

SECONDARY GROWTH

INTRODUCTION

Secondary growth is a process during which there is increase in thickness of parts of the plant body by the two types of meristematic tissue called as Cambium & Cork-Cambium in stems (V.B.) & Endosteolar region (Cortex) respectively. Esau (1956).

The total process of Sec. growth is divided into two parts :-

(1) Activity of Cambium in the region of stem where V.Bs are present :-

→ In D.S the V.Bs are Conjoint, collateral & open & arranged in ring.

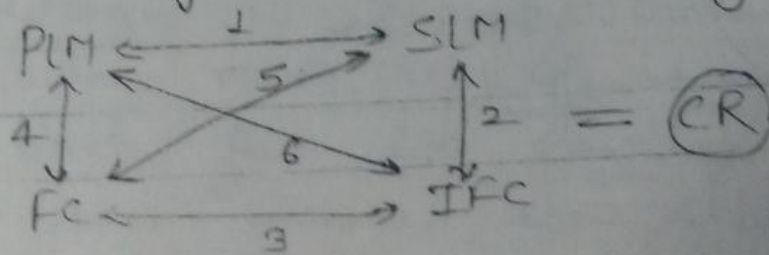
→ xylem present from beginning is called primary xylem, phloem as primary phloem & cambium as fascicular cambium (FC), this is the form of primary lateral meristem (PLM).

→ As Sec. growth starts a new cambium is formed by first conversion of conjunctive tissue to form interfascicular cambium (IFC).

→ IFC is the form of sec. lateral meristem (SLM). It is formed in between the V.Bs.

→ By the association of FC & IFC or PLM or SLM or vice-versa :- there is formation of a continuous circular cambium ring (CR)

→ It is first sign that secondary growth started.



Concept (4) & (5) C.R will be formed in all.

* First movement (activity) → First activity takes place in that Cambium to produce some amount of xylem (secondary) towards region of pith (inner side) & phloem towards the outer (outer side).

⇒ Always Sec. xylem is produced more (3 times) than the primary phloem, so wood & bast are product of Cambium ring as a stand.

⇒ Later on the whole Cambium ring becomes active, thus the pith is covered by sec. xylem & due to this centre will fall pressure to participate in sec. growth.

of Sec. growth in the region of pith are only wood & bast & that IAC, because they are permanent tissue.

Convert into permanent tissue.

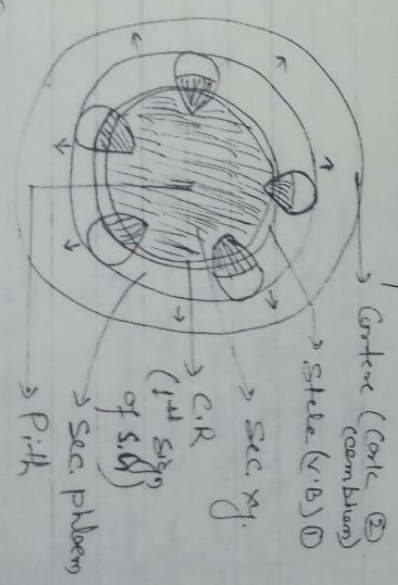


Fig: The beginning of S.G.

