EAMCET/NEET

AP&TS

2023

BIOLOGY

PLANT GROWTH AND REGULATION

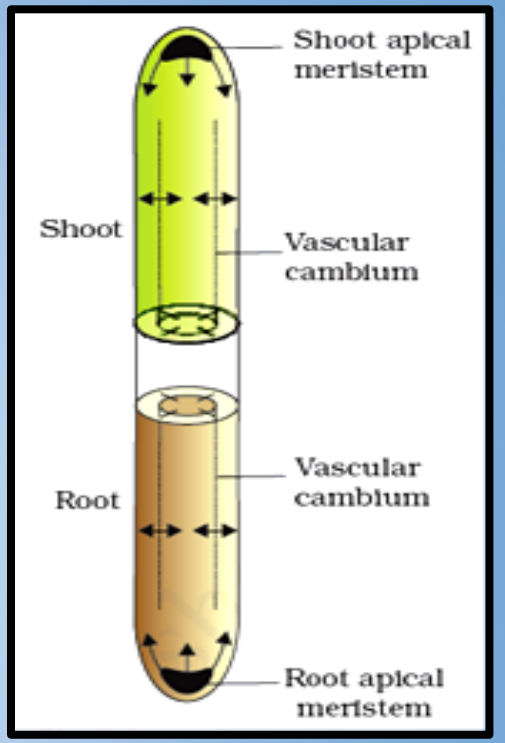
ONE SHOT

UNSTOPPABLE

- GROWTH
- DIFFERENTIATION
- DEDIFFERENTIATION
- REDIFFERENTIATION
- DEVELOPMENT

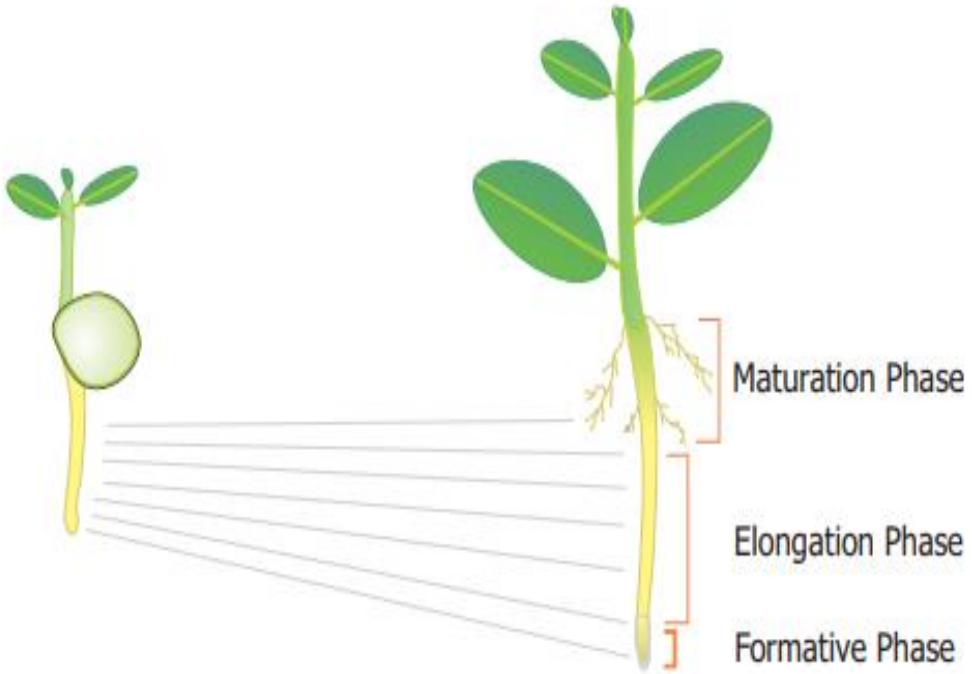
- PLANT GROWTH REGULATORS
- PHOTOPERIODISM
- VERNALIZATION

GROWTH



- Growth is defined as *"an irreversible permanent increase in size of an organ or its part or even of an individual cell."*
- **Plant Growth is generally Indeterminate:**
  - Plants are capable of growing throughout their life due to meristematic tissues present in certain parts.
- **Growth is Measurable:**
  - Growth can be measured by an increase in cell number, length, area, volume and dry or wet weight.

