The use of models that use temperature and water availability to predict plant size and plant carbohydrates

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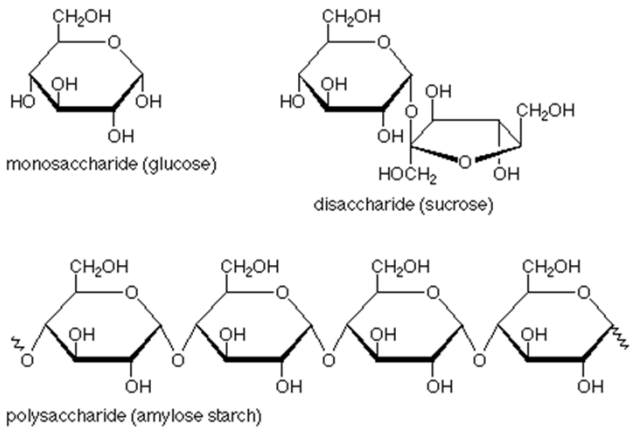
SOUTHERN FOREST NURSERY MANAGEMENT COOPERATIVE

Introduction

- Carbohydrates are the most abundant organic molecule in nature and are the primary energy storage molecule in living organisms
- The simplest carbohydrates are small molecules known as sugars, larger carbohydrates are composed of sugars joined together.
- There are three kinds of carbohydrates:
  - Monosaccharides: single or simple sugars such as ribose, glucose and fructose and consist of 1 sugar molecule
  - Disaccharides: contains two sugar subunits linked covalently. Examples include sucrose, maltose, and lactose
  - Polysaccharides: contains many sugar subunits linked together. Examples include cellulose and starch



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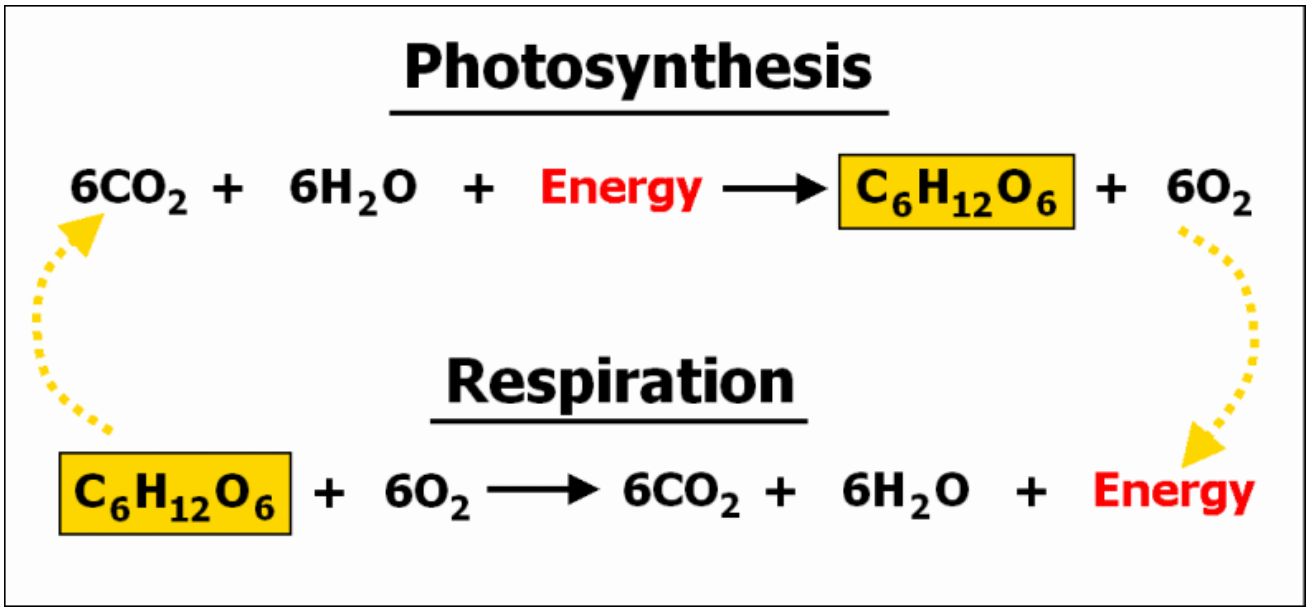

