

CHAPTER. 15. PLANT GROWTH AND DEVELOPMENT

Increase in the size of living organisms is commonly called 'growth'. Many physiological processes play an important role during growth of plants and animals. In plants seed germinates and develops into a seedling and later it assumes the shape of an adult plant. Plants show indefinite and diffuse growth while animals show fixed and uniform growth.

Growth may 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.

15.1- Types of growth

Primary and secondary growth- 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**.

Unlimited Growth- 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.

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

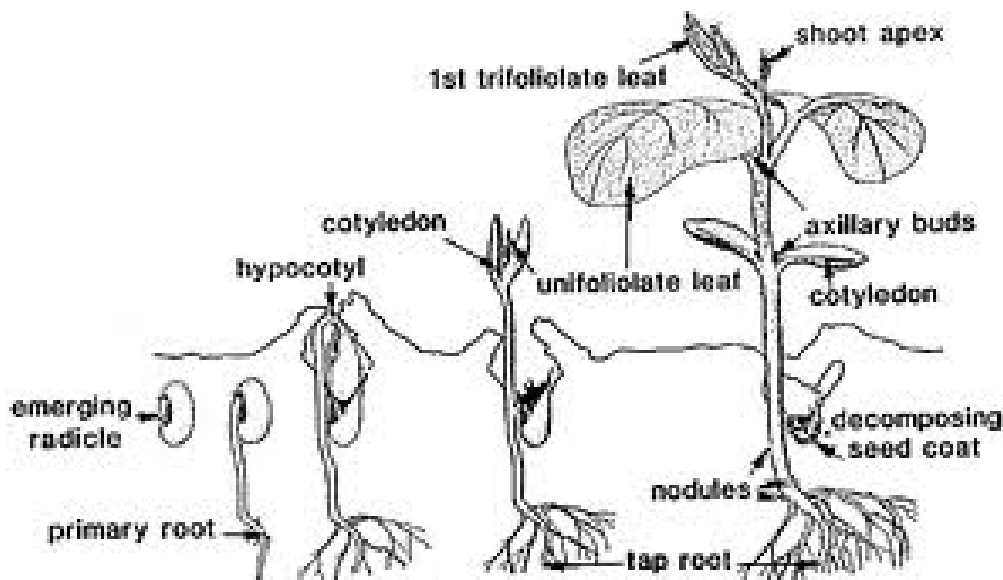


Fig. 15.1 Stages of growth-seed germination to a complete plant

Vegetative growth- The earlier growth of plant producing leaves, stem and branches without flowers is called 'vegetative growth'/ Phase.

Reproductive growth- After the vegetative growth, plants produce flowers which is the reproductive part of the plant. This is called reproductive growth/phase.

15.2- Growth curve – It is an 'S' shaped curve obtained when we plot growth against time (Fig. 15.2). It is also called '**sigmoid**' curve. This curve mainly shows four phases of growth- 1.initial slow growth (**Lag phase**), 2. the rapid period of growth (**log phase/grand period of growth/exponential phase**) where maximum growth is seen in a short period and 3. **The diminishing phase** where growth will be slow and 4. **Stationary / steady phase** where finally growth stops.

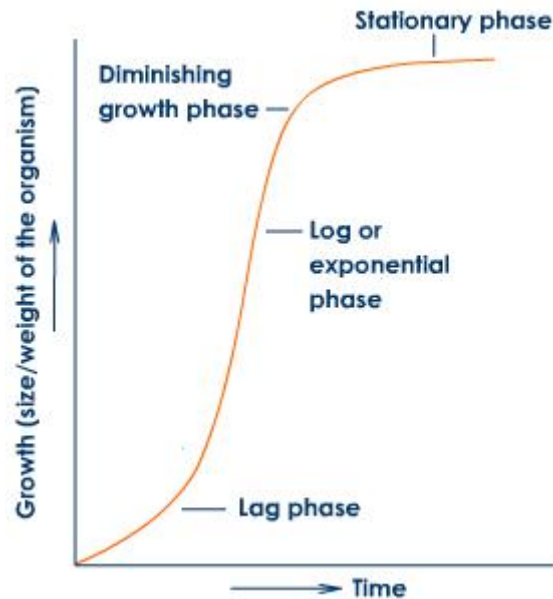


Fig. 15.2 GROWTH CURVE- GROWTH PLOTTED AGAINST TIME

15.3-Differentiation, dedifferentiation and redifferentiation of cells

The three phases of cell growth are **cell division**, **cell enlargement** and **cell differentiation**. The first two stages increase the size of the plant cell while the 3rd stage brings maturity to the cells. **Differentiation**, is a process during which cells undergoes structural changes in the cell wall and protoplasm (Fig. 15.4). A differentiated cell cannot divide.