PHASES OF GROWTH



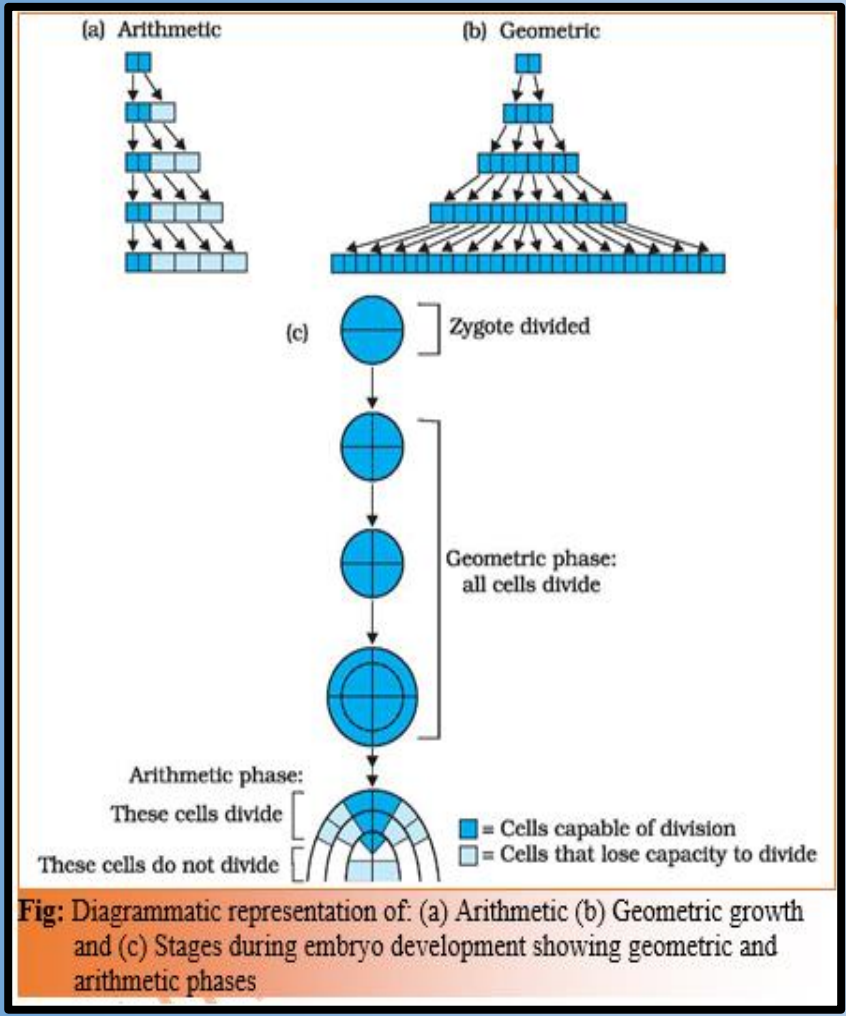


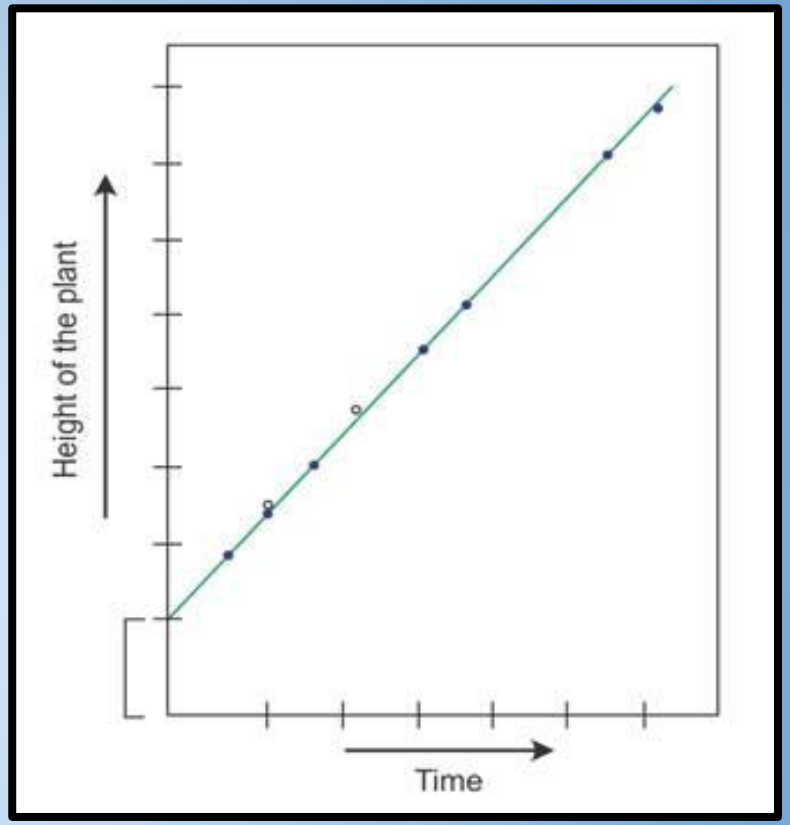
Fig: Diagrammatic representation of: (a) Arithmetic (b) Geometric growth and (c) Stages during embryo development showing geometric and arithmetic phases

