Plant Growth and development

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Growth

Growth is the materialization of life. More accurately, growth can be defined as an irreversible permanent increase in size, volume or mass of a cell or organ or whole organism accompanied by an increase in dry weight. The basic process of growth is the production of new protoplasm, which is clearly evident in the regions of active cell division.

Stages of Growth/Phases of Growth

Various plant physiologists tend to describe growth of a plant in three distinct phases-

- **Stage 1 (Phase of cell division)**: This is the initial phase of growth. It represents the excess of constructive over destructive metabolism. Here an irreversible increase in size is evident which usually indicated by an increase in the overall dry weight of the plant.

- **Stage 2 (Phase of Cell enlargement)**: This is the intermediate stage of the plant growth. As a result of absorption of water and the consequent stretching of the tissues, an increase in the size of the plant takes place in this stage.

- **Stage 3 (Phase of maturation)**: This is the last and most crucial part of the growth cycle of a plant. It involves the entry of plenty of building materials, chiefly carbohydrates, into the expanded young tissues which results in an increase in the dry weight but no visible increase in external size of the plant.

Types of Growth

- **Primary and Secondary growth**: The primary growth occurs by the action of the apical meristem while the secondary growth occurs by the action of the cambium. The mitotic division of meristematic cells present at the root and shoot apex increases the length of the plant body. This is called the primary growth. The secondary meristem increases the diameter of the plant body and it is called the secondary growth.

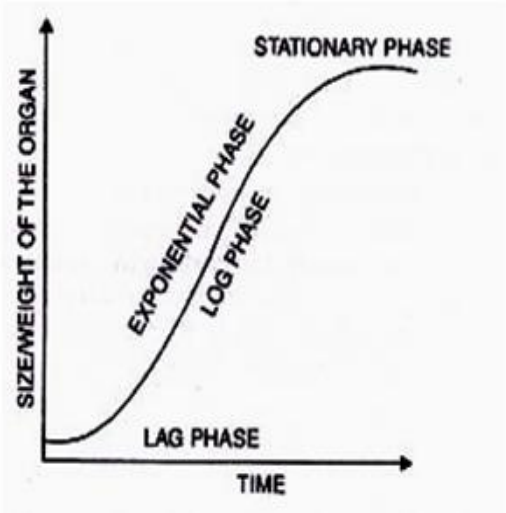
- **Limited and Unlimited growth:** The leaves, fruits and flowers stop growing after attaining certain size. This is called 'limited' or 'determinate' type of growth.

However, the root and the shoot system of plants grow continuously from germination stage to the death or throughout the life span of the plant. It is called 'Unlimited' or 'indeterminate' type of growth.

- **Vegetative and reproductive growth:** The earlier growth of plant producing leaves, stem and branches without flowers is called 'vegetative growth'; and after the vegetative growth, plants produce flowers which is the reproductive part of the plant. This is called reproductive growth/phase.

The grand period of Growth and Growth Curve:

The vegetative growth of most plants in general shows three phases, starting slowly, becoming gradually faster and finally slowing again. These three phases, which are together known as "grand period of growth", cover the whole of the vegetative history of an annual plant. In a perennial plant such a grand period of growth is repeated annually with periods of dormancy between the repetitions. An 'S' shaped curve is obtained when we plot growth against time to understand this mechanism.



The sigmoid curve shows following three distinct phases:

1. Lag phase
2. Log phase
3. Stationary phase

1) **The lag phase or initial phase:** It represents initial stages of growth. The rate of growth is naturally slow during this phase.

2) **Log phase or exponential phase:** It is the period of maximum and rapid growth. Physiological activities of cells are at their maximum. Here, both the progeny cells following mitotic cell division retain the ability to divide and continue to do so. However, with limited nutrient supply, the growth slows down leading to a stationary phase.

3) **Stationary phase:** This phase is characterized by a decreasing growth rate. The plant reaches maturity, hence the physiological activity of cells also slows down and plant begins to senesce.

Important terminology related to Growth

- **Differentiation:** It is a process during which cells undergoes structural changes in the cell wall and protoplasm. A differentiated cell cannot divide anymore.

- **Dedifferentiation:** An undividable differentiated cell sometimes regains the power of division. This process is called dedifferentiation. Dedifferentiation is a common process in plants during secondary growth and in wound healing mechanisms. A dedifferentiated cell can divide and produce new cells.

- **Redifferentiation:** The cells which produced as a result of dedifferentiation again loose the power of division and become a part of permanent tissue. This process is called "**redifferentiation**''. Tumour cells form good example for redifferentiated cells.