

PLANT PHYSIOLOGY Lecture 8 - Photosynthesis: Dark Reactions

IV. (Continued from last time) Dark reactions

- A. Major purpose - use energy from light reactions to fix CO₂ into organic molecules
- B. Reagents of dark reactions
 - 1. ATP and NADPH
 - 2. CO₂
 - 3. Ribulose biphosphate
 - 4. Enzymes (especially RUBISCO - Ribulose biphosphate carboxylase / oxygenase)
- C. Why fix CO₂?
 - 1. Store and use chemical energy in the form of organic compounds
- D. Steps of CO₂ fixation:
 - 1. CO₂ and H₂O (1 carbon) are added to ribulose biphosphate (5 carbons) to form two molecules of 3-phosphoglyceric acid (3-PGA) (total of 6 carbons)
 - 2. Catalysis of this reaction by RUBISCO
 - 3. 3-PGA is reduced to 3-PGAL with the help of NADPH and ATP
 - 4. 3-PGAL is converted to either fructose diphosphate or, eventually ribulose biphosphate
 - 5. Fructose diphosphate goes to other aspects of metabolism and ribulose biphosphate goes back to the original cycle of CO₂ fixation.

- E. Overall reaction of photosynthesis
$$12\text{H}_2\text{O} + 6\text{CO}_2 \xrightarrow{\text{light}} 6\text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O}$$
- F. Other types of CO₂ fixation - under hot conditions (to prevent O₂ competition)
 - 1. C₄ plants - fix CO₂ by combining it with PEP to form OAA (PEP carboxylase)
 - 2. OAA (Malate after reduction) from mesophyll releases CO₂ to bundle sheath where RUBISCO carries on its usual process)
 - 3. Recyclization occurs when Malate is converted to pyruvate and, subsequently PEP for another round of CO₂ fixation.
- G. Now what happens?
 - 1. We have carbohydrate - a principle form of organic energy
 - a) Respiration will harvest energy and convert it to the universal currency - ATP