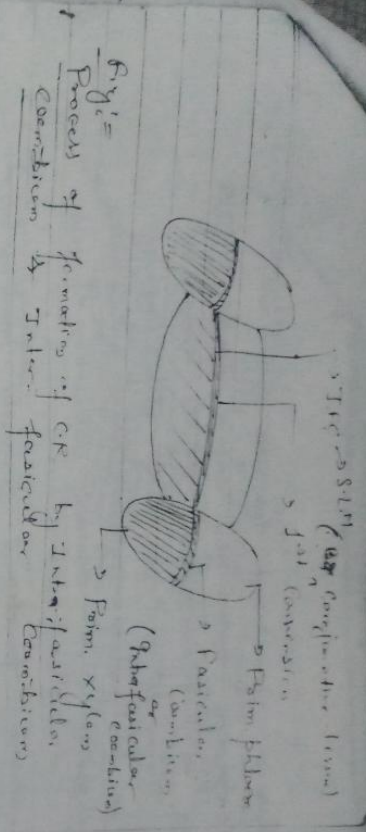
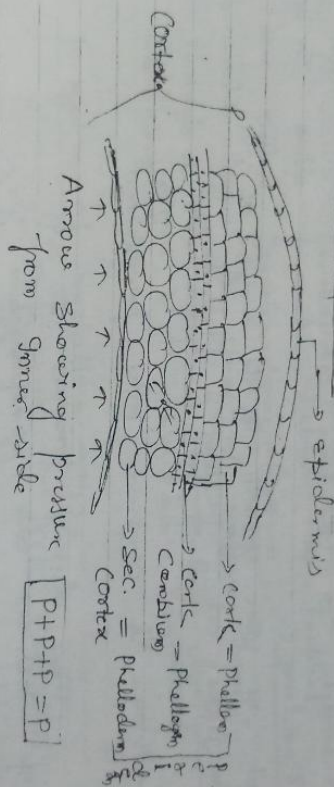


Fig 1 =
Process of formation of CR by Intercellular Cambium
Cambium is Intercellular Cambium

② Activity of Cork-Cambium in Cork-stelar region where cortex is broad =

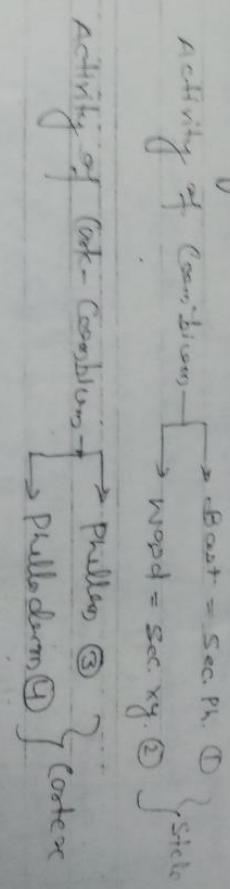


Arrows showing pressure from cambium side

- In the region of cortex only SM are not possible for increasing the thickness. No role of P.M.
- Secondary growth starts in cortex just to avoid the pressure coming from the cambium side.
- A new meristematic tissue appears in the parenchymatous cortex known as Phellogen, Phellogen is actually conversion of inner cortex made up of parenchyma.
- Phellogen divide just like cambium & it produces same tissue above & below.

- The tissue produced towards upper side are compactly arranged called Phellum or Cork
- In case of gymnosperms this is known as Phellod. There is additional deposition of Suberin in phellum or cork of Angio, where as in the gymnosperm cork contain deposition of cellulose
- The tissue produced towards inner side by cork cambium are loosely arranged called phelloderm or sec center.
- Phellum, Phelloderm & Phelloderm or combinationly constitute a tubular structure called Phelloderm.
- Product of sec growth in the region of cortex include only Phellum & Phelloderm & not the phelloderm, because it is meristematic tissue & convert into permanent tissue.

Thus during process of SC four types of tissues are responsible for increasing the thickness as shown below:-



Formation of Lenticels :-

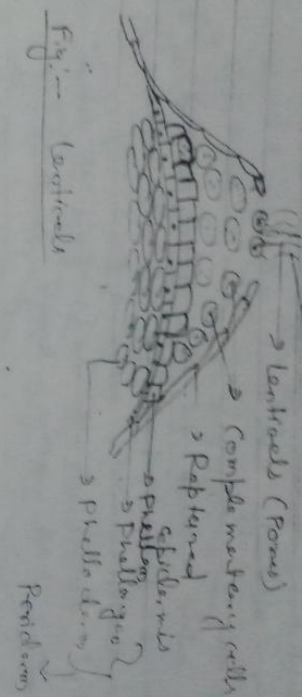


Fig:- Lenticels

→ Lenticels are small pore like structure formed by the rupture of epidermis during S.I.

→ The cells present below the lenticels are called Complementary tissue.

