



HAL
open science

Modelling plant growth and rhizodeposition based on the distribution of sugars within the plant

Frédéric Rees, Christophe Pradal, Romain Barillot, Marion Gauthier, Loïc Pagès, Céline Richard-Molard, Alexandra Jullien, Claire Chenu, Bruno Andrieu

► **To cite this version:**

Frédéric Rees, Christophe Pradal, Romain Barillot, Marion Gauthier, Loïc Pagès, et al.. Modelling plant growth and rhizodeposition based on the distribution of sugars within the plant. 1. Workshop Carbon Allocation in Plants, Sep 2021, Versailles, France. <hal-05217036>

HAL Id: hal-05217036

<https://hal.inrae.fr/hal-05217036v1>

Submitted on 20 Aug 2025

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons CC BY 4.0 - Attribution - International License

A modelling approach for simulating rhizodeposition and root growth based on the distribution of sugars within roots

Authors

Frédéric Rees^{1*}, Christophe Pradal^{2,3}, Romain Barillot², Marion Gauthier^{1,3}, Loïc Pagès⁴, Céline Richard-Molard¹, Alexandra Jullien¹, Claire Chenu¹, Bruno Andrieu¹

*The presenting author's name will appear in underlined text.

Affiliations

¹UMR ECOSYS, INRAE, AgroParisTech, Université Paris-Saclay, 78850 Thiverval-Grignon, France,

²INRAE, UR P3F, F-86600, Lusignan, France

³ITK, avenue de l'Europe, F-34830 Clapiers, France

⁴AGAP, CIRAD, INRAE, Montpellier Sup Agro, Univ Montpellier, France,

⁵CIRAD, AGAP and Inria, Zenith, Univ Montpellier, France,

⁶INRAE, UR 1115 PSH, Site Agroparc, Avignon, France.

Abstract

Rhizodeposition, i.e. the release of any organic material by the roots, has been recognized as a major process that favors plant growth (e.g. by shaping microbial activity in the rhizosphere) and controls the short-term dynamics of carbon in the soil. So far, our understanding of such effects has been hindered by the lack of reliable estimations of the amount and composition of the various organic materials (e.g. exudates, mucilage, sloughed cells, volatile organic compounds) released by the roots over their lifetime. This is due to the technical challenges associated to the measurement of rhizodeposition fluxes, but also to the absence of any mechanistic plant models that explicitly integrate such fluxes as part of plant's metabolism. *RhizoDep* is a new functional-structural plant model (FSPM) that simulates the development of a 3D root system together with physiological processes such as root respiration and rhizodeposition. The overarching principle of this modelling approach is that virtually all processes are regulated by the concentrations of sugars allocated between different pools (e.g. phloem, cortical cytosol, reserve) in each root segment in a dynamic way. *RhizoDep* is thus able to simulate both temporal and spatial variations of rhizodeposition within the whole root system over plant's life, depending on the total amount of photoassimilates allocated from the shoots to the roots. By coupling this root model to plant or crop models able to control C inputs to the root system, on one hand, and to models that simulate soil organic matter dynamics, on the other hand, it has now become possible to recreate a plausible representation of the whole carbon cycle in soil-plant-atmosphere systems, and how it may be affected by different environmental conditions.