

## CHAPTER – 15: PLANT GROWTH AND DEVELOPMENT

### Growth:

It is a characteristic of living beings in which an irreversible permanent increase in size of an organ or its parts occur or an increase in the size of a cell. for example, expansion of a leaf is growth  
Plant Growth Generally is Indeterminate-due to meristematic tissues  
Growth is Measurable-due to increase in protoplasm.

### Growth rate and types

- Growth rate can be defined as the increase in growth per unit time.
- Plants show two types of growth—Arithmetic and Geometric—according to the increase shown by the growth rate.
  - *Arithmetic growth* - Only one daughter cell continues to divide while others differentiate or mature. Example a root elongating at a constant rate. Mathematically, it is expressed as

$$L_t = L_0 + rt$$

$L_t$  = length at time 't'

$L_0$  = length at time 'zero'

$r$  = growth rate / elongation per unit time.

- *Geometric Growth* - Initial growth is slow (lag phase), followed by a rapid increase in growth (log/exponential phase), and followed by a phase where growth slows down (stationary phase). Example – all cells, tissues and organs show this type of growth

The exponential growth can be expressed as

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

$W_1$  = final size (weight, height, number etc.)

$W_0$  = initial size at the beginning of the period

$r$  = growth rate  $t$  = time of growth

$e$  = base of natural logarithms

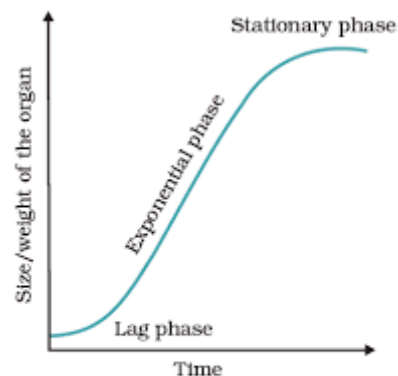
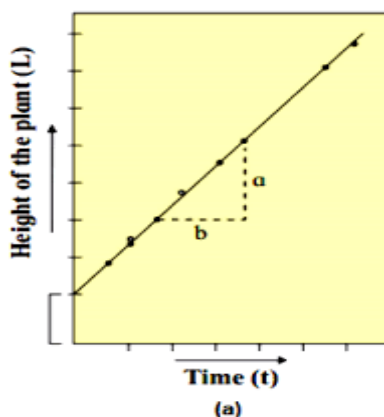
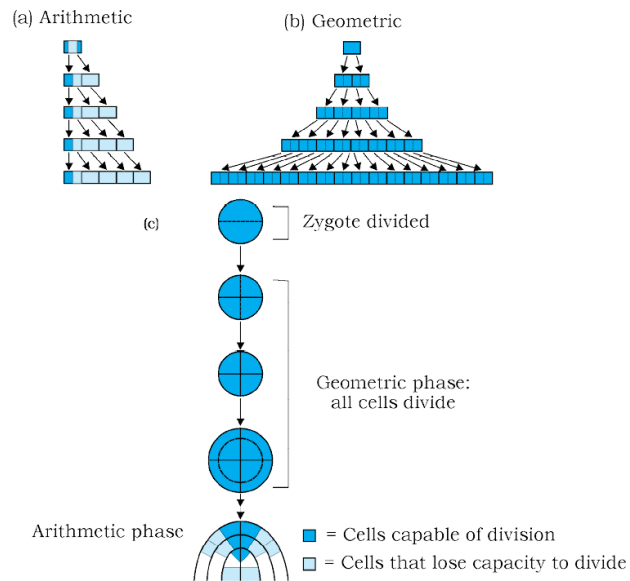


Figure 15.6 An idealised sigmoid growth curve typical of cells in culture, and many higher plants and plant organs



## Conditions for Growth

Include: water, oxygen, nutrients and temperature.

## Differentiation, Dedifferentiation and Redifferentiation:

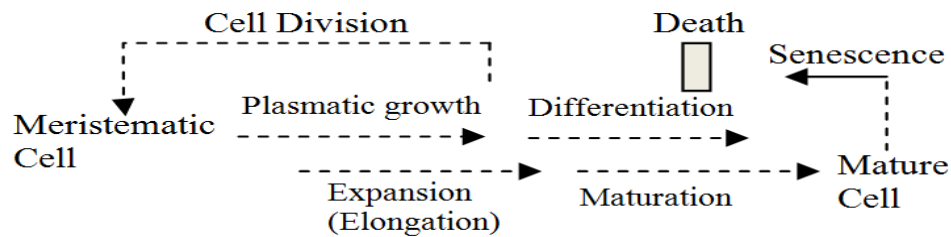
**Differentiation** - In this process, cells derived from root apical and shoot apical meristems and cambium differentiate and mature to perform specific functions.

