

# NATURAL VARIATIONS OF THE $^{13}\text{C}/^{12}\text{C}$ SIGNATURE OF LEAF NOCTURNAL RESPIRATION IN *FAGUS SYLVATICA* BRANCHES RELATED TO PREVIOUS DAY PHOTOSYNTHESIS

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Leaf respiration represents about a quarter of total plant carbon loss. Understanding the dynamics of this flux and identifying its substrates is therefore a prerequisite for an accurate description of the carbon budget of terrestrial ecosystems. The  $^{13}\text{C}/^{12}\text{C}$  ratio of nocturnal leaf respiration ( $\delta^{13}\text{C}_{\text{noc}}$ ) is one of the few signals that can provide clues on the dynamics of leaf non-structural carbohydrate pools in the field and their use for leaf respiration. However, the physiological mechanisms driving long- and short-term dynamics of  $\delta^{13}\text{C}_{\text{noc}}$  are not straightforward, given likely impacts of post-photosynthetic fractionations, temporal dynamics in putative respiratory substrates and the modulation of the latter two by environmental drivers, such as temperature. Progress in laser spectrometry technology now enables high-frequency measurements of  $\delta^{13}\text{C}_{\text{noc}}$  in the field and hence supports the pursuit for a better mechanistic understanding of nocturnal leaf respiration. Here, we present continuous, hourly measurements of nocturnal respiration ( $R_{\text{noc}}$ ) and  $\delta^{13}\text{C}_{\text{noc}}$  on leafy branches of three mature *Fagus sylvatica* trees from a temperate mixed-deciduous forest in Switzerland. These measurements were conducted with open branch chambers and a laser spectrometer for  $\text{CO}_2$  isotopologue measurements (QCLAS-ISO, Aerodyne Research Inc.) in August and September during two consecutive years (in total 38 and 60 days). The data was then analysed for trends occurring over the course of individual nights and for trends from one night to the next. Night-to-night variation in flux-weighted means of  $\delta^{13}\text{C}_{\text{noc}}$  was clearly linked to previous day photosynthetic  $^{13}\text{C}$  discrimination, measured by the same chambers. This link was, however, modified by the strength of previous-day photosynthesis. For a large fraction of measured nights,  $\delta^{13}\text{C}_{\text{noc}}$  decreased progressively over the course of the night (up to  $0.7\text{‰ hour}^{-1}$ ). This trend was analysed with regard to concurrent dynamics of  $R_{\text{noc}}$ , leaf temperature and previous-day environmental conditions. Collectively, these results allowed us to draw a clearer picture of leaf respiratory processes of *F. sylvatica* branches in the field.