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Seasonal dynamic of fine root traits are influenced by age and precipitation in subtropical forests

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Abstract:
Roots are important for tree growth and forest carbon cycle, with biomass accounted for 30% to 80% of annual net productivity of various forest ecosystems. Among underground biomass components of forest, fine roots of trees were the most active and sensitive part in responding to environmental change and were crucial in forest carbon estimation and modeling. Although there were many investigations on forest root around the world, dynamics of fine roots in subtropical forest in Asian monsoonal continental climate were rarely reported, and their response to environment change could play important roles in forest carbon cycling under climate change scenarios.
Four widely distributed subtropical tree species, i.e. Machilus pauhoi, Symplocos sumuntia, Sapium discolor, and Vernicia fordii were investigated, and six individuals of each tree species were monitored in Dagang Mt., Jiangxi Province in south China. By recording Minirhizotron and sampling soil volume around trees with different ages for one year, data of six functional traits of fine roots were obtained and statistics were conducted using R. We reach following conclusions:
1. Vertical distribution of fine root biomass.
Biomass of fine root decreased along soil depth, with 68.63% to 79.62% appeared in upper soil layer (0[U+FF5E]20cm). Age of individuals of different tree species also had influences on fine root occurrence in forest underground, and the two deciduous species (Sapium discolor, Vernicia fordii) own lower amount of fine root biomass compared to two evergreen species (Machilus pauhoi, Symplocos sumuntia).
2. Monthly dynamics of fine root biomass.
Clear pattern of fine root biomass were detected for various tree species during 12 months in 2014. Unimodal patterns were common in four tree species while fluctuation of monthly biomass among individual trees varied in four species. Significant difference between monthly biomass of young and old tree were found by paired t-test.
3. Turnover rate of fine root.
Overall, the turnover rate of fine root production was bigger than root death in four species except the young individuals of Machilus pauhoi. Neither soil depth nor age of tree individuals had significant effects on the turnover rates statistically.
4. Effects of climate on fine root production
Association test between climate and fine root biomass showed that monthly rainfall were related with biomass in significance while monthly temperature did not. The results remained after accounting for tree age, suggesting precipitation is the key for fine root biomass production in subtropical forests.
5. Difference of fine root traits beyond biomass
Other functional traits of fine roots were influenced by identity of tree species in addition to individual age with various degree. For instance, significant difference were found on specific root length and tissue density in Sapium discolor, and diameter, surface area and tissue density were found in Vernicia fordii, suggesting fine root dynamics of different species responded to environment with subtle difference thus might involve different mechanism in forest nutrition cycling.
Key Words fine root, functional trait, Minirhizotron, subtropical forest

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