NARUMALAR ACADEMY – ONLINE COACHING CENTRE

DHARMAPURI

COLLEGE TRB – BIO- CHEMISTRY

DEMO FILE

1. **A barley seed genetically lacks GA receptor (GID1) but produces normal gibberellin levels. On imbibition, what immediate biochemical defect occurs?**
   A. ABA degradation accelerates prematurely.
   B. Lipid conversion in the scutellum increases.
   C. Ethylene accumulates, triggering dormancy.
   D. α-Amylase synthesis in the aleurone fails despite GA presence.
   Answer: D. α-Amylase synthesis in the aleurone fails despite GA presence.
   Explanation: Without GID1 perception, DELLA proteins remain active; GA cannot induce α-amylase synthesis needed for starch hydrolysis.

2. **The triphasic respiration curve during seed germination is altered in anoxic conditions. Which phase disappears first under hypoxia?**
   A. Phase II – metabolic lag.
   B. Phase I – hydration respiration surge.
   C. Phase III – post-germination exponential phase.
   D. None, respiration continues unchanged.
   Answer: C. Phase III – post-germination exponential phase.
   Explanation: Oxidative metabolism for radicle growth requires O_2; Phase III collapses under low oxygen.

3. **Application of fluridone (an ABA synthesis inhibitor) to dormant lettuce seeds in darkness induces germination**

because:

A. Nitrate acts as an alternative hormone.

B. Fluridone increases ethylene synthesis.

C. Reduced ABA levels remove repression on GA-induced α-amylase gene transcription.

D. ABA promotes water uptake in darkness.

Answer: C. Reduced ABA levels remove repression on GA-induced α-amylase gene transcription.

Explanation: ABA normally blocks GA's transcriptional activation of hydrolytic enzyme genes; fluridone relieves this inhibition.

4. **Castor bean endosperm during germination shows high catalase and isocitrate lyase activities but low cytochrome oxidase activity. This pattern reflects:**

   A. Initiation of photorespiration.

   B. Failure of glycolysis.

   C. Predominance of glyoxylate cycle over oxidative TCA cycle.

   D. Nitrogen fixation onset.

   Answer: C. Predominance of glyoxylate cycle over oxidative TCA cycle.

   Explanation: Glyoxysomes conserve carbon skeletons during lipid-to-sugar conversion by bypassing CO_2-losing steps of the TCA cycle.

5. **Imbibition triggers a rapid surge in mitochondrial respiration even before new protein synthesis. The energy mainly fuels:**

   A. Immediate DNA replication.

   B. Repair and reactivation of existing mitochondrial enzymes and membranes.

   C. Lignin biosynthesis.

   D. Protein body formation.

Answer: B. Repair and reactivation of existing mitochondrial enzymes and membranes.

Explanation: Hydration reactivates preexisting mitochondrial structures, fueling recovery processes before new enzyme synthesis begins.

6. **When dormant cereal grains are exposed to nitrate solution, germination occurs even in darkness because nitrate:**
   A. Replaces oxygen in respiration.
   B. Enhances GA biosynthesis via nitric oxide signaling intermediates.
   C. Blocks ABA receptors.
   D. Directly hydrolyzes starch in endosperm.
   Answer: B. Enhances GA biosynthesis via nitric oxide signaling intermediates.
   Explanation: Nitrate-derived nitric oxide activates GA biosynthetic genes, substituting the photoreceptor pathway that normally induces GA.

7. **Ethylene synergizes with GA during germination by:**
   A. Inducing cell wall loosening enzymes in the micropylar endosperm to permit radicle protrusion.
   B. Inhibiting oxygen uptake.
   C. Blocking GA signal transduction.
   D. Promoting ABA accumulation.
   Answer: A. Inducing cell wall loosening enzymes in the micropylar endosperm to permit radicle protrusion.
   Explanation: Ethylene promotes expansin and mannanase synthesis that soften endosperm, complementing GA's reserve mobilization.

8. **In oilseeds, glyoxysomes and mitochondria cooperate to generate sugars for the embryo. Disruption of malate dehydrogenase in glyoxysomes would result in:**
   A. Enhanced CO_2 evolution.
   B. Chlorophyll accumulation.
   C. Failure of succinate export to mitochondria, blocking gluconeogenesis.
   D. Overproduction of oxalate.
   Answer: C. Failure of succinate export to mitochondria, blocking gluconeogenesis.
   Explanation: Glyoxysomal malate dehydrogenase is needed to transfer carbon as malate/succinate to mitochondria for carbohydrate formation.

