DAY SEVENTEEN

Plant Growth and Development

Learning & Revision for the Day

- Plant Growth
- Development Process in Plant Cells
- Growth Regulators or Plant Hormones
- Photoperiodism
- Vernalisation
- Seed Dormancy and Germination

Plant Growth

- **Growth** can be defined as an irreversible permanent increase in size of body or an organ or its parts or even of an individual cell. It is accompanied by metabolic processes (both anabolic and catabolic), that occur at the expense of energy.
- Plant growth is unique because plants retain the capacity for unlimited growth throughout their life.
- This ability of the plants is due to the presence of meristems at certain locations in their body.
- Growth in plants can be measured by increase in fresh weight, dry weight, length, area, volume and cell number.

Phases of Growth

In plants, the period of growth is generally divided into three phases

(i) **Meristematic phase or Lag phase** It occurs in the meristematic region. The cells are constantly dividing, both at the root apex and the shoot apex and are rich in protoplasm and possess large conspicuous nuclei.

(ii) **Elongation phase or Log phase** The cells of this phase are proximal to the meristematic zone. Increased vacuolation, cell enlargement and new cell wall deposition are the characteristics of the cell in this phase.

(iii) **Maturation phase or Senescence phase** In this phase, cells undergo structural and functional differentiation after which their growth deteriorates.

Growth Rate

- It is defined as the increased growth per unit time. The growth rate shows an increase that may be arithmetic or geometrical.

- **Arithmetic growth** occurs when following mitosis, only one daughter cell continues to divide, while the other differentiates and matures. A linear curve is obtained in this growth. Mathematically, it is expressed as

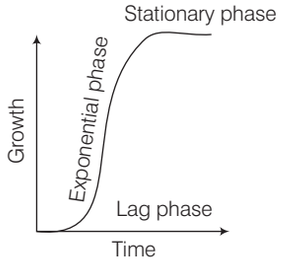
$$l_t = l_0 + rt$$

where, l_t = Length at time 't'
l_0 = Length at time 'zero'
r = Growth rate/elongation per unit time

- **Geometrical growth** occurs when after initial slow growth (lag phase), the growth rate increases rapidly thereafter, i.e. at exponential rate (log phase). Here, both the progeny cells following mitosis retain the ability to divide and continue to do so. However, with limited nutrient supply, the growth slows down leading to stationary phase. A sigmoid or S-curve is obtained in this pattern.

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

where, W_I = Final size, W_0 = Initial size
r = Growth rate, t = Time period of growth
e = Base of natural logarithms



Sigmoid growth curve

S-curve of growth is typical of most living organisms in their natural environment. It also occurs in cells, tissues and organs of plants.

Conditions of Growth

The essential requirements of growth in plants are water, oxygen, nutrients, temperature and light.

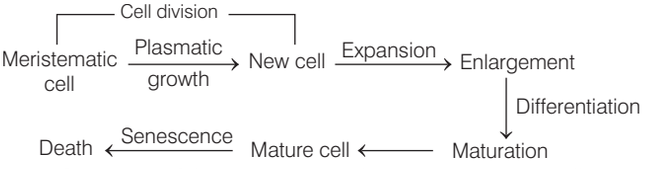
- **Water** helps in maintenance of turgidity of cells. It also provides a medium for enzymatic activities needed for growth.
- **Nutrients** are required by plants for the synthesis of protoplasm and act as a source of energy.
- **Temperature** range above optimum for plant growth may damage the protoplast or denature the enzymes.
- **Oxygen** is essential for aerobic respiration hence availability of energy for biosynthetic activity depends on oxygen.
- **Light** and **gravity** also affect certain phases/stages of growth.

Differentiation, Dedifferentiation and Redifferentiation

- The development of structures and organs of plant involves a switch from one developmental phase to next.
- The three processes that are associated with the specialisation of cells in different organisms including plants are as follows
  (i) **Differentiation** is a permanent localised qualitative change in size, biochemistry, structure and function of cells, tissues or organs, e.g. in plants, palisade parenchyma, tracheid, guard cells, root cap, fibre, trichome are differentiated cells.
  (ii) **Dedifferentiation** is the process of despecialisation of differentiated cells, so that they regain the capacity to divide and form new cells, e.g. formation of meristems, interfascicular vascular cambium, cork cambium, etc.
  (iii) **Redifferentiation** is the structural, chemical and physiological specialisation of cells being derived from dedifferentiated meristematic cells, e.g. formation of secondary phloem, secondary xylem, cork cells and secondary cortex.

