Part 2 : Plant Growth and Development

Introduction

The plants grow and develop from the seedling to the reproductive stage. There are many factors that help in this growth and development.

The germination of the seed and the development of the plant help in the formation of a body organisation that produces roots, leaves, flower, fruits and seeds.

A seed is an embryonic plant enclosed in a protective outer covering. The formation of the seed is part of the process of reproduction in seed plants, the spermatophytes, including the gymnosperm and angiosperm plants.

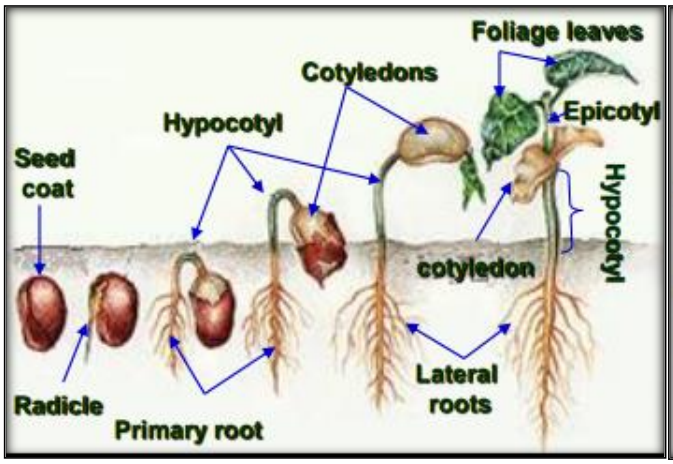
I. Germination

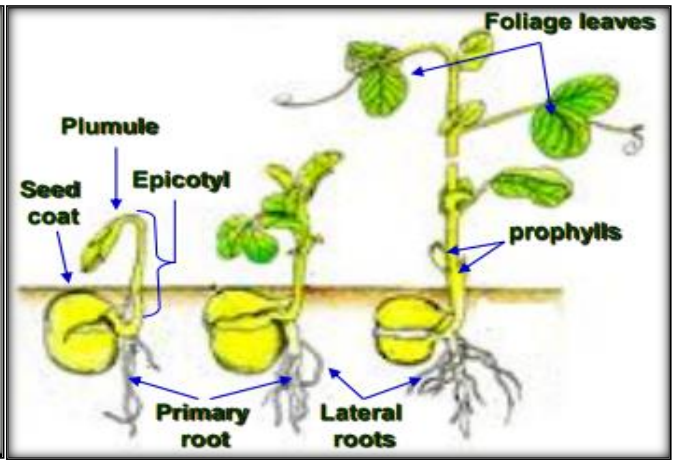
1. Definition

The process by which a dormant embryo becomes active, grows out of the seed coat and develops into a seedling is called seed germination. The embryo uses the water from outside and the food stored from the cotyledons or endosperm to grow.

2. Types of Seed Germination

In flowering plants two types of germination are found. They are:





Epigeal germination **Hypogeal germination**

(a) Epigeal Germination In epigeal (epi - above; geo - soil)germination hypocotyl elongates and cotyledons come out above the soil surface. Examples : seeds of pumpkin, mustard, tamarind, and french bean.

(b) Hypogeal Germination In hypogeal (hypo = below, geo = earth) germination the epicotyl elongates and cotyledons remain below the soil surface. Examples : Most monocots seed like rice, wheat, maize, and coconut.

3. Mechanism of seed germination

There are four major steps involved in seed germination, where the dormant embryo in the seed resumes the metabolic activities and grows into a seedling. The steps are as follows:

- Water imbibition
- Resumption of suspended metabolism
- Mobilisation of reserve food
- Breaking of seed dormancy

4. Factors affecting seed germination

The major factors that affect the seed germination are as follows:

- Water
- Oxygen
- Favourable temperature
- Light
- Nature of the seed coat
- Germination inhibiting substances

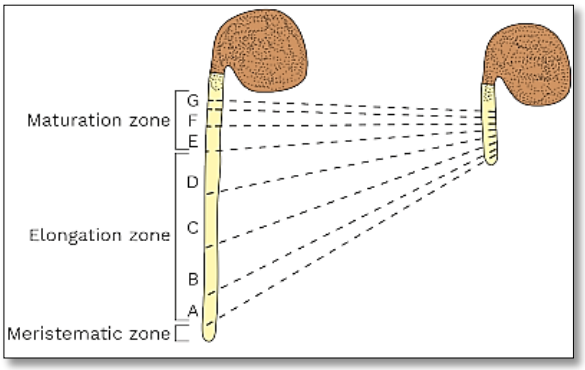
II. Growth

1. Definition

It is an irreversible permanent increase in size, mass of a cell, organ or whole organism.

2. Phases of growth

Stages of Growth/Phases of Growth Various plant physiologists tend to describe growth of a plant in three distinct phases :

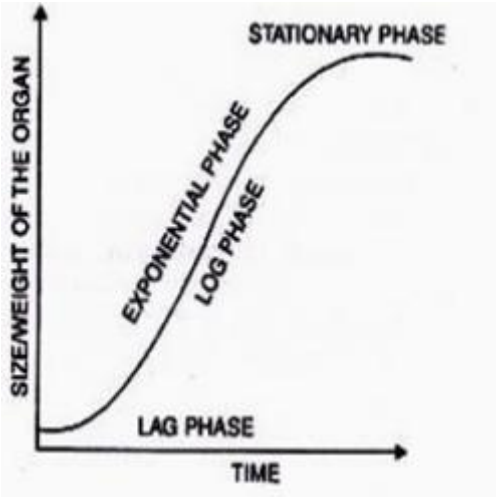


- **Stage 1 (Phase of cell division**): This is the initial phase of growth. It represents the excess of constructive over destructive metabolism. Here an irreversible increase in size is evident which usually indicated by an increase in the overall dry weight of the plant.
- **Stage 2 (Phase of Cell 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.