9. **The first visible sign of germination in a dormant seed exposed to red light is due to:**
   A. Ethylene oxidation.
   B. ABA-induced desiccation tolerance.
   C. Phytochrome Pfr activation leading to GA biosynthesis in the embryo axis.
   D. Inhibition of nitrate reductase.
   Answer: C. Phytochrome Pfr activation leading to GA biosynthesis in the embryo axis.
   Explanation: Red light converts Pr→Pfr form, stimulating GA synthesis, enzyme activation, and embryo elongation.

10. **When cereal embryos are excised and incubated separately, amylase is not induced unless aleurone tissue is also present. This proves that:**
    A. Phytochrome mediates enzyme secretion.
    B. GA acts as a diffusible hormonal signal from embryo to aleurone.

C. Aleurone can germinate independently.
D. ABA is secreted by endosperm.
Answer: B. GA acts as a diffusible hormonal signal from embryo to aleurone.
Explanation: GA diffuses from embryo to aleurone, triggering transcription of hydrolytic enzymes essential for reserve mobilization.

11. **Seeds exposed to desiccation after partial imbibition show poor viability because:**
A. Protein bodies harden cell walls.
B. Lipid droplets crystallize.
C. GA remains active.
D. Active mitochondria generate ROS in absence of repair metabolism.
Answer: D. Active mitochondria generate ROS in absence of repair metabolism.
Explanation: Premature rehydration activates respiration but if dried again, oxidative damage accumulates due to disrupted antioxidant defenses.

12. **In the presence of ABA, the transcription factor ABI5 remains active. This prevents germination by:**
A. Enhancing lipid degradation.
B. Lowering respiration rate.
C. Binding to GA-responsive gene promoters and inhibiting translation of α-amylase mRNA.
D. Blocking cell wall loosening enzymes.
Answer: C. Binding to GA-responsive gene promoters and inhibiting translation of α-amylase mRNA.
Explanation: ABA stabilizes ABI5, which represses GA-induced genes, maintaining dormancy and metabolic quiescence.

13. **Vernalization accelerates flowering in temperate biennials through epigenetic silencing of the *FLC* gene. What molecular change marks this switch?**

A. Histone H3K27 trimethylation of *FLC* chromatin during cold.
B. Acetylation of RUBISCO.
C. Phosphorylation of histone H2A.
D. DNA methylation of chloroplast DNA.

Answer: A. Histone H3K27 trimethylation of *FLC* chromatin during cold.

Explanation: Polycomb repressive complex (PRC2) methylates histones at *FLC*, switching off the floral repressor and enabling flowering post-cold.

14. **Vernalization response is lost if the apical meristem is excised before cold exposure because:**

A. The perception site for cold stimulus resides in meristematic cells undergoing chromatin remodeling.
B. Cold induces photosystem II repair.
C. ABA accumulation occurs in roots.
D. Cold only affects leaves.

Answer: A. The perception site for cold stimulus resides in meristematic cells undergoing chromatin remodeling.

Explanation: Only dividing cells can record epigenetic modifications that translate cold exposure into flowering competence.

15. **When gibberellin synthesis inhibitor (paclobutrazol) is applied to germinating maize seeds, what metabolic effect is observed?**

A. Cytokinin synthesis surges.
B. α-Amylase induction declines due to lack of GA–DELLA signaling.

C. Oxygen uptake increases.
D. ABA catabolism increases.
Answer: B. α-Amylase induction declines due to lack of GA–DELLA signaling.
Explanation: Paclobutrazol blocks GA biosynthesis; DELLA repression persists, so amylase and protease genes remain silent.

16. **Seeds of desert annuals germinate only after rainfall due to the leaching of ABA and nitrate accumulation. Physiologically this exemplifies:**
A. Vernalization.
B. Genetic control independent of hormones.
C. Epigenetic silencing of *FLC*.
D. Environmental modulation of hormone balance determining dormancy break.
Answer: D. Environmental modulation of hormone balance determining dormancy break.
Explanation: Water removes ABA and supplies nitrate—an environmental cue that alters hormone ratio to favor germination.

