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Research paper

Urban environment of New York City promotes growth in northern red oak seedlings

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Urbanization is accelerating across the globe, elevating the importance of studying urban ecology. Urban environments exhibit several factors affecting plant growth and function, including high temperatures (particularly at night), CO_2 concentrations and atmospheric nitrogen deposition. We investigated the effects of urban environments on growth in *Quercus rubra* L. seedlings. We grew seedlings from acorns for one season at four sites along an urban–rural transect from Central Park in New York City to the Catskill Mountains in upstate New York (difference in average maximum temperatures of 2.4 °C; difference in minimum temperatures of 4.6 °C). In addition, we grew *Q. rubra* seedlings in growth cabinets (GCs) mimicking the seasonal differential between the city and rural sites (based on a 5-year average). In the field experiment, we found an eightfold increase in biomass in urban-grown seedlings relative to those grown at rural sites. This difference was primarily related to changes in growth allocation. Urban-grown seedlings and seedlings grown at urban temperatures in the GCs exhibited a lower root : shoot ratio (urban ~0.8, rural/remote ~1.5), reducing below-ground carbon costs associated with construction and maintenance. These urban seedlings instead allocated more growth to leaves than did rural-grown seedlings, resulting in 10-fold greater photosynthetic area but no difference in photosynthetic capacity of foliage per unit area. Seedlings grown at urban temperatures in both the field and GC experiments had higher leaf nitrogen concentrations per unit area than those grown at cooler temperatures (increases of 23% in field, 32% in GC). Lastly, we measured threefold greater ^{13}C enrichment of respired CO_2 (relative to substrate) in urban-grown leaves than at other sites, which may suggest greater allocation of respiratory function to growth over maintenance. It also shows that lack of differences in total R flux in response to environmental conditions may mask dramatic shifts in respiratory functioning. Overall, our findings indicating greater seedling growth and establishment at a critical regeneration phase of forest development may have important implications for the ecology of urban forests as well as the predicted growth of the terrestrial biosphere in temperate regions in response to climate change.

Keywords: allocation, photosynthesis, *Quercus rubra*, respiration, temperature, urbanization.

Introduction

Urbanization is accelerating across the globe, with city dwellers accounting for half the population worldwide (Pickett et al. 2001). The question of how the urban environment affects local plants and wildlife is becoming increasingly important. Urban plants affect local climate, biogeochemical cycling, wildlife habitat and quality of life for city dwellers. Additionally, they sequester anthropogenically produced carbon dioxide and may partially offset a city's carbon footprint. Lastly, urban environments may