PERIDERM

The periderm is a protective tissue of secondary origin, formed by a lateral meristem developing in the extra-stelar region. It replaces the epidermis when it is destroyed as the axis increases in girth by extensive secondary growth. There is much variation in the age if the shoots when the formation of the periderm starts. For e.g., in *Acacia*, its formation starts within two weeks of the growth of the shoots, in *Psidum*, when the shoots are 6-8 weeks old and in *Mangifera* periderm is formed only when the shoots are about 20 months old. Sometimes, a non-technical bark is used for periderm, but as a matter of fact it includes all tissues outside the vascular cambium, i.e., secondary phloem, primary phloem, cortex and periderm. Thus, in strict technical terms periderm is a part of the bark.

1. Structure and Development of Periderm

The periderm includes three parts - the phellogen and it's two derivatives, the phellem (cork) and phelloderm (secondary cortex).

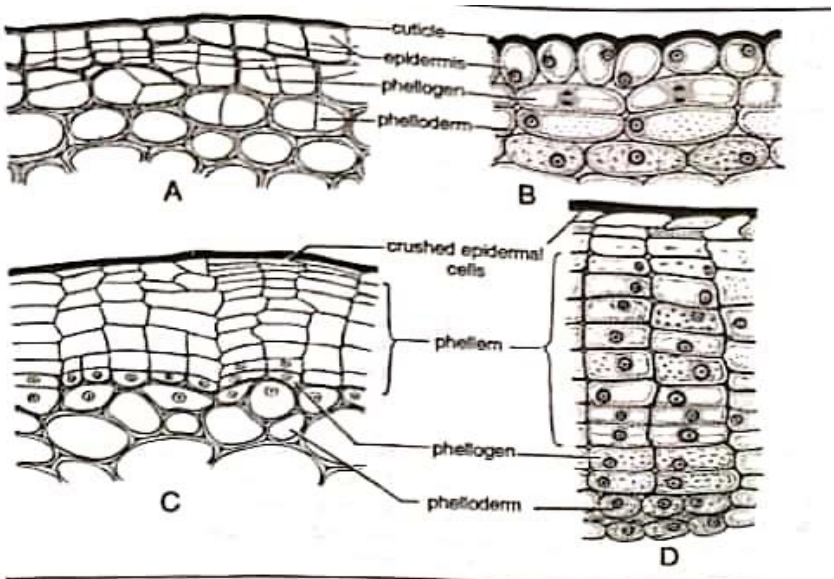

Fig. 10 A-D. Origin of periderm: A-B. Origin of phellogen in epidermis and subepidermal layer respectively; C-D. Origin of phellogen in outer layers of cortex.

(A) Phellogen- The phellogen or cork cambium is a lateral meristem which forms cork or phellem towards the outer side and secondary cortex or phelloderm towards the inner side.

Phellogen originates from relatively mature but living cells. Phellogen cells divide both in periclinal and anticlinal planes. After each division one of the daughter cells remains

meristematic and the other daughter cell gives rise to phellem (if it happens to lie towards the periphery of the stem) or phelloderm (if it happens to lie towards the center of the stem). In most of the woody plants, with the continuation of the process of secondary growth, the original phellogen is replaced by successively more deep seated phellogens. In old stem the latter formed periderm layers are found in secondary phloem. Each of these phellogens functions normally and produces cork and phelloderm. As a result, pockets of dead cortical and phloem tissue becomes isolated between the periderms. These tissues make up the rhytidome. If the phellogen forms complete cylinder around the stem, its activities result in the development of ring bark. On the other hand, if the phellogen is formed in arcs, a scale bark is formed.

(B) <u>Phellem</u>- The cells of the phellem or cork are compact or dead at maturity. They are characterized by suberin deposits on the walls. Electron microscopes studies have revealed that the suberin lamella is layered. Sometimes, non-suberized cells, known as phelloids, also occur in the cork. In *Betula alternating* layers of suberized and non-suberized cells are present. Consequently the cork peels off like sheet of paper. Phellem, being thick walled, prevents the inner tissues of the stems from drying out.

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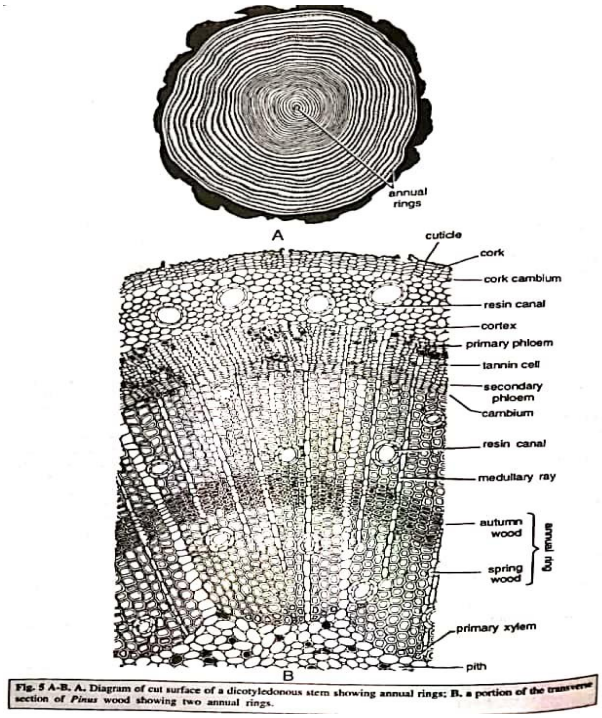

Fig. 5 A-B. A. Diagram of cut surface of a dicotyledonous stem showing annual rings; B. a portion of the transverse section of *Pinus* wood showing two annual rings.

