Course	M.Sc. In Botany I M.Sc.
Paper	I MSc BOT CPT-2.1-Plant Anatomy and Embryology
Concept	Cell Wall development
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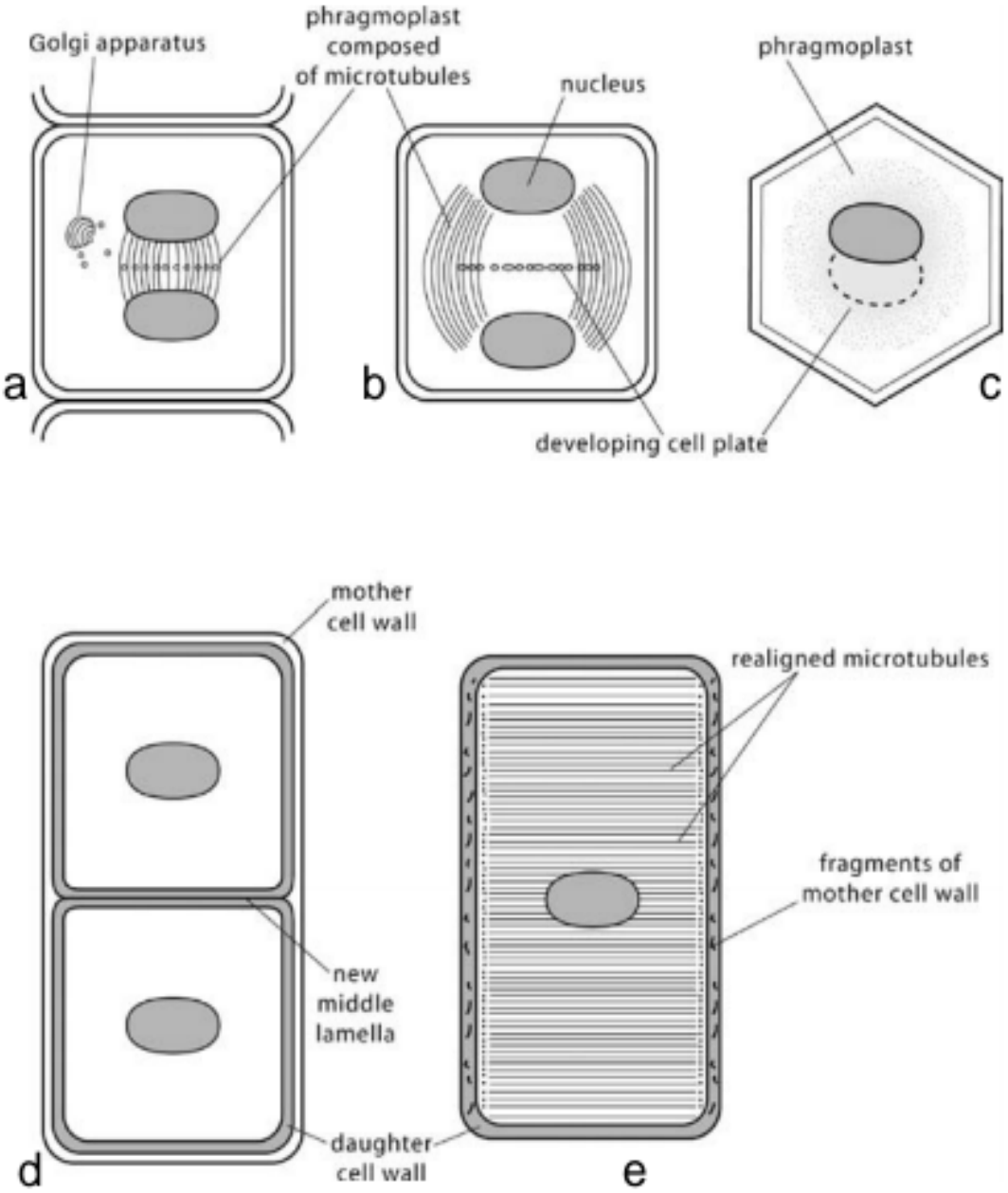
Cellwall development

- The compounds of both Cellulose and matrix materials are synthesised in protoplastand transported to developing wall, where synthesis is completed.
- Transfer of materials accomplished by:
- During the later stages of Mitosis,Microtubules arranged between doughter nuclei forming Phragmoplast and Golgi vesicles aggregate in equatorial plane between incipient doughter cells. This disc like aggregation is called Cell plate and surrounding phragmoplast extend towards original wall of Mother cell.
- Upon fusion Vescicle membranes become plasma membrane of contiguous protoplasts of new cells and new new middle lamella that seperates them.
- A new primary wall is synthesised in both doughter cells, The original Primary wall of mother cell disintegrates and middle lamella become continous. In preparation for elongation of new cell, Microtubules become transversly arranged just under the plasma membrane.