→ Water comes in form of vapor through lenticels & this process is called lenticular transpiration.

② Formation of medullary rays :-

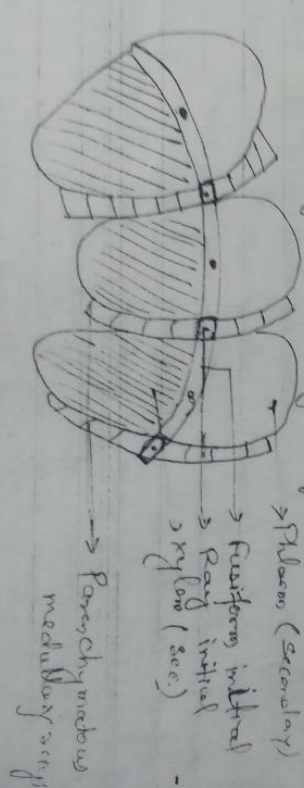


Fig:- Cambium ring

- There are 2 types of initial in Cambium:
- ① Fusiform initial & TI dominant initial, covering max. space & larger in size is called fusiform initial.
- ② Ray initial → The recessive initial or smaller in

- Ring called ~~any~~ initial of combination.
- Both are alternate with each other in whole combination ring.
- Pith from initial divide to form xylem towards inner side & phloem towards -11's outer side, which is converting into wood & bast.
- Ray initial divides to produce parenchyma tissues on both sides known as radial ray.
- Due to formation of radial rays V.B.s are splitted & flattened.

⁵⁰ ③ Dendrochronology =

related with ageing of a tree, through which we can approximately determine the age of a particular tree by counting the no. of Annual ring.

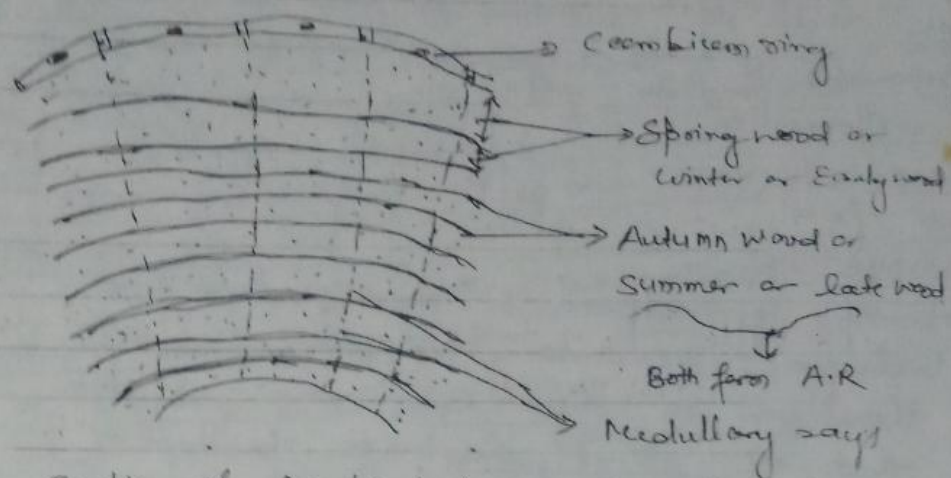
→ Annual ring or Heart ring → A.R. is mostly made-up of see xylem (wood) along with

cracked form of parenchyma in form of M.R. Division of combination depends upon the supply of nutrition, so the seasonal variation are responsible for production of wood.

→ In Spring season wood are produced in more amount in comparison to Autumn wood.

→ Such differentiation of Spring & Autumn wood appear in form of ring in a year alternating with each other, both are combination of annual ring.
This by counting the no. of annual ring

we can know the age of a particular tree.



Section of Cambium ring

Annual ring are formed due to climatic variation, so ~~if~~ ~~if~~ annual ring will be not formed, where there is no climatic variation.

Conclusion

Stem is aerial part & play important role in secondary growth.

From above fact secondary growth of stem forms climatic variation due to this annual ring will be formed, so dendrochronology will be applicable.