Development Process in Plant Cells

- Development includes all changes that an organism goes through during its life cycle from germination of the seed to senescence.
- The sequence of processes, which constitute the development of a cell of a higher plant is given below



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 is called **plasticity,** e.g. heterophylly in cotton, coriander and larkspur.

Growth Regulators or Plant Hormones

- The Plant Growth Regulators (PGRs) or phytohormones are small, complex molecules of diverse chemical composition.
- These may contain indole compounds, adenine derivatives, derivatives of carotenoids, terpenes, etc.
- PGRs like auxins, gibberellins and cytokinins are called **growth promoters** as these are involved in growth promoting activities such as cell division, cell enlargement,

pattern formation, tropic growth, flowering, fruiting and seed formation, while ehylene and abscisic acid are called **growth inhibitors** as they involve in senescence process of plant.

1. Auxins

- Auxins or Indole-3-Acetic Acid (IAA) are generally produced by growing apices of the stems and roots, from where they migrate to the regions to their action.
- Auxins like IAA and IBA (Indole Butyric Acid) have been isolated from plants, while NAA (Naphthalene Acetic Acid) and 2, 4-D (2, 4-dichlorophenoxyacetic) are synthetic auxins.
- They initiate rooting in stem cuttings, promote flowering, i.e. in pineapples, prevent fruit and leaf drop at early stages, promote abscission of older mature leaves and fruits, induce parthenocarpy, i.e. in tomatoes, act as herbicides and control xylem differentiation and help in cell division.
- Apical dominance is a phenomenon in which growing apical bud inhibits the growth of lateral buds in most higher plants. **Thimann** and **Skoog** reported that IAA is responsible for apical dominance.

2. Gibberellins

- These are growth promoting phytohormones. There are more than 100 gibberellins reported from widely different organisms like fungi and higher plants. They are denoted as GA_1, GA_2, GA_3 and so on.
- They produce a wide range of physiological responses in plants, e.g. increase the length of stalks, fruit elongation and improve shape, delay senescence, promote blotting (internode elongation) in many plants, on female plant, male flowers are produced by application of GA, etc.
- They speed up malting process in brewing industry (mainly GA_3).
- They shorten the maturity period leading to early seed production. In lettuce, seed germination occurs by application of GA even in dark.

3. Cytokinins

- Natural cytokinins (kinetin) are synthesised in meristematic regions where rapid cell division occurs, e.g. root apices, developing shoot buds, young fruits, etc.
- Several naturally occurring cytokinins, e.g. zeatin and some synthetic compounds with cell division promoting activity have been identified.
- Cytokinins help to produce new leaves, chloroplasts in leaves, lateral shoot growth and adventitious shoot formation. These help overcome the apical dominance and promote nutrient mobilisation, which helps in delay of leaf senescence.

4. Ethylene

- It is the only gaseous phytohormone. It is synthesised in large amount by tissues undergoing senescence and ripening fruits.
- Ethylene promotes senescence and abscission of plant organs, fruit ripening, enhances respiration rate (during ripening of the fruit), etc.
- It breaks seed and bud dormancy, sprouting of potato tubers and promotes rapid internode/petiole elongation.
- It induces horizontal growth of seedlings, swelling of the axis and apical hook formation in dicot seedlings.
- Its broad spectrum effects make them widely used in agriculture. Ethephon is a most widely used compound of ethylene in agriculture. It hastens fruit ripening in tomatoes and apples and accelerates abscission in flowers and fruits.

5. Abscisic Acid

- Abscisic Acid (ABA) acts as a general plant growth inhibitor and of plant metabolism. It has wide ranging effects on plant growth and development.
- ABA inhibits seed germination, stimulates the closure of stomata, increases the tolerance of plants to various types of stresses (as stress hormone).
- It also plays an important role in seed development, maturation and dormancy.
- It helps seeds to withstand dessication and other factors unfavourable for growth.
- It also acts as an antagonist to gibberellin.

