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Contribution of Different Carbon Sources to Isoprene Biosynthesis in Poplar Leaves

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Abstract

Isoprene is the most abundant VOC emitted by plants and in particular by trees. Leaf isoprene formation is closely linked to photosynthesis by dynamic use of recently fixed photosynthetic precursors in chloroplast. Under steady state conditions in a $^{13}CO_2$ atmosphere, only approximately 75 % of isoprene became isotopically labelled within minutes. The source of unlabelled carbon is suggested to be from extra-chloroplastidic and/or starch degradation.

To test whether these alternative carbon sources - leaf internal carbon pools and xylem-transported carbohydrates - contribute to leaf isoprene formation in poplar (Populus x canescens), proton-transfer-reaction-mass spectrometry (PTR-MS) was used to follow on-line ^{13}C-labelling of the emitted isoprene.

The results support the idea that beside photosynthetically fixed CO_2 other carbon sources are used for isoprene formation, contributing to 20 – 30 % of carbon atoms incorporated into isoprene. A considerable part of this alternative carbon may be derived from xylem transported carbohydrates (shown by feeding poplar leaves with [U-^{13}C]glucose via the transpiration stream). As a consequence of this treatment 8 to 10 % of the carbon was emitted as ^{13}C-labelled isoprene. The data provide clear evidence of a dynamic exchange of carbon between different cellular precursors for isoprene biosynthesis and an increasing importance of these alternative carbon pools

under conditions of limited photosynthesis.