3. The grand period of Growth and Growth Curve

The sigmoid curve shows following three distinct phases:

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



4. 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.

5. Endogenous Growth Regulators

- The chemicals which affect the growth and differentiation process are known as Growth Regulators.

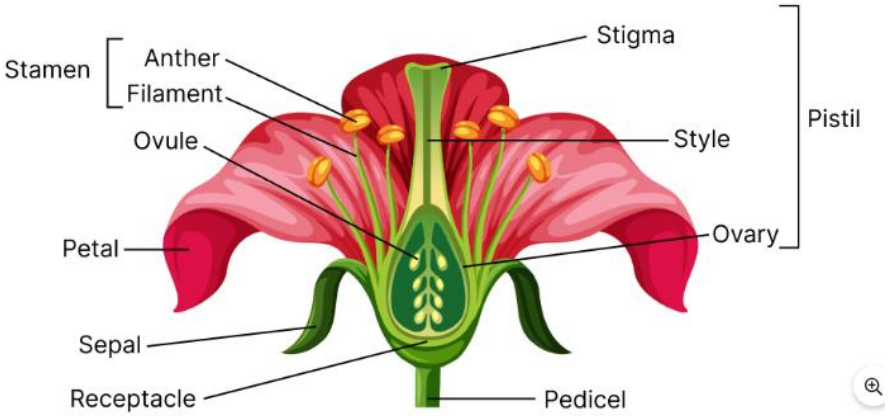
- K.V. Thimann used the term phytohormone for hormones of plants.
- They are the following: ○ Auxins ○ Gibberellins ○ Cytokinin ○ Ethylene ○ Abscisic Acid
- Ethylene and abscisic acid are known as plant growth inhibitor.

III. Flowring

Flowering plants are plants that bear flowers and fruits and form the clade Angiospermae, commonly called angiosperms. The term "angiosperm" is derived from the Greek words angeion and sperma, and refers to those plants that produce their seeds enclosed within a fruit. Angiosperms have male and female reproductive structures present in a flower. It is a characteristic feature of angiosperms.

1. Parts of the Flower Diagram

According to the flower definition, the flower is the seed-bearing part of the plant and it contains reproductive organs like the stamen and carpel. Now, let's move on to the parts of the flower. The four primary elements of most flowers are: sepals, petals, stamens, and carpels.



Parts of the Flower

2. Double Fertilisation in Angiosperms

Angiosperms are the most diverse and flower-bearing group of terrestrial plants. Angiosperms' reproductive part is made up of flowers. They have separate male reproductive organs and female ones. Each one contains both sperm cells and egg cells.

Pollination is a way for pollen grains to achieve stigma through style. Two sperm cells enter the ovule synergid cell. This is followed by fertilization.

In angiosperms results in two structures: zygote & endosperm. Thus, the term "double fertilisation"

Double fertilization (also known as double fertilisation) is a complicated process in which two sperm cellular fusions occur. One fuses to the egg cell, the other with two polar nuclei. These fusions produce a diploid (2n), and a triploid (3n), the primary embryo sperm nucleus.

Endosperm is created by the fusion of three haploid nuclei. This is known as triple fusion. The primary endosperm nuclear unit eventually becomes the primary endosperm cell, then the endosperm.

After numerous cell divisions, the embryo is formed from the zygote.

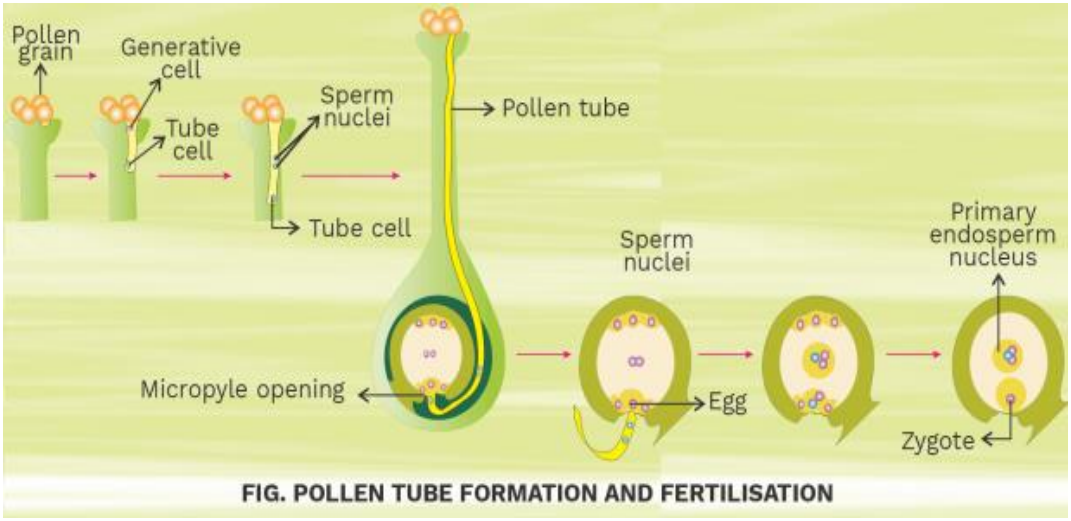


FIG. POLLEN TUBE FORMATION AND FERTILISATION

IV. Fructification

Fructification is the process of growing fruit. During fructification, a pear tree will first grow fragrant blossoms before they develop into delicious pears. When a plant undergoes fructification, you can also say it fructifies, or develops so that it can produce fruit.