NCERT Exemplar Solutions of Class 11 Biology – Chapter 15: Plant Growth and Development

LONG ANSWER QUESTIONS

1. Some varieties of wheat are known as spring wheat while others are called winter wheat. The former variety is sown and planted in spring and is harvested by the end of the same season. However, winter varieties, if planted in spring, fail to flower or produce mature grains within a span of a flowering season. Explain why?

Solution:

Winter wheat characteristics: Winter wheat varieties have evolved to require **vernalization** - a period of cold treatment necessary for flowering induction.

Mechanism:

1. **Cold requirement**: Winter wheat needs exposure to temperatures between **0-10°C** for **6-8 weeks**
2. **Genetic programming**: Genes controlling flowering are activated only after cold treatment
3. **Physiological changes**: Cold treatment modifies hormone levels and gene expression patterns
4. **Flowering competence**: Only after vernalization can plants respond to appropriate day length for flowering

Why spring planting fails:

- **Missing cold period**: Spring-planted winter wheat lacks required cold treatment
- **Vegetative state**: Plants remain in vegetative growth without transitioning to reproductive phase
- **Incomplete development**: May produce some growth but fails to form mature grain
- **Time limitation**: Growing season ends before plants can complete reproductive cycle

Evolutionary significance: This mechanism ensures plants flower only after surviving winter, timing reproduction with favorable growing conditions for seed development.

Enhanced Explanation: Winter wheat varieties are essentially **biennial** in nature, requiring two growing seasons (autumn establishment + winter chilling + spring/summer reproduction), while spring wheats are **annual** types that complete their cycle in one season.

---

2. It is known that some varieties of wheat are sown in autumn but are harvested around next mid-summer.

a. What could be the probable reason for this?

b. What term is used for this promotion of flowering under low temperature?

c. Which plant hormone can replace the cold treatment?

Solution:

a) Probable reasons for autumn sowing:

Vernalization requirement: These wheat varieties need **cold treatment** to flower, which is naturally provided during winter months.

Growth cycle:

- **Autumn**: Seeds germinate, establish root system and basic vegetative growth
- **Winter**: Plants undergo vernalization at low temperatures (**0-10°C**)
- **Spring**: Normal growth resumes with adequate photosynthesis and biomass accumulation
- **Early summer**: Flowering occurs followed by grain filling and harvest

Advantages:

- **Longer growing season** allows maximum biomass accumulation
- **Winter survival** ensures strong, established plants
- **Optimal timing** synchronizes reproduction with favorable conditions

b) Term for cold-induced flowering: VERNALIZATION

c) Hormone replacement: GIBBERELLIC ACID (GA_3)

Mechanism of hormone substitution:

- **GA_3 application** can substitute for cold requirement in many vernalization-requiring plants
- **Concentration**: Typically **100-1000 ppm** GA_3 solutions
- **Application method**: Foliar spray or seed treatment
- **Timing**: Applied to young plants that would normally require cold treatment

Enhanced Explanation: Gibberellic acid activates the same genetic pathways that are normally triggered by cold treatment, effectively bypassing the vernalization requirement. This discovery has practical applications in plant breeding and forcing flowering out of season.

---

3. Name a hormone which:

a. is gaseous

b. is responsible for phototropism

c. induces femaleness in flowers of cucumber

d. is used for killing weeds (dicots)

e. induces flowering in long-day plants

Solution:

a) Gaseous hormone: ETHYLENE (C_2H_4)

- Only gaseous plant hormone
- Diffuses readily through plant tissues and atmosphere
- Involved in fruit ripening, senescence, and stress responses

b) Responsible for phototropism: AUXIN (IAA)

- Creates differential growth by accumulating on shaded side
- Causes cell elongation leading to bending toward light

- Classic example: coleoptile bending in grass seedlings

c) Induces femaleness in cucumber: ETHYLENE

- Promotes development of female flowers
- Inhibits male flower development
- Used commercially to increase fruit yield in cucurbits

d) Used for killing dicot weeds: AUXINS (synthetic - 2,4-D, 2,4,5-T)

- Selective herbicides affecting dicots more than monocots
- Cause uncontrolled growth leading to plant death
- Basis for "weed-and-feed" lawn care products

e) Induces flowering in long-day plants: GIBBERELLIN

- Can substitute for long-day requirement in many species
- Promotes bolting (stem elongation before flowering)
- Useful for forcing flowers in greenhouse conditions

Enhanced Explanation: These diverse functions illustrate how plant hormones have multiple roles depending on concentration, target tissue, and developmental context. Understanding these relationships has enabled numerous agricultural and horticultural applications.