(C) Phelloderm- The phelloderm or secondary cortex is made up of living cells with non-suberized cellulose walls which have simple pits. They contain protoplast like the parenchyma of the primary cortex. They sometimes contain chloroplasts and function in photosynthesis and food storage

Regulation of Cork Development

Several environmental and endogenous conditions induce cork formation. Environmental factors such as submergence in water, direct strong sunlight, mechanical and biotic sounding, etc. are known to increase the production of gaseous phytohormone-ethylene. It is therefore proposed that ethylene is the major activator for phellogen initiation and activity (Lev-Yadun and Aloni,1990). Since, the cork layer formed is almost impermeable to gases, hence as a cork layer is formed, the inner cell layers are exposed to increasing level of ethylene, and more cork layer is induced. In many plant species there is a gap in phellogen initiation around Hudson the nodal region, or a cork free region in stems and branches beneath buds and major veins of leaves. Therefore, it is proposed that the basipetal polar auxin transport inhibits cork formation in this regions. These cork free regions later enable suppressed buds to develop quickly and form new branches after damage to the canopy.

Rhytidome

Bark comprises all the tissues outside the vascular cambium in stem and roots. The majority of the bark of woody plants develops from three meristem; the vascular cambium that gives rise to the secondary phloem, the phellogen or cork cambium that produces cork and the dilation meristem that produces parenchyma cells to prevent cracking when the axis increases in the diameter. Bark is an inclusive term for all tissues outside the vascular cambium. Thus, it includes primary and secondary phloem, cortex, first periderms and subsequent periderms. It also includes the tissues formed by the dilation growth.

Structurally, bark can be differentiated into two regions- the inner bark and the outer bark. The inner bark includes the inner most ares of the periderm. It is alive and some of its cells may differentiate and become meristematic. The outer bark includes the dead tissue on the surface of the stems, along with parts if the inner most periderm. With the formation of the periderm, the tissue external to it gets cut off from the inner tissues. Consequently the water supply to outer bark stops and eventually it dies and becomes cracked forming hard crust on the surface of the stem. The tissue becomes more and thicker as the additional cork layers cut off by underlying

living tissue are added. This thick outer bark along with the layer of tissues that it encloses is called rhytidome. Commonly all the tissue that is peeled off is bark and the name rhytidome is only for outer bark. When the subsequent periderms develop in the form of overlapping scales or shells, the outer layers are sloughed accordingly; it results in the formation of scaly bark (e.g., in the young stem of pinus). In some other plants the subsequent periderms are formed as entire cylinders and are sloughed as hollow cylinders. This type of bark is known as ring bark. An intermediate condition is found in Eucalyptus, Plantanus etc. where layers of the bark peel off in the form of relatively large sheets.

Lenticels

In the periderm of most plants, small areas of loosely arranged cells are present. These areas are known as lenticels. Lenticels are usually formed below a stoma or group of stomata. At such places the phellogen is divided in different planes to form a mass of loosely arranged, rounded, unsuberized cells with many intercellular spaces. The resulting tissue is known as complementary or filling tissue. The pressure exerted by the formation of complementary cells ruptures the epidermis thus exposing the mass of complementary tissue. Lenticels help in the exchange of gases between the exterior and the interior of the stem.

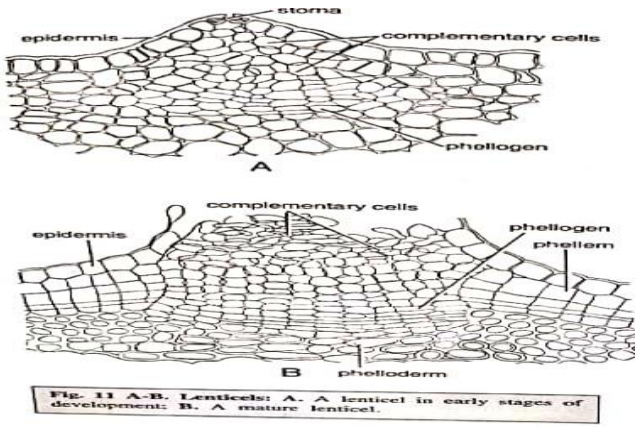

Fig. 11 A-B. Lenticels: A. A lenticel in early stages of development; B. A mature lenticel.

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