

The size and the age of the metabolically active carbon in tree roots

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Abstract

Little is known about the sources and age of C respired from tree roots. Previous research in tree stems has identified two functional pools of non-structural carbohydrates (NSC): an ‘active’ pool supplied directly from canopy photo-assimilates that supports metabolism and a ‘stored’ pool used when fresh C supplies are limited. We compared the C isotope composition of water soluble NSC and respired CO₂ for aspen roots (*Populus tremula* hybrids) that were cut off fresh C supply via stem-girdling and prolonged incubation of excised roots. We used bomb radiocarbon to estimate the time elapsed since C fixation for respired CO₂, water-soluble C, and structural α -cellulose. While freshly excised roots respired CO₂ with mean age <1 yr, within a week the age increased to 1.6-2.9 yr. Freshly excised roots from trees girdled ~3 months previously had similar respiration rates and NSC stocks as un-girdled trees, but respired older C (~1.2 yr). We estimate the NSC in girdled roots must be replaced 5-7 times by reserves remobilized from root-external sources. Using a mixing model and observed correlations between $\Delta^{14}\text{C}$ of water-soluble C and α -cellulose, we estimate ~30% of C is ‘active’ (~5 mg C g⁻¹).

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