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In situ assessment of seasonal variation of assimilated carbon transfer to biochemical compounds by tracing ^{13}C after pulse labelling on *Quercus petraea*

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Soil–vegetation–atmosphere transfer models suffer from a lack of mechanistic integration of carbon allocation. Allocation of assimilated carbon among organs and more specially to biochemical compounds is affected by the environment and affects tree growth, the contribution of each organ to autotrophic respiration, and, in fine, carbon sequestration in the ecosystem.

The aim of this study (ANR CATS) was to assess the seasonal evolution of the contribution of assimilated carbon to leaf, stem and root biochemical compounds and the contribution of photo-assimilates to leaf exportation and autotrophic respiration. In situ ^{13}C pulse labeling of 10–15 m tall trees was conducted in the field on six sessile oak (*Quercus petraea*) throughout the growing season (i.e. in May, July and September). Leaf, stem and root ^{13}C content of starch, soluble sugars, structural matter and total organic matter was analyzed during 30 days after labeling. ^{13}C content in leaf respired CO_2 was also determined

In leaves, the proportion of ^{13}C allocated to total organic matter decreased in average by 48% during the first 3 days after the three labeling date. The proportion of leaf respired ^{13}C stayed stable at 4% of total recovered ^{13}C all along the season. Leaves exported the main part of assimilated ^{13}C to other compartments during the 3 days after labeling with an hourly export rate comprised between 0.5 and 0.8 %. Whatever the labeling date, 6 hours after labeling, in leaves, 60% of labeled organic matter corresponded to starch, soluble sugars and structural matter. In May, this proportion remained similar 30 days after labeling date. However partitioning between each biochemical fraction changed : during the 6 first days after labeling, starch corresponded to the most labeled compound, thereafter structural matter became the more labeled : it reveals the use of starch for leaf growth at this period. For July and September labeling, the proportion of labeling organic matter corresponding to starch, soluble sugars and structural matter decrease to 50 and 40% respectively, until day 30 after labeling. In this fraction, the allocation to structural matter increase to 30% and 20 % respectively for July and September labeling. For those dates, ^{13}C also participated to construction of the leaves but in a lower extent: it progressively diminishes along the season.

In stems and roots, the proportion of ^{13}C allocated to starch, soluble sugars and structural matter increased from 40 % to 80% whatever the season from the first day after labeling to day 30. For May and July labeling, the allocation to structural matter significantly increased: from 10 % the first day after labeling to 70 % the day 30 after labeling. ^{13}C assimilated in May and in July contribute to the structure of stems and roots. For September labeling, allocation of ^{13}C to starch clearly increased from 5 % to 25 % during the month after labeling and showed the priority to reserve accumulation at this period.

This type of study allow determination of allocation to metabolites and exportation rates which are rarely studied