

ROOT GROWTH AND RESPIRATION OF ASPEN IN RESPONSE TO OZONE AND ELEVATED CARBON DIOXIDE

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The response of tree root systems to interacting environmental stress is poorly understood in comparison to knowledge of above-ground organs. This research investigates the effect of ozone (O_3), elevated carbon dioxide (CO_2) and their combination on root system growth and respiration. Adventitiously rooted cuttings of three aspen clones (271, O_3 tolerant; 216, intermediate; 259, O_3 sensitive) were grown in 7 l pots containing peat:sand:vermiculite (2:1:1). Plants were placed in treatment chambers and exposed to either ambient air (control), ambient + 350 ppm CO_2 , 160 ppm O_3 (8 h daily), elevated CO_2 and O_3 . Root respiration was measured by sealing the entire pot into the measurement cuvette of an open-flow gas exchange system. Roots and soil were then separated; roots were dried and weighed, and soil was returned to pots and remeasured to estimate heterotrophic soil respiration. After 12 weeks, O_3 treatment caused up to a 48 percent decrease in root dry weight with a corresponding 53 percent decrease in root system respiration rate ($\mu\text{mol plant}^{-1} \text{s}^{-1}$) compared with control treatments. Changes in root dry weight and respiration rate generally followed the O_3 sensitivity rankings of the clones. In contrast, elevated CO_2 vs. control caused up to a 63 percent increase in root dry weight and a 47 percent increase in root system respiration; again there were big clonal differences in responses. Compared to the control treatment, there was no net change in root weight due to the combined O_3 and elevated CO_2 treatment yet root system respiration declined slightly. When specific root respiration rate ($\mu\text{mol g}^{-1} \text{s}^{-1}$) was calculated, there were no consistent treatment effects; however specific root respiration declined as plants aged, and interesting clonal differences were also observed. For clones 216 and 259, specific root respiration generally increased with either O_3 or elevated CO_2 in 12-week-old plants, but for clone 271 specific root respiration decreased with treatment. These results show that above-ground environmental stress affects the growth and physiology of aspen roots in complex ways, and the particular response obtained has a strong genetic component.

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