2025 Bi H2 Q9

Section: Sustainability and Interdependence
Topic: Crop Protection

Question Summary:
This question investigates the effect of arsenic contamination and ARB bacteria on pigment levels in plants, interprets carotenoid ratios, explains why carotenoids increase photosynthesis, and asks how absorbed light leads to ATP production.

Worked Solution

(a)(i) Carotenoid content values are approximately: - Soil with no arsenic: 1.0 mg per g - Soil with arsenic: 0.4 mg per g - Soil with arsenic plus ARB: 0.3 mg per g Simple whole number ratio: **10 : 4 : 3**.

(a)(ii) Plants grown in soil with arsenic plus ARB still have lower pigment content than plants in soil with no arsenic. This shows **not all arsenic has been broken down**.

(a)(iii) Carotenoids increase photosynthesis by broadening the range of wavelengths absorbed. They absorb light not captured by chlorophyll and transfer the energy to chlorophyll molecules, **increasing total light absorption**.

(b) Light energy excites electrons in pigment molecules. The electrons pass along an electron transport chain, releasing energy used to pump hydrogen ions. Hydrogen ions flow through ATP synthase, generating **ATP required for carbon fixation**.

Final Answer:
10 : 4 : 3 ratio. Some arsenic remains because pigment levels do not

return to normal. Carotenoids extend the absorption spectrum. Light excites electrons, electron transport releases energy, hydrogen ions drive ATP synthase.

Revision Tips

- Arsenic reduces pigment content and therefore photosynthesis.
- Ratios must be whole number and simplified.
- Carotenoids pass absorbed energy to chlorophyll.
- ATP is produced by ATP synthase after electron transport.