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Variation in Fine Root Morphology Among 25 Tree Species in Two Northeastern Forests

A comprehensive understanding of plants' impacts on ecosystems requires studying the form and function of belowground traits, particularly the resources allocated to the ephemeral fine roots of woody plants. Variation in fine root phenotypes was examined across 25 species of mature forest trees in Black Rock Forest, New York, and the Pennsylvania State Experimental Forest, Pennsylvania. Fine roots were grown in pots installed under each tree for three months and additional unmanipulated root tissue was collected from the surrounding soil. The specific root length (SRL), mean diameter, root tissue density and frequency of tips were measured for the first and second order roots of each sample. There was a significant species effect for all four traits measured: SRL ($P<0.0001$), mean diameter ($P<0.0001$), tissue density ($P<0.0001$), and tip frequency ($P=0.0045$). These patterns held across both forests and there was no significant site effect, suggesting that fine root morphology is species specific despite local environmental differences. There was a significant manipulation effect: roots grown in pots had a lower density ($P<0.0001$) and a higher SRL ($P<0.0001$) than the roots gathered directly from the soil, but there was no difference in mean diameter or tip frequency between the two treatments. Since mean diameter ($P<0.001$) and tissue density ($P<0.001$) are significantly correlated with SRL, the higher SRL in pot grown roots can be attributed mainly to changes in tissue density. This could be due to different water contents between the two treatments or a different degree of mycorrhizae colonization. By improving our understanding of root form and function, such studies may be important for improving efforts to model ecosystem-level effects of rapid climate change and shifts in vegetation boundaries.