GROWTH RATE

- Growth Rate is the increased growth in unit time.
- Growth can show either
  - Arithmetic progression.
  - Geometric progression.

ARITHMETIC GROWTH

- It refers to the constant growth rate with time, e.g. elongation of a root and height of a plant.
- It can be represented by
  - $Lt = Lo + rt$
  - Lo is the initial length
  - Lt is the length after time 't'
  - r is the growth per unit time



GEOMETRIC GROWTH

- Wt = Wo e^rt
  - Wo is the initial size, it can be increased in the number of cells, weight or height
  - Wt is the size after time 't'
  - r is the growth per unit time or also referred to as **efficiency index**
  - e is the base of the natural log
- Most of the living organisms follow the sigmoid curve of growth, e.g. cells, tissue and organs of plants.

NEET QUESTION

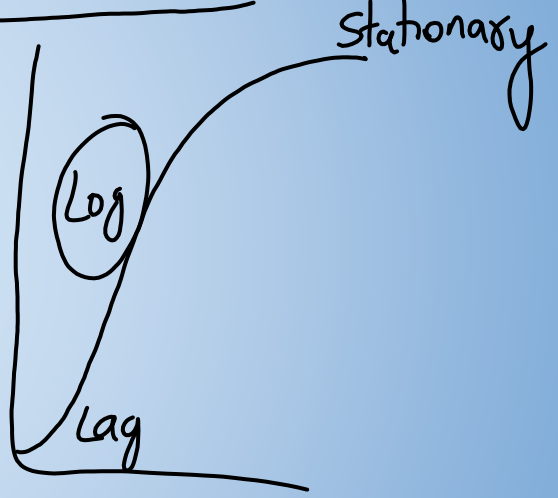
Q) Fastest phase of S-shaped growth curve is

A. Lag Phase

B. Log Phase

C. Stationary Phase

D. Both A and B



NEET PYQ

Q) Typical growth curve in plants is

A. stair-steps shaped

B. parabolic

C. sigmoid

D. linear.

CONDITIONS OF GROWTH

- Essential elements required for growth are:
  - **Water** is essential and also required for enzymatic activity. Turgidity helps in growth
  - **Oxygen** is required for respiration and metabolism of organic compounds to release energy required for growth
  - **Macro and micronutrients** are required as an energy source and for the synthesis of protoplasm
  - In addition to these, optimum temperature, salinity, light, etc. environmental factors also affect growth

DIFFERENTIATION

- Meristematic cells differentiate and undergo structural changes to perform specific functions.
- Examples:
  - Tracheary elements develop lignocellulosic cell walls, which is strong, elastic and required for the transport of water to long-distance.
  - Peripheral meristematic cells develop into the epidermis
  - Cells present apically differentiate into the root cap.