**Dedifferentiation** - Process in which living differentiated cells regain their capacity to divide.

**Redifferentiation** - Process in which differentiated cells that have lost their ability to divide are reformed from dedifferentiated cells and have the ability to perform specific functions.

## Development:

- Development – changes in the life cycle.



- **Plasticity** – different kinds of structure in response to environment or phases of life.  
Eg. Heterophylly in cotton and coriander. In these plants, leaves have different shapes based on the phase of life cycle as well as the habitat.
- Development can also be termed as – growth + differentiation
- Development is controlled by intrinsic as well as extrinsic factors.  
Intrinsic – Genetic factors and plant growth regulators  
Extrinsic – light, temperature, water, oxygen, etc.

## Plant Growth Regulators/ Phytohormones:

### Classification based on their nature of action:

- Plant growth promoters. – Auxins, Gibberellins and Cytokinins.
- Plant growth inhibitors - Abscissic acid (ABA)
- Ethylene may fit in either of the two groups, but is largely an inhibitor.

### Types of phytohormones:

- Auxins
- Gibberellins
- Cytokinins
- Ethylene
- Abscissic acid

## Auxins

**Discovery** :- auxins were discovered by Charles Darwin and Francis Darwin.

**Isolation** :- they were isolated from tips of coleoptiles of oat seedlings by F.W.Went as IAA and IBA.

**Effects:** –

- Initiate rooting in stem cuttings, plant propagation.
- Promote flowering, prevent fruit and leaf drop.
- Promote abscission of older mature leaves.

**Uses:-**

- Induce parthenocarpy
- Widely used as herbicides (2,4 – D)
- To kill dicotyledonous weeds
- Prepare weed free lawns.
- Controls xylem differentiation and helps in cell division



## Gibberellins

**Discovery** : E. Kurosawa identified gibberellins present in a fungal pathogen

*Gibberella fujikuroi*

**Isolation**: Infected rice seedlings when treated with sterile filtrates of fungus

**Effects**:

- GA'S are acidic.
- Increase in length, cause fruits to elongate and improve its shape.
- Delay senescence, extend the market period.
- GA3 used to speed up malting process in brewing

**Uses**:

- Spraying sugarcane crop with this
- Increases length of stem
- Fastens maturity period.
- Promotes bolting

## Cytokinins

**Discovery** : Skoog and Miller

**Isolation**: Crystallized its promoting active substance named it kinetin from coconut milk, corn – kernels.

**Effects**:

- They are synthesized where rapid cell division takes place
- Produce new leaves, chloroplasts in leaves, lateral shoot growth and adventitious shoot formation.

**Uses**:

- Help overcome apical dominance
- Promote nutrient mobilization which helps in the delay of leaf senescence

## Ethylene (gaseous hormone):

**Discovery** : Cousins confirmed the release of a volatile substance from ripened oranges that hastened the ripening of stored unripened bananas

**Effects**:

- Promotes senescence and abscission
- Highly effective in fruit ripening
- Enhances the respiration rate
- Breaks seed and bud dormancy
- Initiates germination in peanut seeds.
- Sprouting potato tubers, promotes root growth root hair formation

**Uses**:

- Used to initiate flowering, for synchronizing fruit, induces flowering, regulates physiological processes.
- Hastens fruit ripening, accelerates abscission and Promotes female flowers.

## Abscissic Acid (ABA):

**Discovery:** Researchers.

**Isolation:** 3 kinds of inhibitors - Inhibitor – B, abscission II & dormin.

**Effects:**

- Regulates abscission dormancy
- ABA stimulates the closure of stomata
- Increases tolerance, seed development
- Maturation, dormancy, withstand desiccation

**Uses:**

- There are no. of events in a plant
- Where more than one PGR interact to affect that event, example - Dormancy in seeds / buds abscission, senescence, apical dominance.

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