Due to this reason in Spring season wood are produced in more amount i.e. Spring & Autumn wood.

It is clear that thickness is increased by secondary lateral meristem.

Q. Discuss the help of suitable diagrams, discuss the process of sec. growth in DR.

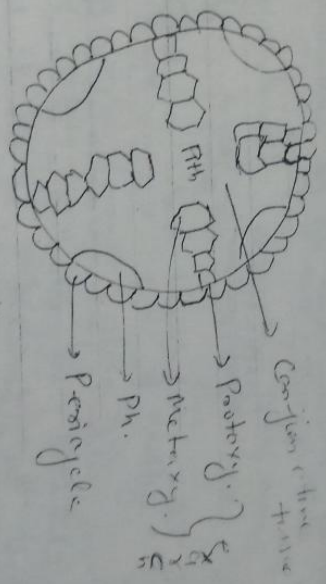
② These differentiations or proliferation are governed by sec. meristem only under suitable conditions. It is not from beginning of

4 - INTRODUCTION :-

The part of gymnosperm & mostly dicot root undergo secondary growth. The sec. tissue developed in axial part are as similar to that of axial stem. The product of S.G. in region of stem is wood & bark & in region of root is phloem & pith from phellogen.

Definition :- Same as stem

→ PROCESSES :-



T.S. of root

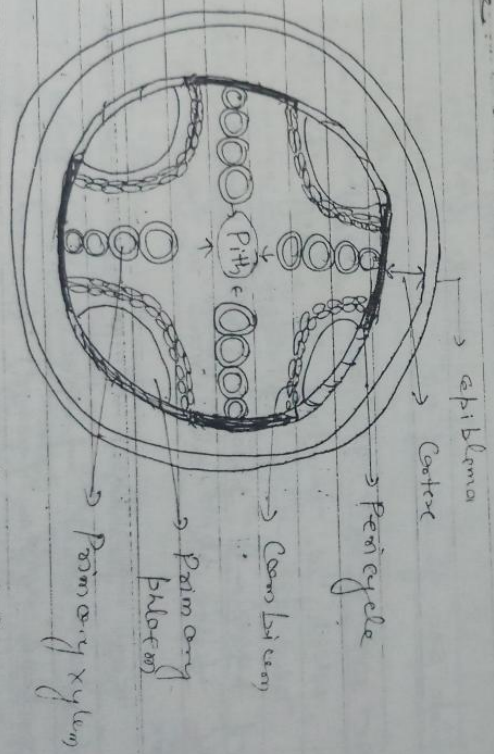
→ DR is such an example where the V.B are radial xylem stretch & number of V.B varies from 2-6. It clearly indicate that it is the differentiations of meristem from the parenchymatous tissue, which initiate process of sec. growth. First Conjunctive tissue, just below the patch

of primary xylem, which is secondary
type & spread of SLM.

Secondary xylem \Rightarrow It takes place that
part of primary xylem which is present just
above the pith, they are oval in shape
& form of SLM.

After the association of
secondary lateral meristem, there is forma-
tion of wavy cambium ring, which indi-
cate that whole part of pericycle are not
involve in formation of cambium.
Thus formed wavy

CR is sign of sec. growth in the region of
stems.



Beginning of sec. growth in DR

First Activity \Rightarrow It takes place in that
Cambium which is product of pericycle,
so that the primary xylem will move towards
the region of pith i.e. wavy pith is formed

by secondary xylem.