Photoperiodism

- The response of plants to periods of light or day/night is termed as photoperiodism.
- On the basis of day/night, plants are divided into three types
  1. **Long-day plants** require light for a period exceeding a well-defined critical duration, e.g. henbane, radish.
  2. **Short-day plants** require exposure to light for a period less than critical duration before the flowering is initiated in them, e.g. *Xanthium*.
  3. **Day-neutral plants** have no relation between exposure to light duration and induction of flowering response, e.g. *Pisum sativum*.
- Not only the duration of light period but also the duration of dark period has equal importance in flowering.
- The site of perception of light/dark duration are the leaves.
- It is said that a hormonal substance (florigen) migrates from leaves to shoot apices for inducing flowering only, when the plants are exposed to the necessary inductive period.

Vernalisation

- The dependence of plants for flowering either quantitatively or qualitatively on exposure to low temperature is called **vernalisation**.
- It prevents precocious reproductive development late in the growing season and enables the plant to have sufficient time to reach maturity.
- Term vernalisation was first given by **TD Lysenko**.
- As a result of vernalisation, a flowering hormone called vernalin is formed but it has never been isolated.

Seed Dormancy and Germination

- The internal inhibition of germination of a normal or viable seed, even when it is placed under most favourable conditions required for its germination is called **seed dormancy**.
- Dormant seeds remain under non-germinating condition only for a specific period of time that may vary from days to years. This specific period is called **dormancy period.**
- Dormancy in seeds is may be due to the presence of some block(s) within the seeds, which act as barriers for germination.
- **Seed dormancy** It keeps seeds in viable state even after a long time.
- The development of plantlet from seed is known as **seed germination**. It occurs in the presence of optimum conditions, i.e. water, oxygen, plant growth regulators, etc. There are two methods for breaking of seed dormancy

1. Natural Breaking of Seed Dormancy

- Weakening or rupturing of tough and impermeable seed coats by mechanical abrasions and microbial action.
- Action of digestive enzymes makes the seed coat soft and permeable. This happens in case of small seeds regularly passing through the alimentary canals of birds and other animals.
- Attainment of maturity during dormant period by immature embryo.
- Formation of growth hormones, e.g. cytokinin, gibberellin, auxin.

2. Artificial Breaking of Seed Dormancy

- Rupturing of seed coats by filing, chipping, machine threshing.
- Weakening of seed coat by hot water, fat solvents, strong mineral acids (e.g. H_2SO_4), etc. These chemicals dissolve surface inhibitors, waxes, etc.
- Hydraulic pressure of 2000 kg for 5-20 min weakens the tough seed coats.
- Exposure to chilling breaks dormancy, e.g. peach, plum, cherry.
- Exposure to red light overcomes dormancy and induces seed germination in lettuce and tobacco.

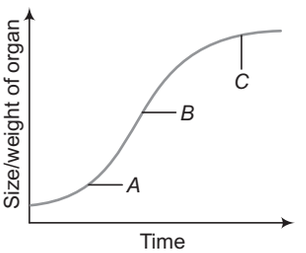
DAY PRACTICE SESSION 1

FOUNDATION QUESTIONS EXERCISE

1 Plant growth is unique because
(a) plant retains the capacity for unlimited growth
(b) plant retains the capacity for limited growth
(c) plants have diffused growth that differs from animals
(d) None of the above

2 The whole series of morphogenetic changes, which occur in an organism during its life cycle is known as
(a) differentiation
(b) development
(c) growth
(d) None of the above

3 Identify *A*, *B* and *C* in the given graph and choose the correct option accordingly.



(a) *A*–Log phase, *B*–Lag phase, *C*–Stationary phase
(b) *A*–Lag phase, *B*–Log phase, *C*–Stationary phase
(c) *A*–Lag phase, *B*–Stationary phase, *C*–Log phase
(d) *A*–Log phase, *B*–Stationary phase, *C*–Lag phase

4 The cells in ..... phase of growth show increased vacuolation, cellular enlargement and new cell wall deposition.
(a) meristematic (b) elongation
(c) maturation (d) differentiation

5 A linear curve is obtained when arithmetic growth is plotted. This is because
(a) lag, log and stationary phase occur
(b) one daughter cell divides repeatedly while other undergoes differentiation and maturation
(c) environment affects mitosis
(d) of the ability of the plant to produce new plants

6 Arrange the below steps of geometrical growth (from beginning to last) in a correct sequence of their occurrence. Choose the correct option.
I. Lag phase. II. Stationary phase
III. Exponential phase
(a) I → II → III (b) I → III → II
(c) III → II → I (d) III → I → II

