

Course- B.Sc. Part-II Botany Subsidiary
PAPER-II

Topic- Secondary growth in *Boerhaavia*(ANATOMY)

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In many vascular plants, secondary growth is the result of the activity of the two lateral meristems, the cork cambium and vascular cambium. Arising from lateral meristems, secondary growth increases the girth of the plant root or stem, rather than its length. During secondary growth Cambium becomes active as a meristematic tissue and cuts off new cells called as Secondary phloem (towards outside) and secondary xylem (towards inside). In this manner the plant goes on adding cells to provide girth to the plant. The behavior of the cambium remains same throughout the growth. However, in "Anomalous secondary growth" cambial conformations, cambial products, and cambial numbers differ from the most common "normal" condition, namely, a single cylindrical cambium that produces phloem externally and xylem internally. The term "variants" is employed here as a way of referring to the less common types; "anomalous" may give the misleading impression of a disorderly action.

The following points highlight the five major reasons of anomalous secondary growth in plants. The reasons are:

1. The Activity of Normal Cambium is Abnormal- *Aristolochia*
2. Abnormally Situated Cambium Forms Normal Secondary Vascular Tissues - *Serjina*
3. Formation of Secondary Tissues by Accessory Cambium- *Boerhaavia*
4. Formation of Interxylary Phloem - *Entada*
5. Formation of Intra-Xylary Phloem.- *Tecoma*

Formation of Secondary Tissues by Accessory Cambium:

Bougainvillea, *Amaranthus*, *Boerhaavia*, *Achyranthes*, *Celosia* etc. exhibit accessory cambia that form vascular and non-vascular tissues. This type of anomaly is illustrated below taking the example of *Boerhaavia diffusa*.

In *Boerhaavia diffusa* endodermis delimits stele of stem. All segments of endodermis are not always distinct. Just below the endodermis there occurs the pericycle. It is narrow and consists of one or two cell layers. In older stems just below the endodermis a few scattered fibers are present. The position of fibers is of special interest because they locate the endodermis when the latter is indistinct. The other structures of stele include parenchymatous ground tissue, conjunctive tissues and primary vascular bundles.

Important characters

Epidermis:

1. Single layered epidermis consists of compactly arranged thin walled cells and is covered by thick cuticle.
2. It bears many multicellular hairs when young.
3. In the stem showing secondary growth, cork cambium is present which cuts cork towards outer side and secondary cortex towards inner side.

Cortex:

4. It consists of collenchyma, parenchyma and endodermis.
5. Collenchyma in young stems is present in patches but in old stems it remains in the form of a continuous ring of few layers, present just below the epidermis.
6. Next to the collenchyma is situated the region of parenchyma consisting of many thin walled, oval to spherical cells with intercellular spaces. Sometimes they develop chlorophyll.
7. Endodermis is the innermost layer of the cortex the cells of which are barrel shaped and contain starch grains. In old stems, however, it is not a conspicuous layer.

Pericycle:

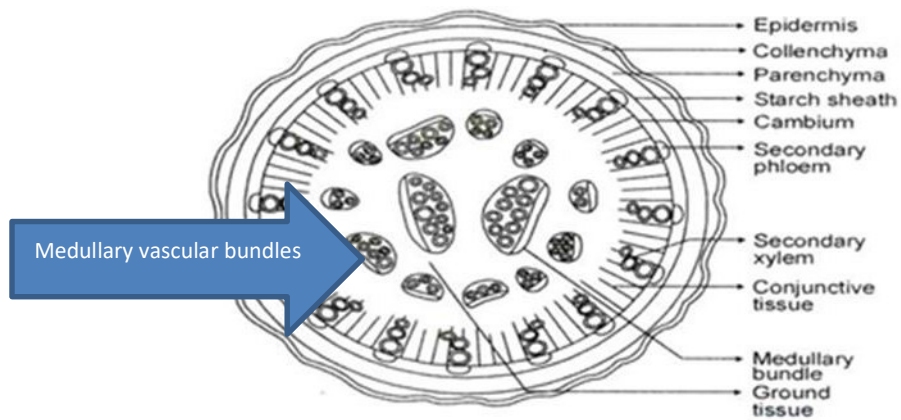
8. It is represented by thick, sclerenchymatous stone cells forming a discontinuous layer.

Vascular System:

9. It consists of phloem and xylem.
10. In the young stem are present many vascular bundles arranged in ring. Bundles are conjoint, collateral, open and endarch. Many medullary bundles are also present.
11. The old stem shows secondary growth.
12. Just below the pericycle are present the patches of primary phloem.
13. Secondary phloem is present inner to the primary phloem.
14. Cambium is present in between secondary phloem and secondary xylem.
15. Primary xylem is present near the pith facing its protoxylem towards the centre of stem.
16. Many groups of secondary phloem are embedded in the region of secondary xylem and called interxylary phloem or included phloem.

Medullary Bundles:

16. Many conjoint, collateral, open and endarch bundles are present in the pith. These are called medullary bundles.



T S Of Boerhaavia stem showing Abnormal secondary growth as Medullary vascular bundles

