BIOLOGY

CLASS NOTES FOR CBSE

Chapter 15. Plant Growth & Development

01. Growth

Growth can be defined as an irreversible increase in size of an individual cell or organ or its parts. This increase occurs as a result of all the metabolic activities. These activities make use of energy obtained by nutrition. Growth occurs when there is synthesis of new materials inside or outside the cell.

Characterstics of growth

The characteristics of plant growth are as follows

(i) **Plant growth is indeterminate** Plants have the capacity of growing throughout their life. It is due to the presence of meristem tissue in them, which divide and self- perpetuate. Some plant structures such as leaves, flowers and fruits may show **determinate growth.** These grow upto a size and them undergo death.

(ii) **Growth is measurable** At cellular level growth is due to increase in amount of protoplasm. This leads to increase in cell number and size. These two broad parameters are used in calculating the growth. In detail, different parameters used for measuring the growth of plants are as follows

(a) Increase in cellular dimensions, i.e. length, diameter, surface area, etc.

(b) increase in dry and fresh weight, volume of cells.

02. Phases of Growth

In plants, growth occurs in three phases depending upon the region of its occurrence

(i) **Meristematic phase** It occurs in the meristematic regions, e.g. shoot apex and root apex. The cells in this phase can be easily differentiated from other cells. They have a dense protoplasm and a have a large nucleus. They possess a primary cell. wall. The cells divide actively and grows in number. The respiratory rate is higher.

(ii) **Elongation phase** Cells of this phase are found around the meristematic cells. These cells are highly vacuolated. Cell wall starts accumulating new material. These are lager then the other cells.

(iii) **Maturation phase** Cells of this phase undergo structural and functional differentiation and thus, these cells develops into a specialised tissue. After differentiation, no further growth occurs in them, e.g. xylem and phloem.

03. Types of Growth

Arithmetic growth

It is the growth of an organ or a part of a plant at a constant rate. In this type of growth, after mitosis two cells are formed. One of these cells, differentiate into a particular type of cell. The other one undergo further division again and again. In this way, growth progress in arithmetic manner, i.e. 2, 4, 6, 8, etc This type of growth is found in root and shoot elongation. On plotting the growth against time, a linear curve is obtained.

This growth can be expressed as

$$L_t = L_0 + rt$$

Where, L_t = Length of plant after time t,

L_0 = Length of plant at initial stage (time = 0),

t = Time taken for the growth,

r = Growth rate or elongation per unit time.

Geometric growth

In this type of growth, cell divides repeatedly to form many daughter cells and each cell divide again. This type of growth is common on microorganisms. Geometric growth rate when plotted against time, shows S-shaped curved. *This curve can be studied in following phases*

(i) **Lag phase** This phase represents the beginning of growth. Here the growth rate is very slow.

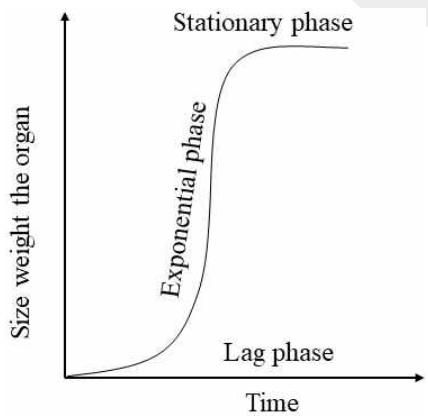
(ii) **Exponential or log phase** In this phase, growth occurs at a very hight rate, i.e. exponentially. Both parent and daughter cells divide repeatedly by utilising the available food.

(iii) **Stationary phase** Due to rapid growth, number of cells are more in this phase. It leads to shortage of food and space. Also, there is increase in toxin accumulation. Thus, growth becomes slow and constant. This is the stationary phase.

The geometric growth can be expressed as

$$W_1 = W_0 e^{rt}$$

Where, W_1 = final size, W_0 = initial size, r = growth rate (efficiency index), t = time and e = base of natural logarithm.



An idealised sigmoid growth curve typical of cells in culture and many higher plant and plant organs

04. Conditions For Growth

The conditions required by a plant for growth are as follow

(i) **Light** during initial stages of growth, light is not essential. Later on, it is required for tissue differentiation, synthesis of photosynthesis pigment and photosynthesis. It also determines the direction of root and shoot growth. In the absence of light, plants exhibits etiolation.

(ii) **Temperature** Optimum temperature for growth is 20-35^{0}C. Temperature above 45^{0}C may damage the protoplast and denaturation of enzyme. Thus, growth is retarded.

(iii) **Water** It maintains the turgidity of plants. It is essential for enzymatic activities in protoplasm and cell elongation.

(iv) **Oxygen** It is necessary for cellular respiration to produce metabolic energy.

(v) **Mineral nutrients** They are raw material for synthesis of protoplasm as well as source of energy. Nutrients like Na, K, Cu, etc. are necessary for growth and metabolism of plants.

(vi) **Growth regulators** These are manufacture by living protoplasm. These growth regulators include several phytohormone and some synthetic substances.

(vii) **Genetic factors** These are internal factors. They are involved in overall maintenance of a plant.

05. Measurement of Growth

The growth can be measured by measuring the increase in length, surface area, volume, dry weight, diameter and fresh weight, of a plant. Various aids designed to measure the growth include horizontal microscope, auxanometer, crescograph (sensitive instrument giving magnification upto 10000 times). etc.

06. Differentiation, Dedifferentiation and Redifferentiation

Differentiation It is permanent localized change in size, biochemistry, structure and function of cells, tissue or organs, etc. Fro example, normal cells differentiate into tracheary elements. It occurs by elements. It occurs by elongating, loosing the protoplasm and developing a strong, elastic lingo−cellulosic secondary wall.

Dedifferentiation Occurs when the living differentiated cells (in capable of dividing) regain their capacity of division under certain condition. For example, interfascicular cambium and cork cambium are formed fully differentiated parenchyma cells.

Redifferentiation It is the process where dedifferentiated cells again loose their ability to divide. These become specialised (permanent) to perform for a particular function. For example, secondary phloem, secondary xylem, cork are formed *via* redifferentiation The process of plant tissue culture occurs as a result of redifferentiation in which parenchyma cells are made to divide under controlled laboratory condition Development of plants depends on its intrinsic and extrinsic factors.