Botany Hons.

Structure and function of cell-wall

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All living organisms are cellular, i.e., their body is made of cells. Each cell contains a number of subcellular components like plasmamembrane, cytoplasm, cytoskeleton and organelles. In addition, plant cells possess cell wall. Previously, cell and its components were studied under a branch of biology called Cytology (Gr.Kytoscell, logos-study) which limits its study to the description of cell and its organelles.

However, with the advent of electron microscope and other modem techniques the scope of study of cells expanded and modem branch of biology called Cell Biology has developed, which includes morphological, physiological, cytochemical, genetical, developmental and other aspects of cell. In this chapter we will learn about the ultrastructure of cells with special reference to their components along with their functional importance.

The cell wall is present in all the plant cells including bacteria. It is present external to the plasmamembrane and is formed of dead substances secreted by the protoplasm of the cell. Cell wall is not uniform in thickness. It is very thin in living cells like meristematic cells and parenchymatous cells but very thick in xylem tissue.

Morphology

The cell wall is differentiated into middle lamella, primary cellwall, secondary cellwall and tertiary cell-wall.

Middle lamella is present between two adjacent cells and is formed soon after cell division, particularly, during cytokinesis. This layer is present outside the primary cell wall and is composed of calcium and magnesium pectate. It holds the adjacent cells together like the cement holds the bricks.

Primary cell wall is the fist cell wall laid down by the protoplast inner to the middle lamella. The primary wall is thin and elastic and composed of cellulose, hemicellulose, pectic substances, lipids, proteins, some minerals and water. During development of middle lamella and primary wall, certain openings are left at places between the adjacent cells. These are called **plasmodesmata** (**Strasberger** 1901). Through these pores cytoplasmic continuity is maintained between the neighbouring cells. It is also made of cellulose, hemicellulose, proteins and polysaccharides.

Secondary cell wall is formed towards inner side primary wall and is made of several layers of cellulose, hemicellulose. Deposition of lignin and suberin takes place after the primary wall is fully formed. The wall is thick and nonelastic and provide additional strength.

In addition to primary and secondary cell wall, **tertiary cell wall** is deposited in a few cells. First reported by **Butchen** (1955) in tracheids of some gymnosperms, it is considered to be a dried residue of the protoplasm. It looks like swollen nodules on the inner side of the secondary wall. Besides cellulose and hemicellulose, xylan is also present in the tertiary cell wall.

Ultra structure of cell wall

The electron microscopic study of the cell wall reveals that the wall is composed of a ground substance called the **matrix** in which the cellulosic fibres are embedded. Cellulose molecules are long chains formed by the condensation of about 3000 glucose residues. These units are arranged in a linear order which are present in parallel bundles of about 100 units forming **micelles** or **elementary fibrils**. Each micelle is a rhombus with a cross sectional area of about 3000A. The next largest unit is the **microfibril** which is composed of about 20 micelles with a cross sectional area of about 62,500A. About 250 such microfibrils form a **fibril** with a cross sectional area of about $0.256u^2$, which can be seen under light microscope.

Cell wall depositions

The cell wall is very thin and delicate in the beginning. As the cell grows, it is stretched and new substances are deposited on the primary cell wall. The various substances found on the cell wall are:

1. **Lignin**:

It is a complex chemical substance deposited in the secondary wall. With the lignin deposition, the protoplasm is lost and the cells become woody and hard. Lignin deposition is generally not uniform and may result in annular, spiral, scalariform, reticulate or pitted patterns. These thickenings provide mechanical support to the cell. Most of the vegetable fibres are lignified.

2. **Cutin**:

It is a waxy substance, forms a thin or thick layer called cuticle on the stem or leaf surfaces. Cutin is impervious to water and checks evaporation. Deposition of cutin is found to be more in xeric plants.

3. **Suberin**:

This fatty substance is also waxy in nature. This is deposited on cork cells and is impermeable to water and gases.

4. **Mucilage**:

It is a slimy substance made of complex carbohydrates. It absorbs water and stores it. It becomes hard when dry and viscous when moist. Mucilage is present in leaves of Aloe, flowers of Hibiscus, seeds of Linum, etc.

5. **Mineral crystals**:

Silica, calcium oxalate and calcium carbonate, etc. are deposited in the cell wall in the form of crystals.

The main function of cell wall is to provide mechanical strength. It is also capable of imbibing water and thus, helps the movement of water and solutes inside the cell.

Economic Importance of Algae

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1. Algae Constitute the Link of Food Chain
2. Algae is Useful in Fish Culture
3. Algae is Used for Recreational Purposes
4. Algae is Useful in Sewage Treatment Plants
5. Algae and Water Supplies
6. Algae as the Origin of Petroleum and Gas
7. Algae and Limestone Formation
8. Algae is Used in Space Research and Other Fundamental Studies
9. Algae is Used as Food
10. Algae is Used as Fodder
11. Algae is Used as Fertilizers
12. Algae is Used as Medicine
13. Industrial Utilization of Algae