7 In geometrical growth, log phase is represented by
(a) rapid consumption of nutrients
(b) rapid increment of cell number
(c) highest growth rate
(d) All of the above

8 An intrinsic factor necessary for proper plant development is
(a) temperature (b) light
(c) growth regulators (d) water

9 Given below are some statements with respect to plant growth. Identify the incorrect option for the same.
(a) Some plant growths are irreversible
(b) It is open-ended
(c) It is indeterminate or determinate
(d) There is no increase in number of plant parts

10 Leaf 'A' of 20 cm^2 grows 5 cm^2 per hour and Leaf 'B' of 25 cm^2 grows 5 cm^2 per hour. Identify the option which indicates the correct relative growth of leaves A and B, respectively.
(a) 25% and 20% (b) 25% and 50%
(c) 50% and 100% (d) 20% and 25%

11 When the mature differentiated cells reverse to meristematic activity to form callus in experimental flask is known as
(a) dedifferentiation (b) redifferentiation
(c) differentiation (d) maturation

12 At maturity, the cells of tracheary elements loose their protoplasm and become dead. This occurs due to the deposition of lignocellulosic cell wall thickenings. The above fact is an example of
(a) growth (b) differentiation
(c) development (d) redifferentiation

13 The submerged leaves of aquatic plants like *Ranunculus flabellaris* are highly dissected whereas the aerial leaves are broad and lobed. This pattern of development in plants is called
(a) environmental plasticity
(b) heterophylly
(c) Both (a) and (b)
(d) None of the above

14 Which of the following hormones is concerned mainly with root initiation?
(a) IBA (b) ABA
(c) GA_3 (d) CK

15 Fruit ripening is promoted by hormone
(a) ethylene (b) ABA
(c) auxin (d) Both (a) and (b)

16 Induction of cell division and delay in senescence is done by
(a) cytokinin (b) kinetin
(c) gibberellin (d) auxin

17 During seed germination its stored food is mobilised by → NEET 2013
(a) ethylene (b) cytokinin
(c) ABA (d) gibberellin

18 To increase sugar production in sugarcanes, they are sprayed with
(a) IAA (b) cytokinin
(c) gibberellin (d) ethylene

19 Sprouting of potato under storage condition can be prevented by
(a) auxin (b) gibberellin
(c) ethylene (d) cytokinin

20 Which one of the following generally acts as an antagonist to gibberellins? → CBSE-AIPMT 2017
(a) Zeatin (b) Ethylene
(c) ABA (d) IAA

21 Commercial fruit growers in an area started leaving the fruits on trees for longer time in order to extend the market period by delaying ripening. This action can also be achieved by application of *A* which causes *B*. Here *A* and *B* are,
(a) *A* – auxin, *B* – bolting
(b) *A* – cytokinin, *B* – internodal elongation
(c) *A* – gibberellins, *B*–delayed senescence
(d) *A* – ethylene, *B* – parthenocarpy

22 A plant becomes bushier when the tip of its shoot is removed, this is because
(a) it removes auxin, which promotes development of lower buds
(b) it increases the level of morphogens from root to stem
(c) abscission of lateral leaves
(d) None of the above

23 To promote the development of parthenocarpic fruits, which of the following combinations is used?
(a) IAA and IBA (b) 2, 4-D and IBA
(c) NAA and GA (d) 2,4-D and IAA

24 Cytokinins are commonly called anti-ageing hormones because they cause delay in senescence by
(a) regulating synthesis of proteins
(b) regulating mobilisation of plant nutrients
(c) Both (a) and (b)
(d) increasing respiration

25 The malting process in brewing industry is a long time consuming process, which can speed up by the application of
(a) GA_3 (b) auxin
(c) ethylene (d) cytokinin

26 To increase the number of female flowers in crop plant, which plant growth regulator can be applied to crop?
(a) ABA (b) Ethylene (c) GA (d) Cytokinin

27 Dr. F Went noted that if coleoptile tips were removed and placed on agar for one hour, the agar would produce a bending when placed on one side of freshly cut coleoptile stumps. Of what significance is this experiment? ➞ CBSE-AIPMT 2014
(a) It made possible the isolation and exact identification of auxin
(b) It is the basis for quantitative determination of small amounts of growth promoting substances
(c) It supports the hypothesis that IAA is auxin
(d) It demonstrated polar movement of auxins

