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Understanding Photosynthesis and Carbohydrate Movement




Information adapted from "Leaf Canopy Structure and Performance" by M. Carmo Vasconcelos and Steve Castagnoli AJEV Vol. 51(4): 390-396 and presentations of Kevin Ker and Dr. Wendy McFadden Smith




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Photosynthesis

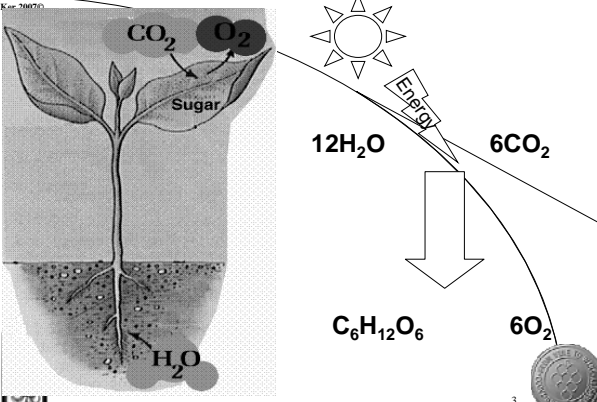
- Absorption of light and retention of light energy
- Conversion of light energy into chemical potential
- Stabilization and storage of chemical potential




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$12\text{H}_2\text{O} + 6\text{CO}_2 + \text{Energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$



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Cellular Respiration

- Mitochondrion breaks down CHO (developed by photosynthesis)
- Captures stored energy in ATP molecules
- ATP used for
 - Biosynthesis
 - Active transport

Chemical energy

$12\text{H}_2\text{O}$ 6CO_2

\uparrow

$\text{C}_6\text{H}_{12}\text{O}_6$ 6O_2

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Factors affecting Photosynthesis

- Leaf Age
- Temperature
- Light levels
- Time of Day
- Leaf orientation
- Sunflecks

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accessory cell

guard cell

vacuole

guard cell

pore

cellulose microfibril

<http://www.botany.uwc.ac.za/ecotree/leaves/images/stomdig.gif>



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Leaf Age

- Young newly expanding leaves
- Leaves at 30 to 45 days
- Leaves at 70 days plus
- Influence of hedging/tipping






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Factors Affecting Photosynthesis

- Leaf Age
 - Young leaf
 - CO₂ compensation point 300 ppm – high demand to meet its own needs
 - Mature leaf
 - 30-40 days after unfolded
 - Optimum photosynthetic activity
 - Respiration rate decreases
 - CO₂ compensation point 20-60 ppm
 - Older senescent leaves
 - Low photosynthetic rates due to low N content






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Temperature

- Optimal temperature ranges
- Influenced by other factors – cv, light levels, stresses
- Typical 75 to 86 F
- 95 to 102 F rapid decline and shut down by temp alone
- Stomatal conductance

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Light Intensity

- Light balance
 - 85% absorbed
 - 9 % transmitted
 - 6% reflected
- Light saturation point (1/3 full sunlight)
- Light Compensation point

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Direct Sunlight Interception by Leaves

Sunlight 1500 units

First layer of leaves
-above light saturation
-Photosynthesis maximum

1500 units

Second layer of leaves
- about 1/3 light saturation
- Photosynthesis 25% of maximum

150 units

Third Layer of leaves
-At compensation
- No net Photosynthesis
- Leaves are drain for CHO

15 units

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Bud break to 4 Leaves

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MCV 1997

