Final Technical Report

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by

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Title
Photosynthetic acclimation to elevated carbon dioxide: Basis for variability among plants.

Keywords
Assimilate partitioning, CO₂ enrichment, growth, photosynthesis, sink-strength, acclimation, soybean, *Glycine max*

Objective
Investigate the acclimation phenomena involved in plants as they adjust to a CO₂ enriched atmosphere.

Approach
Grow plants under various CO₂ concentrations in the controlled chambers of the Duke University Phytotron. Control soil nutrients, irradiance, temperature, soil water, and atmospheric relative humidity. Measure photosynthesis, leaf structure, leaf biomass of photosynthetic leaves or leaflets and of growth points that are not assimilating CO₂ to determine contributions of carbon source tissues to sink tissues. Specifically examine export and import rates following movement of plants into atmospheres of higher carbon dioxide concentration.

Results
Net CO₂ exchange rate (CER) immediately increased and remained elevated in high CO₂. Initially, the additional assimilate at high CO₂ levels in the light was utilized in the subsequent dark period. After approximately 7 days, assimilate export in the light began to increase and by 12 days reached rates 3 to 5 times that of the control. In the developing leaves, high rates of export in the light occurred as the leaf approached full size.

Conclusions
A specific acclimation process occurs in photosynthetic source leaves which increases the capacity for assimilate export in the light phase of the diurnal cycle as plants adjust to enriched CO₂ and a more rapid growth rate. Future efforts to model plant responses to increasing atmospheric carbon dioxide will have to incorporate this phenomenon to successfully predict plant growth in a high CO₂ world.
Deliverables