28 GA_4 and GA_5 were isolated from
(a) *Gibberella*
(b) *Gibberella* and bean seeds, respectively
(c) bean seeds and *Gibberella*, respectively
(d) bean seeds

29 A farmer observed that some spinach plants were undergoing rapid wilting under open conditions. However, when transferred to a humid greenhouse chamber, they flourished successfully. The most likely explanation for the wilting of spinach leaves could be
(a) deficiency of auxin
(b) inadequate photoperiodic exposure
(c) excess nutrients
(d) ABA deficiency

30 Shoot bud formation in a tissue culture can be induced by
(a) high auxin
(b) low cytokinin
(c) high auxin and low cytokinin
(d) low auxin and high cytokinin

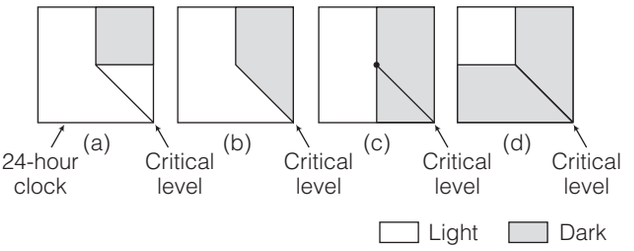
31 Amylase formation mediated by gibberellins during germination of cereal grains is inhibited by
(a) abscisic acid (b) ethylene
(c) cytokinin (d) auxin

32 One hormone hastens maturity period in juvenile conifers, a second hormone controls xylem differentiation while the third increases the tolerance of plants to various stresses. They are respectively
(a) auxin, gibberellin, ABA
(b) gibberellin, auxin, ABA
(c) auxin, gibberellin, cytokinin
(d) gibberellin, auxin, cytokinin

33 If a tree flowers thrice in a year (October, January and July) in Northern India, it is said to be
(a) photosensitive but thermoinsensitive
(b) thermosensitive but photoinsensitive
(c) photo and thermosensitive
(d) photo and thermoinsensitive

34 What will be the effect on phytochrome in a plant subjected to continuous red light?
(a) Level of phytochrome decreases
(b) Phytochrome is destroyed
(c) Phytochrome synthesis increases
(d) Destruction and synthesis of phytochrome remain in equilibrium

35 A short day plant, e.g. Maryland Mammoth has critical requirement for duration of darkness, i.e. 10 hours. Among which conditions from those given below will Maryland Mammoth tobacco not flower?



36 The perception of stimulus of cold treatment vernalisation is received by
(a) leaves (b) shoot apex
(c) axillary buds (d) ethylene

37 A hormone which can replace vernalisation is
(a) ethylene (b) gibberellin
(c) cytokinin (d) auxin

38 Treatment of seed at low temperature under moist conditions to break its dormancy is called
(a) vernalisation
(b) chelation
(c) stratification
(d) scarification

39 Plants present in area with excess salts and oxygen deficiency adapt to …… to solve the problem of seed germination. Identify the correct option.

(a) vivipary (b) ovovivipary
(c) dormancy (d) None of these

40 Match the following columns.

	Column I		Column II
A	Zeatin	1.	Flowering hormone
B.	Florigen	2.	Synthetic auxin
C.	IBA	3.	Cytokinin
D.	NAA	4.	Natural auxin

Codes

	A	B	C	D
(a)	3	4	1	2
(b)	2	1	4	3
(c)	1	2	3	4
(d)	3	1	4	2

41 On the basis of correlation, find the correct option from columns.

	Column I		Column II		Column III
A.	Foolish plant	1.	Volatile hormone	i.	Induces dormancy
B.	Induces senescence	2.	GA	ii.	Ripens fruits
		3.	Zeatin	iii.	Usually sterile plant

Codes

A B
(a) 1–ii, 3–i
(c) 2–iii, 1–ii

A B
(b) 2–iii, 3–iii
(d) 2–i, 3–ii

42 Match the following columns.

	Column I		Column II
A.	*Dahlia*	1.	Long-day plant
B.	Wheat	2.	Day-neutral plant
C.	Cotton	3.	Lack dormancy
D.	Mangrove seeds	4.	Short-day plant

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	4	1	2	3
(c)	4	2	3	1	(d)	1	4	3	2

Directions (Q. Nos. 43-44) *In each of the following questions, a statement of Assertion is given followed by corresponding statement of Reason. Of the statements, mark the correct answer as*

(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(c) If Assertion is true, but Reason is false
(d) If Assertion is false, but Reason is true
(e) If both Assertion and Reason are false

43 **Assertion** Plants have open form of growth.
Reason They continuously grow by adding new cells as a result of meristematic activity.