REDIFFERENTIATION

- The dedifferentiated cells again lose their capacity to divide, it is called **redifferentiation.**

DEVELOPMENT

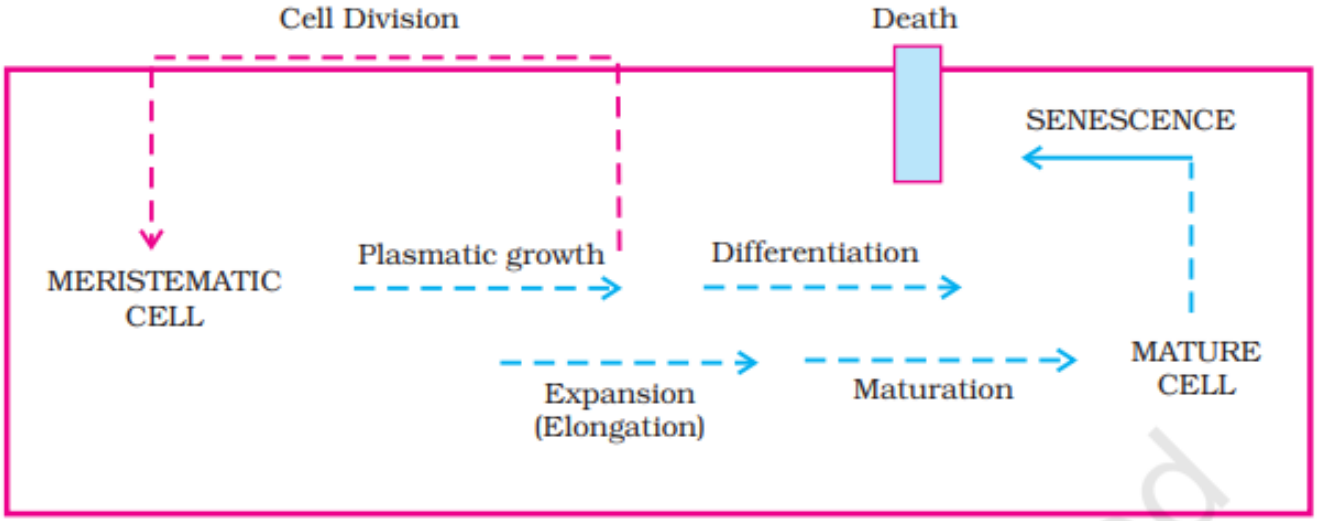


Figure 15.8 Sequence of the developmental process in a plant cell

Plants follow different pathways in response to environment or phases of life to form different kinds of structures. This ability is called **plasticity,** e.g. heterophylly in cotton, coriander and larkspur. In such plants, the leaves of the juvenile plant are different in shape from those in mature plants. On the other hand, difference in shapes of leaves produced in air and those produced in water in buttercup also represent the heterophyllous development due to environment (Figure 15.9). This phenomenon of heterophylly is an example of plasticity.