17. **A mutant lacking lipoxygenase in cotyledons shows delayed germination. The most likely reason is:**
A. Chlorophyll inhibition.
B. Excess GA accumulation.
C. Phytochrome malfunction.
D. Reduced lipid mobilization due to impaired breakdown of triglycerides.
Answer: D. Reduced lipid mobilization due to impaired breakdown of triglycerides.
Explanation: Lipoxygenase catalyzes initial oxidation of fatty acids, linking lipid reserves to β-oxidation and glyoxylate metabolism.

18. **In vernalized Arabidopsis, *VIN3* gene expression precedes *FLC* silencing because:**

A. *VIN3* recruits the polycomb repressive complex for histone methylation.

B. *VIN3* degrades GA.

C. *VIN3* promotes ABA biosynthesis.

D. *VIN3* alters RNA editing in chloroplasts.

Answer: A. *VIN3* recruits the polycomb repressive complex for histone methylation.

Explanation: *VIN3* functions as a cold-inducible chromatin remodeler that initiates PRC2-mediated *FLC* repression.

19. **In germinating seeds, oxygen concentration below 2% inhibits radicle emergence but not water uptake. This reveals that:**

A. GA synthesis is anaerobic.

B. Hydration and metabolism are uncoupled; respiration is essential for energy-dependent growth.

C. Water uptake is ATP-driven.

D. Oxygen blocks ABA transport.

Answer: B. Hydration and metabolism are uncoupled; respiration is essential for energy-dependent growth.

Explanation: Imbibition is passive but radicle protrusion needs ATP from aerobic respiration to drive cell expansion.

20. **When seeds are stored at high temperature and humidity, viability declines rapidly. The main biochemical basis is:**

A. Accumulation of reactive oxygen species causing membrane peroxidation.

B. Loss of GA receptor proteins.

C. Increased chlorophyll degradation.

D. ABA polymerization.

Answer: A. Accumulation of reactive oxygen species causing membrane peroxidation.

Explanation: Seed aging generates ROS leading to lipid peroxidation and protein oxidation, reducing germination potential.

21. **Vernalization response becomes irreversible after transition to flowering because:**

A. *FLC* repression is stably maintained through mitosis by histone mark propagation.

B. ABA replaces GA in signaling.

C. Root respiration increases.

D. Cold sensitivity of apical meristem is lost permanently.

Answer: A. *FLC* repression is stably maintained through mitosis by histone mark propagation.

Explanation: Histone methylation patterns are faithfully transmitted during cell division, locking the plant in flowering mode.

22. **The mobilization of protein reserves in seeds is coordinated with carbon metabolism by:**

A. Co-expression of proteases and gluconeogenic enzymes under GA regulation.

B. ABA-induced protein storage.

C. Formation of glyoxylate intermediates only.

D. Direct oxidation of amino acids in chloroplast.

Answer: A. Co-expression of proteases and gluconeogenic enzymes under GA regulation.

Explanation: GA synchronizes protein degradation with carbohydrate metabolism, ensuring balanced C–N flux for embryo growth.

23. **Application of auxin to germinating seeds does not directly induce α-amylase activity but enhances cell elongation. This indicates:**

A. Auxin blocks respiration.

B. Auxin acts primarily on cell wall loosening and not on reserve mobilization.

C. Auxin activates phytochrome.

D. Auxin is a substitute for GA.

Answer: B. Auxin acts primarily on cell wall loosening and not on reserve mobilization.

Explanation: Auxin promotes cell elongation via acid growth mechanism; GA regulates hydrolytic enzyme synthesis instead.

24. **Vernalization requires continuous cold exposure for several weeks. If the duration is shortened, flowering is incomplete because:**

A. GA degradation accelerates.

B. Epigenetic threshold for stable *FLC* repression is not reached.

C. Cytokinin decreases.

D. ABA rises sharply.

Answer: B. Epigenetic threshold for stable *FLC* repression is not reached.

Explanation: Sustained *VIN3*–PRC2 activity is necessary to fully establish *FLC* chromatin silencing for flowering induction.

25. **In germinating cereal endosperm, Ca^{2+} acts as a secondary messenger after GA stimulation by:**

A. Activating calmodulin-dependent protein kinases that phosphorylate transcription factors for amylase gene expression.

B. Inhibiting proton pumps.

C. Neutralizing ABA.

D. Directly hydrolyzing starch granules.

Answer: A. Activating calmodulin-dependent protein kinases that phosphorylate transcription factors for amylase gene expression.

Explanation: Ca^{2+}/CaM-dependent kinase cascade links GA receptor activation to nuclear gene transcription of hydrolytic enzymes.

References

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