Anomalous Secondary Growth

In many plants, the pattern of the secondary thickening shows deviation from the normal type. The term “Anomalous Secondary Growth” is given for this deviation or variation. The anomalous secondary growth is more common in tropical plants. Anomalous secondary thickening is NOT an anomaly or disease in plants; rather it is an adaptation to suit the habit and habitat of the plant.

In Dicots Vascular bundles are Conjoint, collateral, open and arranged in a ring. Formation of secondary tissues takes place by Fascicular cambium in stele and Cork cambium in cortex. In Monocots Vascular bundles are conjoint, collateral, closed and are scattered in the ground tissue. Secondary growth is absent. Any deviation in the above pattern of development in Primary and secondary structure is called “Anomalous secondary growth”.

Reason for Anomalous Secondary Growth in Plants

- The normal cambium behaves peculiarly or irregularly, resulting in the abnormal arrangement of the vascular tissue.
- The normal cambium is situated in an abnormal position hence the tissue cut is placed abnormally.
- The normal cambium does NOT develop or if present, it is replaced by additional or accessory cambial rings.
Types of anomalous growth

There are two types of anomalous secondary Growth;

1. Abnormal growth from abnormal cambium in monocot
2. Abnormal growth from normal cambium in dicot

1) Anomalous Secondary Thickening in Dracaena stem (Monocot)

The secondary thickening is usually absent in monocot plants since the vascular bundles in monocots are closed type (no cambium). However, a very few plants in monocots shows anomalous secondary growth such as Dracaena, Yucca, Aloe, Sansevieria and Agave.

- The secondary growth happens by abnormal growth from abnormal cambium in monocot. In monocotyledons normally the vascular bundles are closed. The cambium being absent the secondary growth is absent; but in some plants like Dracaena and Yucca secondary growth takes place.

- The normal cambium either does not develop. This abnormal cambium may either develop from cortex or pericycle and shows abnormal activity.

- The young stem has typical structure i.e. epidermis is followed by sclerenchymatous hypodermis. A large number of closely arranged bundles are scattered in ground tissue.

- One of the outer layers of cells from the ground tissue becomes meristematic and functions as cambium. The cambium formed in the region which has ceased elongating.

- The activity of this cambium is more on the inner side and very little on the outside where it forms only parenchyma. On the inner side it forms xylem and parenchyma in alternate patches. The inner parenchymatous cells are called conjunctive tissue.

- After a short while the activity of cambium on inner side changes and above the xylem it starts forming phloem and then again xylem. The xylem formed earlier has bigger vessels.

- Around each vascular bundle is developed sclerenchymatous sheath.

- The cambium after sometime alters its activity and forms xylem on the inner side, at those places where it was previously forming the
parenchyma and parenchyma in place of xylem. Similar to earlier case again by change in activity it forms a ring of vascular bundles.

- Activity of cambium goes on changing regularly and more rings of vascular bundles are formed.
- Cork cambium is formed below hypodermis and forms cork and cork cambium in normal fashion.

2. Anomalous Secondary Thickening in Dicot stem (Boerhaavia – Stem):

The abnormal secondary growth from normal cambium. In this type; cambium of normal type is present and persist but by peculiarity or irregularity in its Activity develop vascular tissues of unusual arrangement.

The anomalous secondary growth of dicot (Boerhaavia) stem showed following tissues from outside within:

**Epidermis:**

- Single layered epidermis consists of small, radially elongated cells.
- Multicellular epidermal hairs arise from some cells.
- A thick cuticle is present on the epidermis.
- Some stomata are also present.

**Cortex:**

- It is well differentiated and consists of few layered collenchymatous hypodermis followed by chlorenchyma.
- Collenchyma is 3 to 4 cells deep, but generally near stomata it is only one layered.
- Chlorenchyma is present inner to collenchyma in the form of 3 to 7 layers.
- Chlorenchymatous cells are thin walled, oval, full of chloroplasts and enclose many intercellular spaces.
- Endodermis is clearly developed and made up of many, tubular, thick-walled cells.

**Pericycle:**

- Inner to the endodermis is present parenchymatous pericycle but at some places it is represented by isolated patches of sclerenchyma.
**Vascular System:**

- Vascular bundles are present in three rings. In the innermost ring are present two large bundles; in the middle ring the number ranges from 6 to 14 while the outermost ring consists of 15 to 20 vascular bundles.
- Vascular bundles of innermost and middle rings are medullary bundles.
- Vascular bundles are conjoint, collateral and endarch.
- Two vascular bundles of the innermost ring are large, oval and lie opposite to each other with their xylem facing towards centre and phloem outwards.
- Middle ring consists of 6-14 small vascular bundles.
- Vascular bundles of inner and middle rings may show a little secondary growth.
- Phloem consists of sieve tubes, companion cells and phloem parenchyma while the xylem consists of vessels, tracheids and xylem parenchyma.
- Outermost ring of the vascular bundles contains interfascicular cambium which is absent in other two rings.
- Cambium develops secondarily from the pericycle and becomes active. It cuts secondary phloem towards outer side and secondary xylem towards inner side. Due to these changes the primary phloem becomes crushed and present next to pericycle. Primary xylem is situated near the pith.
- Interfascicular cambium also soon becomes active and cuts internally the row of cells which become thick walled and lignified and are known as conjunctive tissue.

**Pith:**

- It is well developed, parenchymatous and present in the centre.