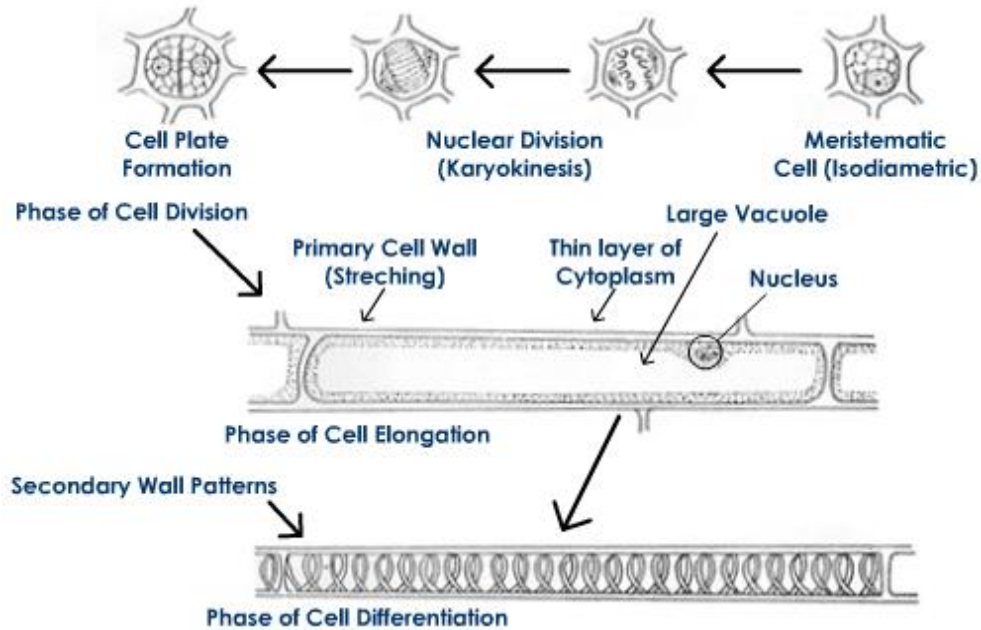


Fig15.4- Phases of Cell growth-Cell division, cell elongation and cell differentiation phases

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. Thus produced new cells again lose the power of division and become a part of permanent tissue. This process is called "**redifferentiation**". Tumour cells form good example for redifferentiated cells.

15.4-Development- Development is defined as sum total of growth and differentiation. Development is governed by both environmental and internal factors. One of the internal factors that regulate growth and development is 'plant hormones'.

Plant hormones/ phytohormones/ Growthregulators- Plant hormones are chemically diverse substances produced in minute quantity and they involve in most of the plant cell activities. They regulate the growth process both by promoting and inhibiting growth. They are produced in certain parts of the plant and transported to other tissues where their action is shown. Based on their promotory and inhibitory activity they have been classified into growth promoters and growth inhibitors.

Name and functions of growth regulators

Growth promoters	Some Functions of growth promoters	Growth inhibitors	Functions of growth inhibitors
1.Auxins, 2.Gibberellins, 3.cytokinins	1. Cell division. 2.cell enlargement 3.Tropic movement 4.Fruiting and flowering 5.Seed germination 6.Root formation	1. Ethylene 2 Dormin or abscissic acid	1. Induces senescence. 2.Induces dormancy of seeds

15.5- Photoperiodism

It has been discovered that duration of light also plays a major role in inducing flowering in plants. This flowering response in plants to the relative length of light and dark periods within a 24 hour cycle is called '**Photoperiodism**'. Every plant has a specific critical period of light duration needed for flowering. In order to flower they must be exposed to either more or less light hour than that of critical period. Based on flowering response to light duration, plants have been classified into Long day plants, short day plants and day neutral plants.

