Eissenstat D. M., C. E. Wells, R.D. Yanai and J. L. Whitbeck. Building Fine Roots in a Changing Environment: Implications for Root Longevity. ***New Phytologist.***

SUMMARY

Root turnover is important to the global carbon budget as well as to nutrient cycling in ecosystems and to the success of individual plants. Predicting the effect of environmental change on root turnover is limited by the difficulty of measuring root dynamics, but evidence is emerging to suggest that roots, like leaves, possess suites of interrelated traits that are linked to root lifespan. In graminoids, high tissue density has been linked with increased root longevity. Other studies have found root longevity positively correlated with mycorrhizal colonization, and negatively correlated with nitrogen concentration, root maintenance respiration and specific root length (SRL). In fruit trees, apple rootstocks, which have roots characterized by relatively small diameter, low tissue density, and low lignification of the exodermis have much shorter longevity than roots of citrus with opposite traits. Likewise, within the branched network of fine roots in the root system of a plant, the finest roots with no daughter roots are associated with higher nitrogen concentrations, faster maintenance respiration, higher SRL and shorter longevity than secondary and tertiary roots that bear daughter roots. Mycorrhizal colonization can enhance root longevity by diverse mechanisms, including greater tolerance of drying soil and greater defense against root pathogens. The various aspects of root construction, including root diameter, tissue density, nitrogen concentration, mycorrhizal fungal colonization and accumulation of secondary phenolic compounds, consequently, all may affect root longevity. These root traits are highly plastic and strongly affected by resource supply (e.g., CO2, N, P and water). Consequently, predicting how changes in resource availability associated with global climate change will affect root longevity can be approached from a functional perspective of how the resources will affect root construction and physiology. A cost-benefit approach to predicting root longevity assumes that a plant maintains a root only until the efficiency of resource acquisition is maximized. Using an efficiency model, we show that reduced tissue N concentration and reduced root maintenance respiration, predicted to result from elevated CO2, should lead to slightly longer root lifespans. Complex interactions with soil biota and shifts in plant defenses to root herbivory and parasitism, which are not included in the present efficiency model, may amplify the potential importance of future climatic changes on root longevity.