Figure 4.9 Formation of a new cell wall following mitosis. (a) Upon separation of the daughter nuclei, vesicles derived from Golgi bodies accumulate in a plane among the microtubules of the phragmoplast. (b) The phragmoplast begins to migrate toward the lateral walls of the cell. The Golgi vesicles begin to fuse, forming the cell plate. (c) The phragmoplast and the developing cell plate between the daughter nuclei, as seen from above. (d) The two new cells are separated by a new middle lamella, and each cell has a newly formed cell wall. (e) As each new cell begins to elongate, the microtubules become realigned transversely just beneath the plasma membrane. The mother cell wall disintegrates.



- The process of cellulose microfibril formation and orientation during wall development have been the subjects of extensive research.
- Two types of Microfibril generating complexes have been recognized

1. Linear complexes of particles, commonly found in algae
2. Rosette shaped complexes found in some algae and in higer plants.

- Rosette-shaped complexes consists of cluster of six particles and sometimes contain a globular component.These particles are the enzymes responsible for synthesis of B-1,4 glucon chains of which cellulose comprised.
- The correlation between Microtubules and Microfibrils is especially apperant in regions of synthesis of borders of circular bordered pits and as well as annular and helical thickenings in primary walls.

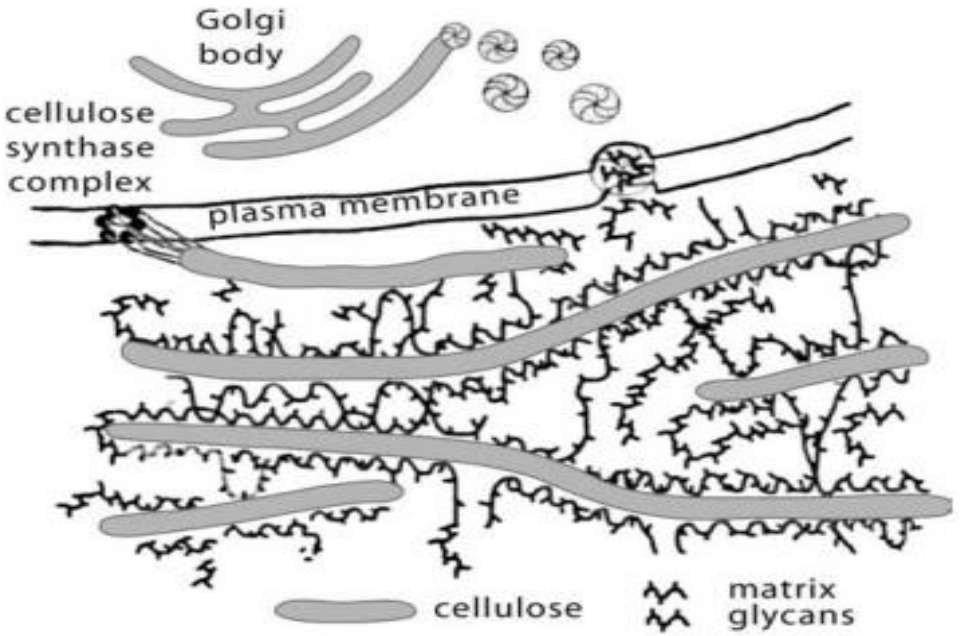


Figure 4.12 Diagram illustrating the biosynthesis of the cell wall. Cellulose microfibrils are generated by cellulose synthase complexes (large complexes of enzymes) in the plasma membrane, and hemicelluloses and pectins (glycans) which comprise the wall matrix are synthesized in Golgi bodies and delivered to the wall by secretory vesicles. Within the developing wall, pectins form ionic gels and the hemicelluloses bind to the cellulose microfibrils. From Cosgrove (2000). Used by permission of Macmillan Magazines Limited.

- The movement of Cellulose synthase complexes within the Plasma membrane was observed to be directly related to their intimate association with microtubules
- Cellulose synthase complexes observed to move along Paired, Linear trajectories, on either side of microtubules. This indicates that Microtubules might actuallly guide the cellulose synthase complexes, with the result newly synthesised cellulose microfibrils will be arranged parallel to the microtubules.
- There are 10 cellulose synthase proteins are known. Atlest 3 are required to form functional Rosette in Vascular plants. Synthesis of cellulose in primary wall requires presence of CESA1, CESA3, CESA6 wheras CESA4, CESA7 and CESA9 are required for synthesis of cellulose in secondary walls.
- Because of there is no always parallism between Microtubules and Cellulose microfibrils, several authors concluded that microtubules are not essential for allignment of cellulose microfibrils.
- An intersenting early hypothesis to explain the movement of cellulose synthase complexes where strong evidence indicates a close relationship between Microtubule and cellulose microfibril orientation.According to this Microtubules restricted to channels between adjacent microtubules and were pushed along with these “channles” by polimerization and Crystallization of cellulose microfibril.

