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Quantifying the Impacts of Elevated CO2 and N Fertilization on Wood Density in Loblolly Pine

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Abstract : It is accepted that atmospheric CO2 concentration will increase in the future. For the past 30 years, researchers have used FACE (Free-Air Carbon Dioxide Enrichment) facilities to study the development of terrestrial ecosystems under elevated CO2 (eCO2). Forest responses to eCO2 are likely to impact timber industries with potential feedbacks towards the atmosphere. The main objectives of this study were to examine whether eCO2 alone or in combination with N-fertilization alter wood properties and to identify changes in wood anatomy related to water transport. Wood disks were sampled at breast height from mature loblolly pine trees (Pinus taeda L.) harvested at the Duke FACE site (NC, USA). By measuring ring width and intra-ring changes in density (X-ray densitometry) and tracheid size (lumen and cell wall thickness) from pith to bark, the following hypotheses were tested: 1) eCO2 and N-fertilization interact positively to increase significantly above-ground primary productivity; 2) eCO2 and N-fertilization lead to a decrease in density; 3) eCO2 and N-fertilization increase lumen diameter and decrease cell wall thickness, thus affecting water transport capacity. Our results revealed a boost in earlywood tracheid production induced by eCO2 lasting a few years. The following decrease seemed to be buffered by N-fertilization. X-ray profiles did not show a marked decrease in wood density under eCO2 or N-fertilization, although there were changes in cell anatomical properties such as a reduction in cell-wall thickness and an increase in lumen diameter. If such effects of eCO2 are confirmed, forest management strategies for example N-fertilization should be redesigned.

Keywords : wood density, Duke FACE (free-air carbon dioxide enrichment), N fertilization, tree ring
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