

SKIP COS 47-6: Effects of elevated CO₂ and O₃ on Aspen carbon and nitrogen metabolism in aspen at the aspen FACE (Free-Air Carbon Dioxide Enrichment) study site

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Background/Question/Methods The objective of the present study was to evaluate the long-term (10 years) effects of elevated CO₂ and O₃ on the carbon and nitrogen metabolism of aspen trees. The study was conducted at the Aspen Free-Air Carbon Dioxide Enrichment (FACE) experimental site, Rhinelander, WI, (USA). The Aspen FACE experiment started in 1998 when 12 experimental rings planted in 1997 underwent four different open air treatments; i.e. control, elevated CO₂ (560 ppm), elevated O₃ (1.5x ambient concentration), and elevated CO₂ (560 ppm) + O₃ (1.5x ambient). Details on the layout of the plots, the treatments, and summaries of various studies are given at <http://aspenface.mtu.edu>. In our study, foliage samples of trembling aspen (*Populus tremuloides* Michx.) were collected during summer in 2006, 2007 and 2008 from each of three clones; namely, 216 (O₃ tolerant), 271 (intermediately O₃ tolerant) and 259 (O₃ sensitive) within the aspen only sector of each ring. Each year, 36 samples were collected per clone (3 per ring x 3 rings/treatment x 4 treatments). Samples from the three years were analyzed separately for N containing organic compounds (polyamines, amino acids, chlorophyll and soluble proteins) using HPLC and spectrophotometric methods. The results described below are based on average of three year data.

Results/Conclusions Under control conditions, O₃ tolerant clone 216 had the highest concentrations of N-rich foliar metabolites (putrescine, glutamic acid, arginine, proline, and GABA) that typically increase in response to abiotic stress. In contrast, the sensitive clone 259 had the lowest concentrations of these metabolites. With a few exceptions, stress related N metabolites in all clones varied similarly in response to treatments. One exception was the response of the O₃ sensitive clone 259 when exposed to O₃, as there was an increase in cellular concentrations of soluble proteins, proline, glycine, and serine with concomitant reduction in chlorophyll. When comparing clone 271 to clone 216, the observed lower concentrations of putrescine and GABA combined with published data on lower isoprene emissions and faster growth of clone 271 support the hypothesis that clone 271 has a growth dominated strategy (i.e. allocation of extra C to growth relative to N). Tolerant clone 216, on the other hand, allocated more C to secondary metabolites and to processes other than growth; and thus was more tolerant to O₃ stress at the expense of reduced growth. The ratio of common polyamines (spermidine: putrescine) was also another good predictor of overall growth differences between the two clones.

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