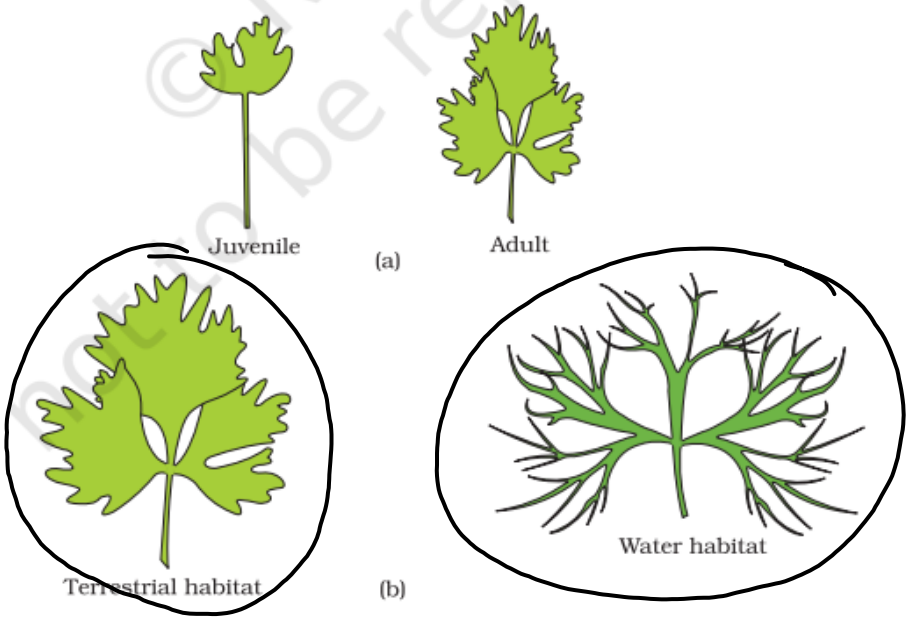


Figure 15.9 Heterophylly in (a) larkspur and (b) buttercup

NEET PYQ

Q) Juvenile Heterophylly is seen in

A. Cotton

B. Coriander

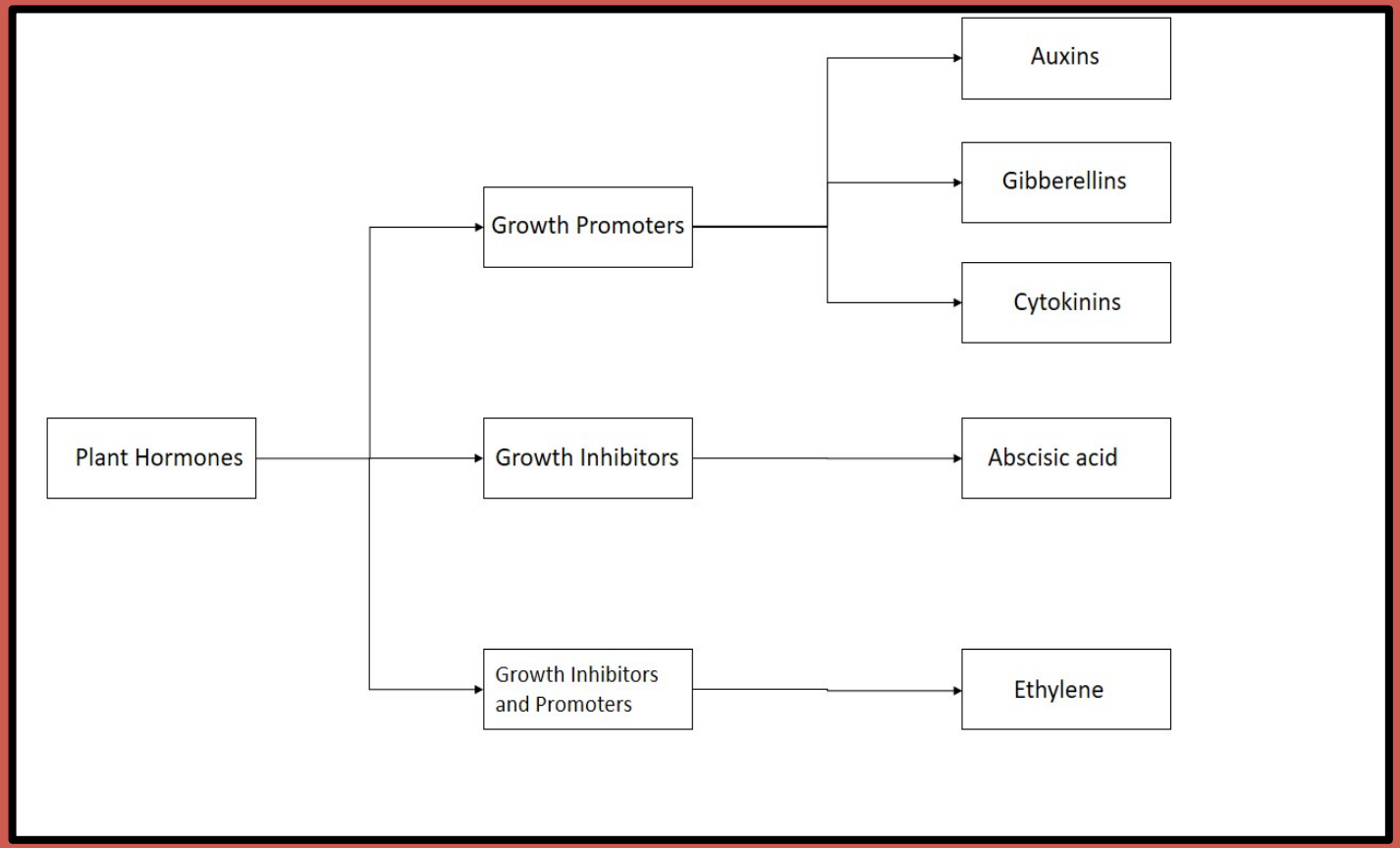
C. Larkspur

D. All the above

CHARACTERISTICS

- They are derivatives of:
  - adenine (kinetin),
  - carotenoids (ABA),
  - terpenes (GA3) and
  - indole compounds (auxins).
- Ethylene is a gaseous hormone
- They are present in a very low concentration and act as chemical signals between cells