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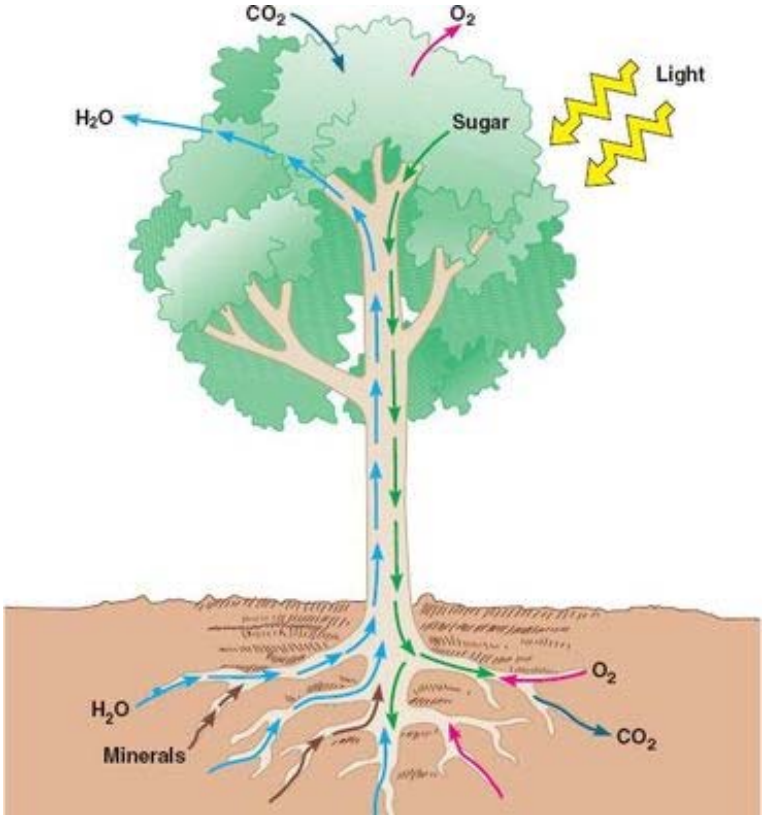
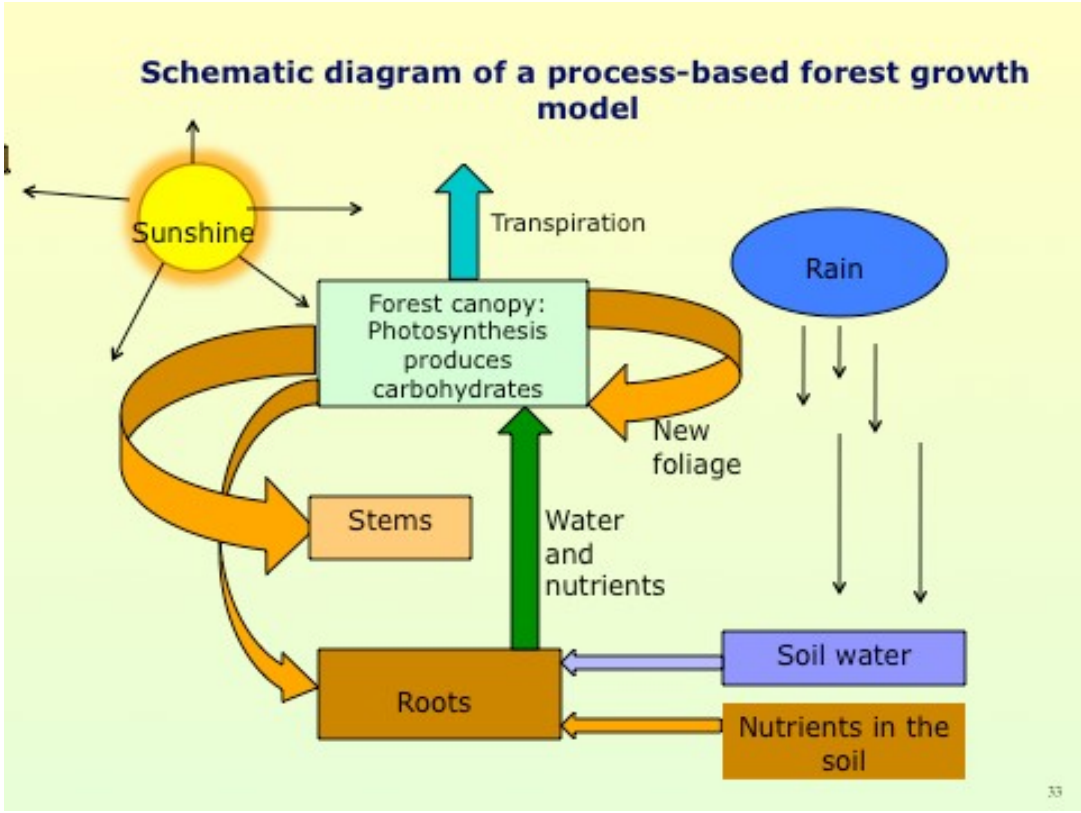
Photosynthesis



