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Nitrogen Dioxide in the Urban Forest: Exposure and Uptake

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Abstract
Nitrogen dioxide (NO₂) levels were measured inside and adjacent to canopies of urban trees in Springfield, MA, over two growing seasons. Nitrogen dioxide levels were consistently and significantly higher inside tree canopies compared to levels outside. During the second growing season, ozone (O₃), temperature, and relative humidity (RH) were also measured using samplers co-located with the NO₂ samplers. Ozone levels were significantly lower inside the canopy whereas temperatures were higher inside the canopy, and RH was not different between inner and outer canopy locations. The results corroborate theoretical models predicting elevated NO₂ and depressed O₃ levels inside tree canopies based on photochemistry, but put into question the mechanisms involved in generating these levels.

In a separate study, the use of a common urban street tree (*Acer rubrum*) as a tool for measuring NO₂ uptake under field conditions was evaluated using a model previously applied only to potted herbaceous plants and

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coniferous trees. Using potted saplings of *A. rubrum* located at locations with high or low NO₂ levels in Springfield, MA, and Amherst, MA, we measured 15N stable isotope signatures ($\delta^{15}\text{N}$) and total N (%N) of leaves throughout the growing season. There was no significant difference in leaf $\delta^{15}\text{N}$ or %N change between sites over the course of the season. Changes in $\delta^{15}\text{N}$ were likely the result of input from N sources in the nutrient solution. Changes in %N followed a natural seasonal decline reported elsewhere in the literature. The study highlights the difficulties in applying this particular model to deciduous trees and suggests work needed to overcome these challenges.

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