44 **Assertion** Photomodulation of flowering is a phytochrome regulated process.
Reason Active form of phytochrome directly induces floral induction in shoot buds.

DAY PRACTICE SESSION 2

PROGRESSIVE QUESTIONS EXERCISE

1 Growth can be measured in various ways, which of these can be used as parameters to measure growth?

(a) Increase in cell number
(b) Increase in cell size
(c) Increase in length and weight
(d) All of the above

2 Lateral stem development in plants is controlled by the levels of

(a) cytokinin and auxin
(b) auxins only
(c) auxin and gibberellins
(d) ABA and ethylene

3 Growth of an organism is characterised by

(a) an irreversible permanent increase in size of an organ
(b) an irreversible permanent increase in size of a cell
(c) Both (a) and (b)
(d) reversible permanent changes

4 Plants deficient of element zinc, show its effect on the biosynthesis of plant growth hormone

(a) abscisic acid
(b) auxin
(c) cytokinin
(d) ethylene

5 In short-day plants, flowering is induced by
(a) photoperiod less than 12 hrs
(b) photoperiod below a critical length and uninterrupted long night
(c) long night
(d) short photoperiod and interrupted long night

6 Gibberellins can promote seed germination because of their influence on
(a) rate of cell division
(b) production of hydrolysing enzymes
(c) synthesis of abscisic acid
(d) absorption of water through hard seed coat

7 A plant hormone is produced under water deficient conditions and helps in developing tolerance response in plants to droughts is
(a) cytokinin (b) ABA (c) ethylene (d) gibberellins

8 The effect of apical dominance can be overcome by which of the following hormones?
(a) IAA (b) Ethylene
(c) Gibberellin (d) Cytokinin

9 Removal of apical (terminal) bud of a flowering plant (or pruning of a flowering plant) leads to
(a) formation of new apical buds
(b) formation of adventitious roots on the cut side
(c) early flowering (or stopping of floral growth)
(d) promotion of lateral branches

10 Senescence is an active developmental cellular process in the growth and functioning of a flowering plant, is indicated in
(a) vessels and tracheid differentiation
(b) leaf abscission
(c) annual plants
(d) floral parts

11 You are given a tissue with its potential for differentiation in an artificial culture. Which of the following pairs of hormones would you add to the medium to secure shoots as well as roots?
(a) IAA and gibberellin
(b) Auxin and cytokinin
(c) Auxin and abscisic acid
(d) Gibberellin and abscisic acid

12 Mowing grass lawn facilitates better maintenance because
(a) wounding stimulates regeneration
(b) removal of apical dominance and stimulation of intercalary meristem
(c) removal of apical dominance
(d) removal of apical dominance and promotion of lateral meristem

13 Through their effect on plant growth regulators, what do the temperature and light control in the plants?
(a) Apical dominance (b) Flowering
(c) Closure of stomata (d) Fruit elongation

14 Light stimulates germination of seeds, promotes leaf expansion and induces flowering. These responses induced by light are the examples of
(a) photoperiodism (b) phototropism
(c) photonasty (d) photosynthesis

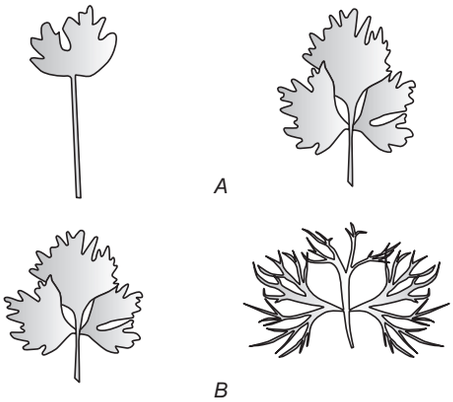
15 The stomata in a plant leaves close during stress condition due to the influence of plant hormone *A* by *B* .
(a) *A* – ethylene, *B*–enhanced dropping of leaves
(b) *A* – abscisic acid, *B*–inhibiting an ATP dependent proton pump
(c) *A* – cytokinin, *B*–inducing carotenoid synthesis
(d) *A* – gibberellins, *B*–abscission of leaves