CLASSIFICATION



15.4.2 The Discovery of Plant Growth Regulators

Interestingly, the discovery of each of the five major groups of PGRs have been accidental. All this started with the observation of Charles Darwin and his son Francis Darwin when they observed that the coleoptiles of canary grass responded to unilateral illumination by growing towards the light source (phototropism). After a series of experiments, it was concluded that the tip of coleoptile was the site of transmittable influence that caused the bending of the entire coleoptile (Figure 15.10). Auxin was isolated by F.W. Went from tips of coleoptiles of oat seedlings.

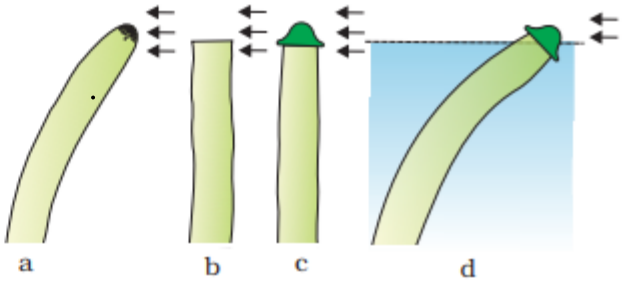
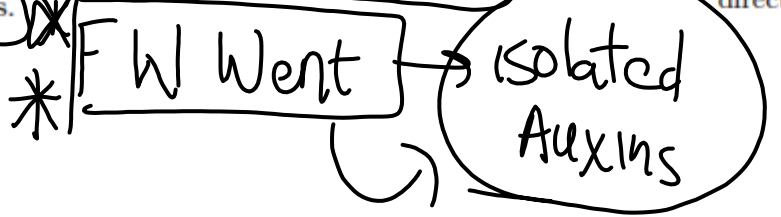


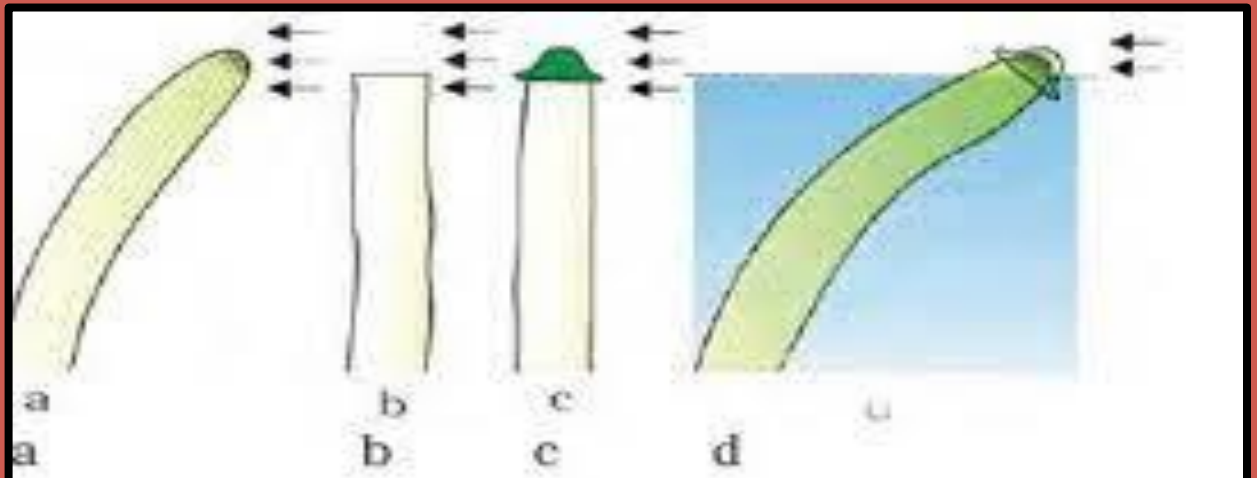
Figure 15.10 Experiment used to demonstrate that tip of the coleoptile is the source of auxin. Arrows indicate direction of light



