.e.*, consisting of centripetal and centrifugal xylem. Phloem is present on the outer side and consists of sieve tubes and phloem parenchyma, while companion cells are absent.

The vascular bundle in the rachis shows differences in their structure at the base, middle

and apex. At the base the vascular bundles are endarch in origin with centrifugal protoxylem towards the centre and centripetal metaxylem towards outside of the rachis. The vascular bundle in the middle are pseudomesarch, while at the apex the vascular bundles are exarch in origin with protoxylem towards outside and centripetal metaxylem towards centre.

Internal structure of stem:

Anatomy of young stem of *Cycas* (T.S.):

The transverse section of young stem of *Cycas* is wavy in outline due to the presence of numerous woody leaf bases The outermost layer is epidermis and consists of compactly arranged thick walled cells. Following the epidermis is multilayered cortex comprising of number of layers of loosely arranged parenchymatous cells. The cortical region contains a large number of leaf traces and mucilage ducts. The leaf traces are of two types-straight (direct) and girdled. Each leaf has four leaf traces of which two appears in front of the leaf base (straight type) and girdled, round the central cylinder and called girdle traces.

The vascular cylinder is ectophloic siphonostele with vascular bundles arranged in a ring like manner. The vascular bundles are conjoint, collateral, open type with endarch xylem. The xylem consists of tracheids and xylem parenchyma while, vessels are absent. Outside the xylem lies the phloem which consists of sieve tubes and phloem parenchyma. Phloem lacks the companion cells. The center is occupied by pith formed of parenchymatous cells enclosing mucilage canals.

Secondary growth in old stem:

Anatomy of old stem of *Cycas* (T.S.)

The transverse section of old stem of *Cycas* is wavy in outline due to the presence of numerous woody leaf bases The outermost layer is epidermis and consists of compactly arranged thick walled cells. Following the epidermis is multilayered cortex comprising of number of layers of loosely arranged parenchymatous cells. The cortical region contains a large number of leaf traces and mucilage ducts. The leaf traces are of two types-straight (direct) and girdled. Each leaf has four leaf traces of which two appears in front of the leaf base (straight type) and the girdled round the central cylinder and called girdle traces.

Secondary growth in old stem of *Cycas* begins by the formation of secondary xylem and secondary phloem outside the already existing primary xylem and primary phloem. It is a result of activity of inter and intra-fascicular cambium which cuts off secondary xylem towards inner side and secondary phloem towards outer side along with well traversed numerous, broad, parenchymatous medullary rays. Thus, a number of concentric rings of secondary tissues develop due to the activity of cambium.