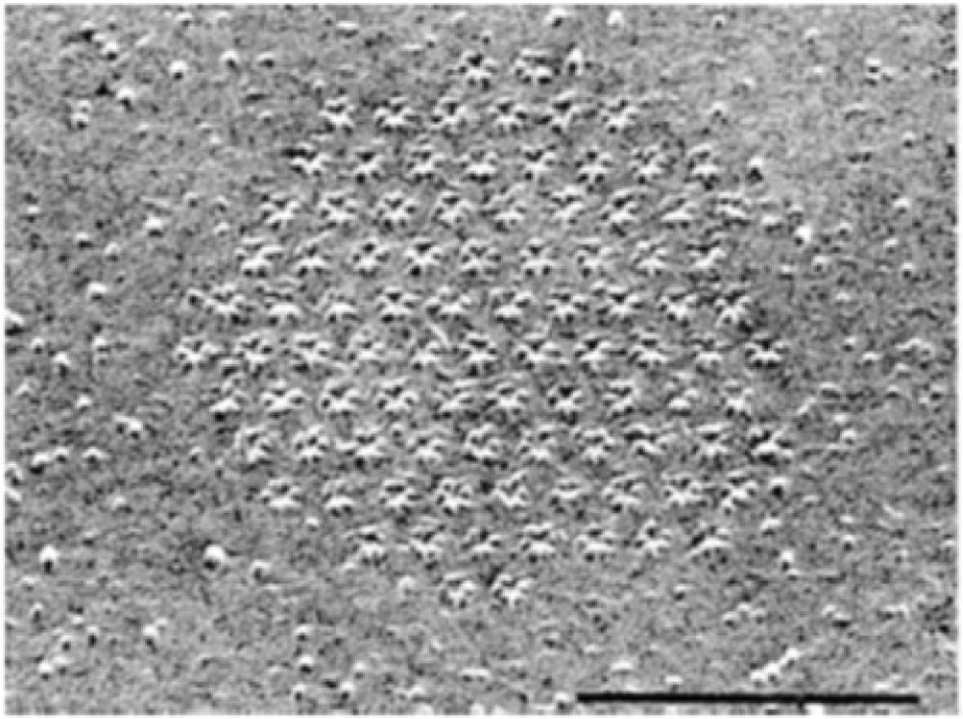


Figure 4.13 Cellulose synthase complexes, also called rosettes, in the plasmalemma of a cell of the alga *Microsterias denticulata*, as seen in a freeze-fracture electron micrograph. Bar = 0.1 μm. From Giddings *et al.* (1980). Used by copyright permission of the Rockefeller University Press.

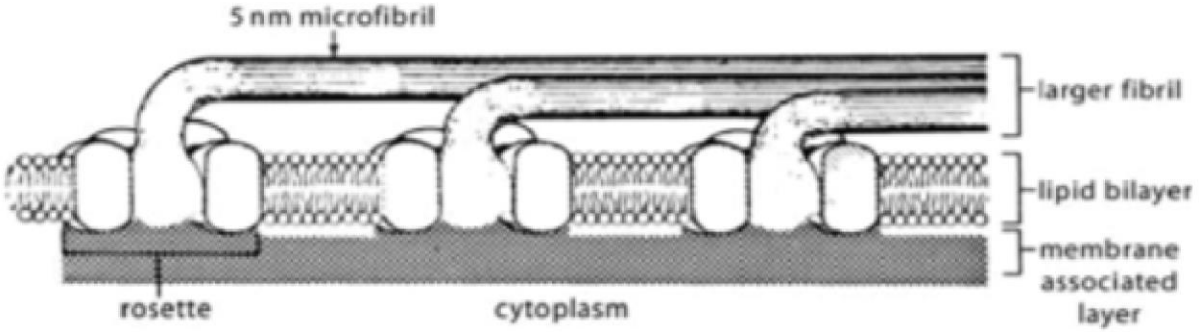


Figure 4.14 Diagram of a model of cellulose synthase complexes (rosettes) in the plasmalemma of *Microsterias*, and the microfibrils they have formed. From Giddings *et al.* (1980). Used by copyright permission of the Rockefeller University Press.