Mitigation of Decreased Protein Synthesis Under Elevated Carbon Dioxide in Arabidopsis thaliana Using Transgenic and Exogenous Approaches

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The purpose of this experiment is to evaluate two transgenic and one exogenous approach to ameliorating decreased protein synthesis under elevated carbon dioxide (CO2) in A. thaliana, as well as evaluate the role of previously implicated pathways in the phenomena through metabolite analysis. Previous research has shown that competition between carbon assimilatory and nitrogen assimilatory processes for the reductant reduced ferredoxin has led to decreases in nitrogen assimilation under elevated CO2, a condition that upregulates carbon assimilatory processes. Knocking down ferredoxin:NADP-reductase (FNR) may decrease the competition for reductant, and yield loss by lack of NADPH may be compensated by greater amounts of available carbon. Peroxisomal senescence has also previously been observed as an effect of elevated CO2. Agrobacterium-mediated transformation of A. thaliana with the IPT8 gene, encoding the cytokinin producing enzyme isopentenyl transferase, may prevent senescence and maintain peroxisomal integrity. Exogenously supplementing subjects with the synthetic cytokinin, 6-benzylaminopurine (6-BAP) may yield similar effects. Under a constructed elevated CO2 (850ppm) environment, the FNR mutant had significantly decreased mass and significantly greater glutamate and protein than eCO2-wildtype but not aCO2-wildtype. Supplementation with 6-BAP caused growth inhibition at aCO2 but not at eCO2, and 6-BAP subjects contained significantly greater glutamate and protein levels than eCO2 wild type. IPT8 similarly increased glutamate and protein levels but did not induce growth inhibition at either CO2 concentration, supporting its viability in increasing protein without sacrificing yield. A positive correlation between photorespiration and peroxisomal health was observed.

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