16 Among the given choices, identify the number of long day plants.
Bryophyllum, *Glycine max*, Radish, *Triticum*, *Dahlia*, Oat, Sugarcane, Lettuce
(a) 4 (b) 7 (c) 2 (d) 3

17 Secondary cortex $\xrightarrow[\text{Phloem}]{\text{Xylem}}$ Secondary phellem, Phellogen
Which options are the odd ones associated with development from the process of redifferentiation?
(a) Secondary cortex and xylem
(b) Secondary phloem and phellem
(c) Secondary cortex and secondary phloem
(d) Phellem and phellogen

18 In an agricultural field, the crops planted were not growing to the desired stem height. This can be corrected by treating the plants with
(a) auxin + cytokinin (b) auxin + ethylene
(c) gibberellins (d) abscisic acid

19 Diagram *A* and *B* indicate the shape of leaves in larkspur and buttercup, respectively. Choose the correct option.



(a) The juvenile and adult leaf of larkspur differ in size due to genetic and plant growth regulator factors
(b) Both leaves of buttercup differ in size due to genetic and intercellular factors
(c) Both larkspur and buttercup leaves size variation is due to habitat plasticity
(d) None of the above

20 What causes a green plant exposed to the light on only one side, to bend toward the source of light as it grows?
(a) Green plants need light to perform photosynthesis
(b) Green plants seek light because they are phototropic
(c) Light stimulates plant cells on the lighted side to grow faster
(d) Auxin accumulates on the shaded side, stimulating greater cell elongation there

21 Match the following columns.

	Column I		Column II
A.	Differentiation	1.	Act of maturation
B.	Redifferentiation	2.	Act of again losing cell division capacity and mature to perform special function act of gaining cell division after dedifferentiation
C.	Dedifferentiation	3.	Act of gaining cell division capability after differentiation

Codes

	A	B	C
(a)	1	3	2
(b)	3	2	1
(c)	1	2	3
(d)	3	1	2

22 Match the following columns.

	Column I		Column II
A.	Increase in wall elongation	1.	Cytokinin
B.	Bolting and flowering	2.	Abscisic acid
C.	Cell division	3.	Gibberellins
D.	Dormancy	4.	Auxins

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	3	1	2	4
(c)	4	3	1	2	(d)	2	4	3	1

Directions (Q. Nos. 23-24) *In each of the following questions a statement of Assertion is given followed by a corresponding statement of Reason just below it. Of the statements, mark the correct answer as*
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are true but reason is not the correct explanation of Assertion
(c) If Assertion is true but Reason is false
(d) If both Assertion and Reason are false

23 **Assertion** Differentiation is a process in which plant undergoes maturation.
Reason During differentiation, cells loose their protoplasm.

24 **Assertion** Short–day plants generally require light period of less than 12 h and continuous dark period of about 14-16 h.
Reason They produce florigen in darkness, rather than light.

ANSWERS

SESSION 1

1 (a)	**2** (b)	**3** (b)	**4** (b)	**5** (b)	**6** (b)	**7** (d)	**8** (c)	**9** (a)	**10** (a)
11 (a)	**12** (b)	**13** (c)	**14** (a)	**15** (a)	**16** (a)	**17** (d)	**18** (c)	**19** (a)	**20** (c)
21 (c)	**22** (a)	**23** (a)	**24** (c)	**25** (a)	**26** (b)	**27** (d)	**28** (b)	**29** (d)	**30** (d)
31 (a)	**32** (b)	**33** (d)	**34** (b)	**35** (a)	**36** (c)	**37** (b)	**38** (c)	**39** (a)	**40** (d)
41 (c)	**42** (b)	**43** (a)	**44** (a)						

SESSION 2

1 (d)	**2** (a)	**3** (c)	**4** (b)	**5** (b)	**6** (b)	**7** (b)	**8** (d)	**9** (d)	**10** (b)
11 (b)	**12** (d)	**13** (b)	**14** (a)	**15** (b)	**16** (a)	**17** (c)	**18** (c)	**19** (c)	**20** (d)
21 (c)	**22** (c)	**23** (c)	**24** (c)						