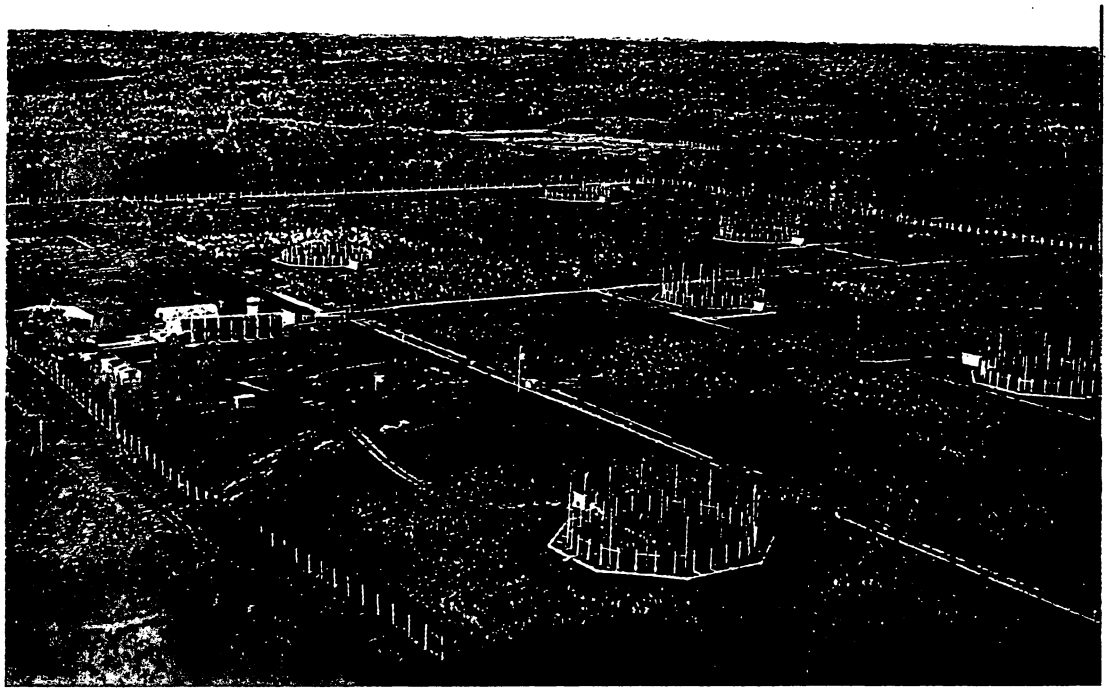
Air Pollution, Global Change and Forests in the New Millennium

The 19th International Meeting for Specialists in Air Pollution Effects on Forest Ecosystems

May 28-31, 2000

Michigan Technological University, Houghton, Michigan, USA



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Introduction

As IUFRO Division 7 (Forest Health) coordinator and a long-time participant and former deputy coordinator of 7.04 "Genetic Aspects of Air Pollution and Climate Change", it is my pleasure to welcome all participants to this 19th meeting of air pollution specialists. We are anticipating lively discussions from our nearly 100 participants who represent some 25 countries.

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Consequences of elevated levels of atmospheric CO_2 and O_3 for growth of *Populus tremuloides* clones: The role of competition

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Abstract

Concomitant increases in atmospheric CO_2 and O_3 are expected to impact temperate forest ecosystems. Free air CO_2 and O_3 enrichment (FACE) was used to examine the interactive effects of these gases on shoot growth responses of quaking aspen grown in an experimental system (FACTS-II, Aspen FACE) in northern Wisconsin. A central goal was to examine how the interactions of atmospheric treatments and genotype impact competitive relations among genotypes. Several aspen clones with differing sensitivities to CO_2 and O_3 were planted in randomized mixtures within half of each 30 m diameter FACE ring, with 3 replications of each combination of low and high levels of CO_2 (ambient and 56 Pa) and O_3 (ambient and 1.5×ambient). We hypothesized that several factors, apart from atmospheric treatments, will have strong effects on individual tree growth in this system, such as genotypic potential, initial size, and competitive status. We non-destructively measured tree size and estimated annual biomass increments. A competitive index for each individual tree at the beginning of the growth interval was calculated using the ratio of its size to the average size of adjacent neighbors. We tested treatment effects using initial size as a covariate and competitive index divided into representative categories was evaluated as a class variable nested within clone. In 1998, effects of CO_2, O_3 and their interaction were not significant, but O_3×clone and O_3×competitive index interactions were significant. In 1999, CO_2×O_3×competitive index interactions were highly significant, so we tested treatment effects within competitive index categories where individuals are competitively disadvantaged, neutral or advantaged in terms of size relative to their neighbors. Main effects and interactions of CO_2 and O_3 became larger and more significant as competitive index increased. At high competitive indices, elevated CO_2 increased net growth in 1999 by 29% ($p<0.01$), compared with an 11% (ns) increase at low competitive indices. Elevated CO_2 exacerbated growth responses to elevated O_3 exposure. Overall, elevated O_3 decreased growth 34% in elevated CO_2 compared with 24% in ambient CO_2 (CO_2×O_3 $p=0.003$). Significant clone×treatment interactions were limited to competitive indices reflecting moderately suppressed conditions. Competition effects in these mixed clonal stands have emerged before canopy closure, and long-term competitive outcomes may depend on the interactive effects of atmospheric CO_2 and O_3 levels.

Key words: Quaking aspen, elevated CO_2, ozone, growth, competition

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