Long day plants (LDP)- They are plants which produce flower only when they are exposed to light duration more than the critical period. They produce flower in summer. E.g.-Oat and Rye plants.

Short day plants (SDP)- They are plants which produce flower only when they are exposed to light duration shorter than the critical period. They produce flower in spring or winter. E.g.- Chrysanthemum, Tobacco and Coffee.

Day neutral plants- They produce flowers throughout the year irrespective of length of light hours to which they are exposed. E.g.- Tomato

15.6- Vernalisation

Some biennials like carrot, cabbage and sugar beet need a cold/low temperature treatment before they flower. This is called 'vernalisation'. In other words, Vernalisation is promotion of flowering by low temperature treatment. Spraying gibberellins is a substitute to cold treatment and biennials can be made to flower in one year without the cold treatment.

SUMMARY

- Growth is an irreversible increase in mass, volume or weight of an organism accompanied by increase in dry weight.
- Plants growth shows vegetative and reproductive phases. Some parts of the plant like fruits and leaves show limited growth, whereas stem and root show unlimited growth.
- The rate of growth can be measured, by plotting growth against time.
- Growth curve or sigmoid curve is an 'S' shaped curve showing four phases namely lag, log, diminishing and steady phase
- Cells in their life cycle show three phases- cell division phase, cell enlargement phase and cell differentiation phase.
- Development is the sum total of growth and differentiation.
- Growth is controlled by internal factors like hormones, which can both promote and inhibit growth.
- Flowering in plants is seasonal as the flowering process is influenced by the duration of light hours to which they are exposed, and it is called photoperiodism.
- Promotion of flowering in biennial plants by cold treatment is called vernalisation.

Exercise

1. Define growth.
2. Differentiate differentiation, dedifferentiation and redifferentiation of cells.
3. What is a sigmoid curve?
4. Name the phases of growth curve.
5. What are phytohormones?
6. Name growth promoters and growth inhibitors. List their functions.
7. What is photoperiodism?
8. Classify the plants based on their photoperiodic response.
9. Define vernalization.

Chapter 15- Growth and development in plants

Exercise-Question and answers

10. Define growth.

Growth may 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.

11. Differentiate differentiation, dedifferentiation and redifferentiation of cells.

Differentiation, is a process during which cells undergoes structural changes in the cell wall and protoplasm. An undividable differentiated cell sometimes regains the power of division. This process is called **dedifferentiation**. The new cells produced by dedifferentiated cells again loose the power of division and become a part of permanent tissue. This process is called "**redifferentiation**'

12. What is a sigmoid curve?

It is an 'S' shaped curve obtained when growth is plotted against time. It is also called growth curve.

13. Name the phases of growth curve.

The four phases of growth curve are lag phase, log phase, diminishing phase and steady phase.

14. What are phytohormones?

Plant hormones are chemically diverse substances produced in minute quantity and they involve in most of the plant cell activities. They regulate the growth process both by promoting and inhibiting growth. They are produced in certain parts of the plant and transported to other tissues where their action is shown.

15. Name growth promoters and growth inhibitors. List their functions.

Growth promoters	Some Functions of growth promoters	Growth inhibitors	Functions of growth inhibitors
1.Auxins, 2.Gibberellins, 3.cytokinins	1. Cell division. 2.cell enlargement 3.Tropic movement 4.Fruiting and flowering 5.Seed germination 6.Root formation	1. Ethylene 2 Dormin or abscissic acid	1. Induces senescence. 2.Induces dormancy of seeds

17. What is photoperiodism?

This flowering response in plants to the relative length of light and dark periods within a 24 hour cycle is called '**Photoperiodism**'

18. Classify the plants based on their photoperiodic response.

There are three types of plants based on their photoperiodic response. They are long day plants, short day plants and day neutral plants.

19. Define vernalization.

Some biennials like carrot, cabbage and sugar beet need a cold/low temperature treatment before they flower. This is called 'vernalisation'

xxxxxxxxxxxxx