

# **Why are non-photosynthetic tissues generally $^{13}\text{C}$ enriched compared to leaves in C3 plants? Review of current hypotheses and opportunities for compound-specific isotopic analyses**

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Non-photosynthetic, or heterotrophic, tissues in C3 plants tend to be enriched in  $^{13}\text{C}$  compared to the leaves that supply them with photosynthate. This isotopic pattern has been observed for woody stems, roots, seeds and fruits, emerging leaves, and parasitic plants incapable of net  $\text{CO}_2$  fixation. Unlike in C3 plants, roots of herbaceous C4 plants are generally not  $^{13}\text{C}$ -enriched compared to leaves. In this talk, I will review a number of hypotheses aimed at explaining this isotopic pattern: 1) differential use of day versus night sucrose between leaves and sink tissues, with day sucrose being relatively  $^{13}\text{C}$ -depleted and night sucrose  $^{13}\text{C}$ -enriched; 2) isotopic fractionation during dark respiration; 3) carbon fixation by PEP carboxylase; and 4) developmental variation in photosynthetic discrimination against  $^{13}\text{C}$  during leaf expansion. By enabling direct tests of these hypotheses, compound-specific carbon isotope analyses could play an important role in elucidating the physiological mechanisms underlying  $^{13}\text{C}$  enrichment of heterotrophic tissues.