

Table of Contents

In Press

Online First

Article Archive

SWR (13) 2018

SWR (12) 2017

SWR (11) 2016

SWR (10) 2015

SWR (9) 2014

SWR (8) 2013

SWR (7) 2012

SWR (6) 2011

SWR (5) 2010

Issue No. 1 (1-38)

Issue No. 2 (39-74)

Issue No. 3 (75-119)

Issue No. 4 (121-185)

SWR (4) 2009

SWR (3) 2008

SWR (2) 2007

SWR (1) 2006

Editorial Board

Ethical Standards

For Authors

Author Declaration

Instruction for Authors

Submission Templates

Copyright

Guide for Authors

Fees

Submission/Login

For Reviewers

Guide for Reviewers

Reviewers Login

Subscription

Tracer experiments within composite soil column investigated by MRI

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<https://doi.org/10.17221/4/2009-SWR>

Citation: Jelínková V., Císlarová M., Pohlmeier A., Van dusschoten D. (2010): Tracer experiments within composite soil column investigated by MRI. *Soil & Water Res.*, 5: 39-48.

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The magnetic resonance imaging (MRI) technique was used for the visualisation and interpretation of flow paths. A set of tracer-infiltration experiments was performed on soil columns filled with packed homogeneous sand and with a composite sand-soil system. The flow paths were visualised using a tracer-solution containing $\text{Ni}(\text{NO}_3)_2$ which is characterised by relaxation times different from that of the infiltrating water. The tracer pulse was added under hydraulic steady state conditions. Small disturbances in the tracer front were observed during the breakthrough in the case of a homogeneous sample. More pronounced effects were seen with the composite sample. The vertical components of the velocity fields were evaluated for the experiments presented. The irregularities in the tracer front and in the velocity fields were in this case attributed to the preferential flow phenomena in combination with air bubble entrapment. Beside that, two consecutive tracer pulses were performed with the aim of testing the potential influence of the different solute concentrations on the adsorption power. Both concentrations had negligible impacts on the acquired image. The presented results are constrained by the limits of the described technology; further investigations are being carried out using more advanced equipment. I

Keywords:

Cambisol; infiltration; laboratory experiments; magnetic resonance imaging; porous medium; preferential flow; sand; soil samples; tracer; velocity field

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Impact factor (Web of Science – Thomson Reuters)

2017: 0.882

5-Year Impact Factor: 1.11

SJR (SCImago Journal Rank – SCOPUS)

2017: 0.379 – Q3 (Aquatic Science), Q3 (Aquatic Science)

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