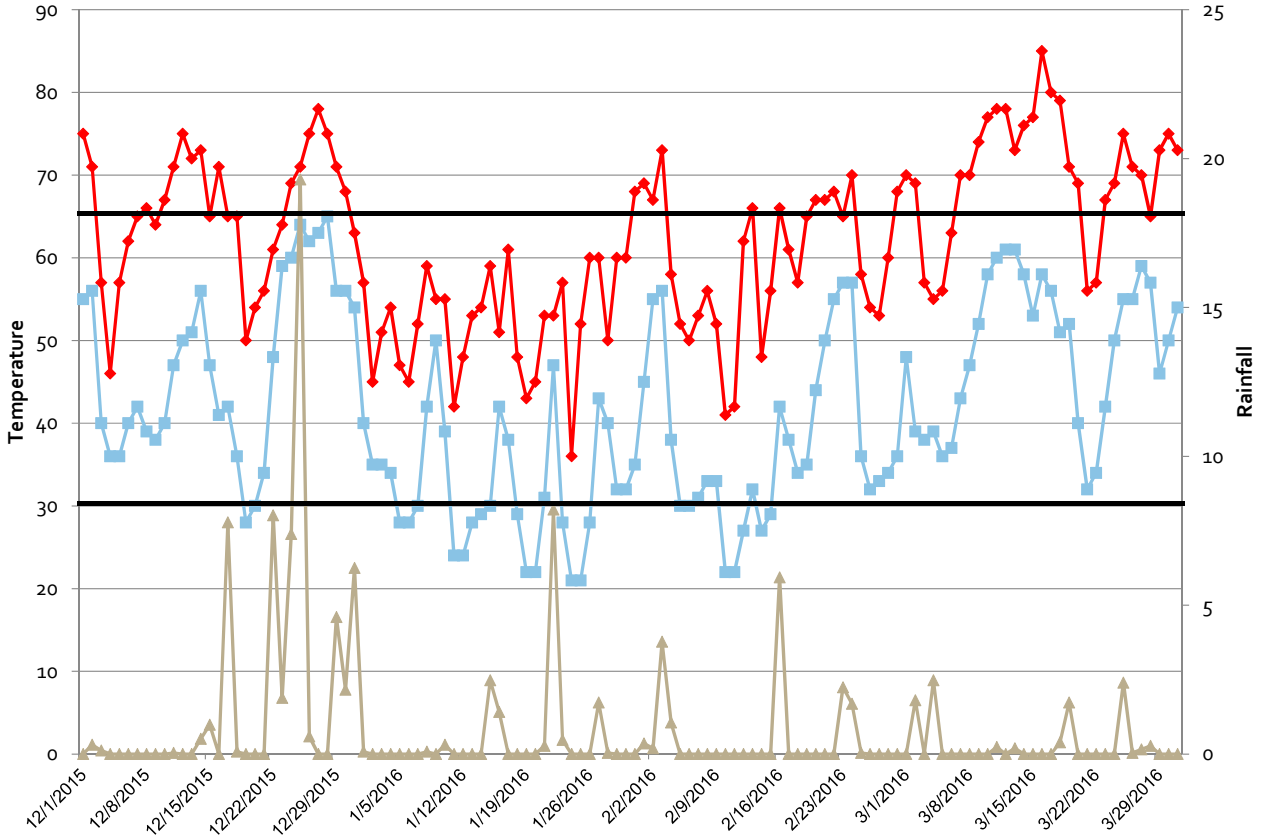


https://islandpress.org

Introduction

- Carbon reserves are important for maintaining tree function during and after stress.
- Carbohydrate storage buffer the tree during periods of low carbon gain relative to carbon use.
- Excess sugars accumulate as non structural starch when carbon production exceeds growth demands.
- Starch accumulates during active photosynthesis and then mobilized and exported as sucrose for respiration.
- Conifers accumulate non-structural carbohydrates in needles prior to bud-break, and mobilize them during the initiation of shoot growth.
- A decrease in starch content reflects a carbon sink of the tree in relation to the production of photosynthate.
- A starch deficit aboveground will lead to a decline in productivity

Temperature and Rainfall

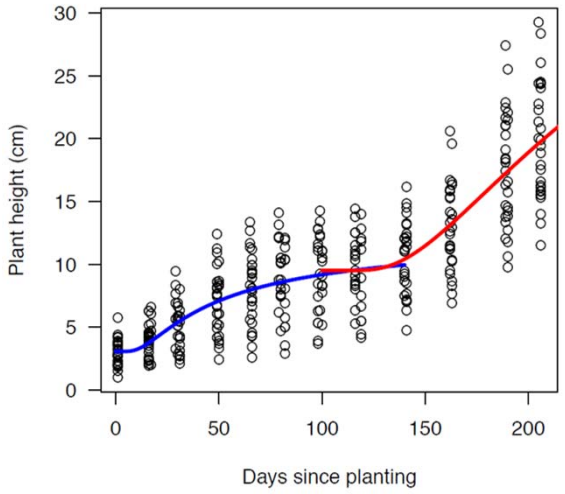


Proposed study

- Climate models predict global increases in drought frequency, intensity and duration.
- Stomatal closure occurs during drought conditions to prevent desiccation and hydraulic failure but also reduces photosynthetic carbon uptake.
- The degree in which environmental stress management practices impact carbohydrate distribution is of increasing concern as plantation management intensifies.
- Understanding the impact of nursery management practices on carbon storage in seedlings can lead to improved long-term productivity.
- There is a need to quantify the effects of water availability on whole tree carbohydrate budgets from the seedling growth stage and determine allocation patterns of storage of carbohydrates for loblolly pine.

Proposed study

- Information obtained will allow one to develop seedling growth models as a function of environmental variables
- Characterize the way trees acquire carbohydrates
- Can measure the amount of carbohydrates lost with top-pruning practices.
- Provides information as to whether seedlings have enough carbohydrates to survive in field.
- Determine how to carbohydrate load a seedling
- Potential survival, based on stress vs water deficit
  - Plantation Management Research Coop will undertake this aspect



Methodology

- Tissue samples will be collected monthly
- Three levels of planting stress
  - No water stress – seedling to be watered
  - Water stress: +30% and -30%
- Track seedlings from germination until planting
- Measurements include:
  - Photosynthetic active radiation
  - Monitoring soluble carbohydrates in roots and shoots overtime