DISCOVERY

- Charles Darwin and his son Francis showed that there was some substance at the tip of coleoptile of canary grass, which is transmittable and responsible for the phototropism, i.e. bending towards the light
- Auxin was first isolated from human urine
- F.W. Went isolated Auxin from the coleoptiles of oat
- E. Kurosawa discovered that foolish seedling or 'bakanae' disease of rice seedlings was due to the presence of gibberellic acid in the fungus *Gibberella fujikuroi*

DISCOVERY OF AUXIN



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PHYSIOLOGICAL EFFECTS OF AUXIN

- Apical Dominance
- Induces cell differentiation in xylem
- Induce parthenocarpy i.e. formation of seedless fruits, e.g. Tomatoes
- Promote flowering, e.g. Pineapples
- Delay abscission of young leaves and fruits,whereas, promote falling of older leaves and fruits
- Root initiation in stem cuttings for vegetative propagation
- 2, 4-D is widely used as herbicides to kill dicot weeds

GIBBERELLIN

- More than 100s gibberellins are found.
- GA3 (Gibberellic acid) is one of the first and the most common gibberellins.
- All the gibberellins are acidic.

GA1, GA2, GA3

Bolting
↓
Elongation of internodes before harvesting

PHYSIOLOGICAL EFFECTS OF GIBBERELLIN:

- Cell elongation
- Delay in senescence
- Stimulate malting process
- Internode elongation (sugarcane stem, grape stalks)
- Promote maturation and seed germination

Beer, wine

PHYSIOLOGICAL EFFECTS OF CYTOKININ

- Cell division
- Inhibition of apical dominance, i.e. promote lateral shoot growth
- Delay of leaf senescence
- Embryo development
- Seed germination
- Promote nutrient metabolism
- Formation of chloroplasts in leaves
- Adventitious shoot formation

ETHYLENE

- It is a gaseous hormone.
- Produced by ripened fruits and tissues undergoing senescence.
- **Ethephon** is the most widely used compound (aqueous solution)

Ethephon

NEET PYQ

Q. Fruit and leaf drop at early stages can be prevented by the application of:

A. Ethylene
B. Auxins
C. Gibberellic acid
D. Cytokinins

PHOTOPERIODISM

It refers to the effect of the duration of light on plant growth and development, especially flowering.

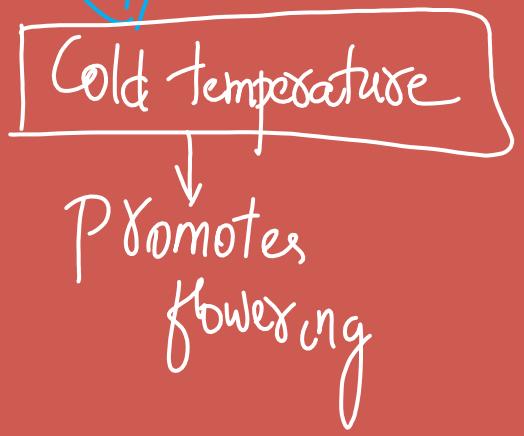
1st characterised in tobacco plant

Flowering plants are classified into the following categories, based on their flowering pattern in response to light:

- **Short day plants:** Flowering is initiated on the exposure of light for a shorter duration
- **Long day plants:** Flowering is initiated on the exposure of light for a longer duration
- **Day-neutral plants:** Flowering does not depend on the duration of light exposure

VERNALISATION

- It is a temperature-dependent phenomenon.
- Flowering is promoted by a period of cold temperature.
- Seeds are cooled during germination to accelerate flowering.
- Wheat, rye, barley, etc. food crops are grown twice in a year.
- Spring varieties are planted in spring and harvested at the end of the growing season.



SEED DORMANCY

- Seed dormancy is controlled endogenously.
- Seeds do not germinate even in favourable external conditions.

NEET PYQ

Q.Photoperiodism was first characterised in

A. Tobacco
B. Cotton
C. Tomato
D. Potato

NEET PYQ

Q. Treatment of seed at low temperature under moist conditions to break its dormancy called

A. Scarification
B. Stratification
C. Vernalisation
D. Chelation