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# Carbon input by roots into the soil: Quantification of rhizodeposition from root to ecosystem scale

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Despite its fundamental role for carbon (C) and nutrient cycling, rhizodeposition remains 'the hidden half of the hidden half': it is highly dynamic and rhizodeposits are rapidly incorporated into microorganisms, soil organic matter, and decomposed to $CO_2$. Therefore, rhizodeposition is rarely quantified and remains the most uncertain part of the soil C cycle and of C fluxes in terrestrial ecosystems.
This review synthesizes and generalizes the literature on C inputs by rhizodeposition under crops and grasslands (281 data sets). The allocation dynamics of assimilated C (after 13C-$CO_2$ or 14C-$CO_2$ labeling of plants) were quantified within shoots, shoot respiration, roots, net rhizodeposition (i.e. C remaining in soil for longer periods), root-derived $CO_2$, and microorganisms. Partitioning of C pools and fluxes were used to extrapolate belowground C inputs via rhizodeposition to ecosystem level.
Allocation from shoots to roots reaches a maximum within the first day after C assimilation. Annual crops retained more C (45% of assimilated 13C or 14C) in shoots than grasses (34%), mainly perennials, and allocated 1.5 times less C belowground. For crops, belowground C allocation was maximal during the first 1-2 months of growth and decreased very fast thereafter. For grasses, it peaked after 2-4 months and remained very high within the second year causing much longer allocation periods.
Despite higher belowground C allocation by grasses (33%) than crops (21%), its distribution between various belowground pools remain very similar. Hence, the total C allocated belowground depends on the plant species, but its further fate is species independent.
This review demonstrates that C partitioning can be used in various approaches, e.g. root sampling, $CO_2$ flux measurements, to assess rhizodeposits' pools and fluxes at pot, plot, field and ecosystem scale and so, to close the most uncertain gap of the terrestrial C cycle.