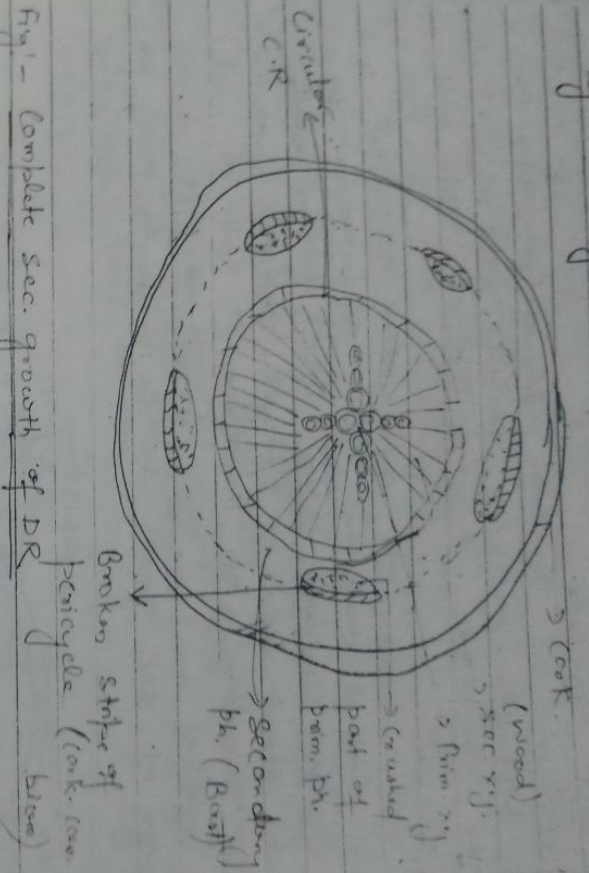


Fig. 1 - Complete sec. growth of DR

SECOND ACTIVITY: \Rightarrow It occurs in that condition, which is product of Coniferive class. Due to their arising, crushed patches of primary phloem with broken strips of pericycle will move in the region of cortex.

Thus formation of circular ring, as direct stem, which produces more amount of secondary xylem (wood) towards region of pith & also amount of secondary phloem (BARK) towards outer side i.e. S.I.D. So the product of secondary growth in the region of stem will be: Wood & Bark.

③ Secondary growth in stems - stem region (Cork) of stem part: $\rightarrow [P+P+P]$

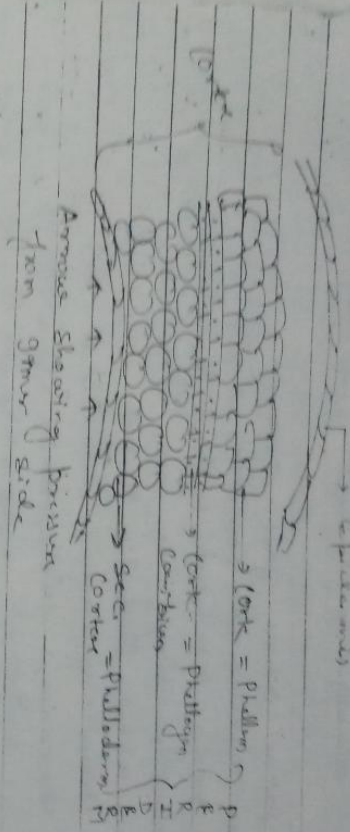


Fig - Secondary growth in later stage

\rightarrow The whole activity is governed by sec. \rightarrow along lateral meristem.

\rightarrow tall breaks strip of pericycle which is present in the region of cork cambium will convert into cork-cambium (Phelloderm), but will appear in patches.

\rightarrow Cork-cambium will divide in same way like dict. stem, producing densely arranged phelloderm (Sec. Cortex) towards inner side, & compactly arranged cork (Phelloderm) towards outer side.

Thus there is formation of bands by way of Phelloderm, Phelloderm & Phelloderm (P+P+P).

The process indicates that increase in thickness of DR is due to formation of DR as DR: =

DR: =

(I) word (II) word (III) problem (IV) problem.

(CONCLUSION) \rightarrow Root's underlying part & they are always in contact with syll (problems).

From above fact secondary root don't face seasonal variations i.e. daily irregular rings are not well differentiated, so dendrochronology is not applicable.

\rightarrow Due to water ~~content~~ context, the word of root have no commercial ~~value~~ value, because such word is important.

So only it is clear that the thickness is increased by the activity of secondary lateral meristem in which only action of parenchyma & one marked function trache one marked.