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Biophysical factors controlling rhizodeposition under drought

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Aims:
Rhizodeposition is an important energy source for soil microorganisms. It is therefore crucial to estimate the distribution of root derived carbon (C) in soil and how it changes with soil water content and root traits.

Methods:
We tested how drought affects exudate distribution in the rhizosphere by coupling $14CO_2$ labelling of plants and phosphor imaging to estimate C allocation in roots with and without hairs and subjected to different water stresses. Rhizosphere water content was visualized by neutron radiography. A numerical model was employed to predict the exudate release and its spatiotemporal distribution along and around growing roots.

Results:
Dry and wet plants allocated similar amounts of 14C into roots but root elongation decreased by 48% in dry soil leading to reduced longitudinal rhizosphere extension. Rhizosphere water content was identical (31%) independent of drought, presumably because of the high water retention by mucilage. The model predicted that the increase in rhizosphere water content will enhance diffusion of exudates especially in dry soil and increase their microbial decomposition. Presence of root hairs increased the spatial extent of exudate distribution.

Conclusion:
Root growth, root hairs and rhizosphere water content play an important role in C release by roots and in shaping the profiles of root exudates in the rhizosphere. The release of mucilage may be a plant strategy to maintain fast diffusion of exudates and high microbial activity even under water limitation.