

# Soil mechanics and soil management

## Selected recent publications

- Colombi T. & Keller T. 2019. Developing strategies to recover crop productivity after soil compaction – A plant eco-physiological perspective. *Soil & Tillage Research*, 191, 156-161.
- Colombi T., Hermann A.M., Vallenback P. & Keller T. 2019. Cortical cell diameter is key to energy costs of root growth in wheat. *Plant Physiology*, 180, 2049-2060.
- Colombi T., Kirchgessner N., Ileskog D., Alexandersson S., Larsbo M. & Keller T. 2021. A time-lapse imaging platform for quantification of soil crack development due to simulated root water uptake. *Soil & Tillage Research*, 205, 104769.
- Keller T., Sandin M., Colombi T., Horn R. & Or D. 2019. Historical increase in agricultural machinery weights enhanced soil stress levels and adversely affected soil functioning. *Soil & Tillage Research*, 194, 104293.
- Sjulgård H., Ileskog D., Kirchgessner N., Bengough A.G., Keller T. & Colombi T. 2021. Reversible and irreversible root phenotypic plasticity under fluctuating soil physical conditions. *Environmental and Experimental Botany*, 188, 104494.
- Williams H., Colombi T. & Keller T. 2020. The influence of soil management on soil health: an on-farm study in southern Sweden. *Geoderma*, 360, 114010.

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### 2021:

- Bölscher T., Koestel J., Etana A., Ulén B., Berglund K. & Larsbo M. 2021. Changes in pore networks and readily dispersible soil following structure liming of clay soils. *Geoderma*, 390, 114948.
- Capowiez Y., Sammartino S., Keller T. & Bottinelli N. 2021. Decreased burrowing activity of endogeic earthworms and effects on water infiltration in response to an increase in soil bulk density. *Pedobiologica*, 85-86, 150728.
- Colombi T., Chakrawal A. & Herrmann A.M. 2021. Carbon supply-consumption balance in plant roots: effects of carbon use efficiency and root anatomical plasticity. *New Phytologist*, <https://doi.org/10.1111/nph.17598>.
- Colombi T., Kirchgessner N., Ileskog D., Alexandersson S., Larsbo M. & Keller T. 2021. A time-lapse imaging platform for quantification of soil crack development due to simulated root water uptake. *Soil & Tillage Research*, 205, 104769.
- Getahun G.T., Etana A., Munkholm L.J. & Kirchmann H. 2021. Liming with CaCO<sub>3</sub> or CaO affects aggregate stability and dissolved reactive phosphorus in a heavy clay subsoil. *Soil & Tillage Research*, 214, 105162.
- Hirte J., Walder F., Hess J., Büchi L., Colombi T., van der Heijden M.G. & Mayer J. 2021. Enhanced root carbon allocation through organic farming is restricted to topsoils. *Science of the Total Environment*, 755, 143551.
- Hui L., Fiorani F., Jäck O., Colombi T., Nagel K.A. & Weih M. 2021. Shoot and root traits underlying genotypic variation in early vigor and nutrient accumulation in spring wheat grown in high-latitude light conditions. *Plants*, 10, 174.

- Keller T., Colombi T., Ruiz S., Schymanski S.J., Weisskopf P., Koestel J., Sommer M., Stadelmann V., Breitenstein D., Kirchgessner N., Walter A. & Or D. 2021. Soil structure recovery following compaction: Short-term evolution of soil physical properties in a loamy soil. *Soil Science Society of America Journal*, 85, 1002-1020.
- Koestel J., Fukumasu J., Garland G., Larsbo M. & Nimblad Svensson D. 2021. Approaches to delineate aggregates in intact soil using X-ray imaging. *Geoderma*, 402, 115360.
- Lima R.P. & Keller T. 2021. Soil stress measurement by load cell probes as influenced by probe design, probe position, and soil mechanical behaviour. *Soil & Tillage Research*, 205, 104796.
- Longepierre M., Widmer F., Keller T., Weisskopf P., Colombi T., Six J. & Hartmann M. 2021. Limited resilience of the soil microbiome to mechanical compaction within four growing seasons of agricultural management. *ISME Communications*, 1, 44.
- Or D., Keller T. & Schlesinger W.H. 2021. Natural and managed soil structure: on the fragile scaffolding for soil functioning. *Soil & Tillage Research*, 208, 104912.
- Parvin N., Sandin M. & Larsbo M. 2021. Seedbed consolidation and surface sealing for soils of different texture and soil organic carbon contents. *Soil & Tillage Research*, 206, 104849.
- Romero-Ruiz A., Linde N., Baron L., Solazzi S.G., Keller T. & Or D. 2021. Seismic signatures reveal persistence of soil compaction. *Vadose Zone Journal*, 20, e20140.
- Sjulgård H., Iseskog D., Kirchgessner N., Bengough A.G., Keller T. & Colombi T. 2021. Reversible and irreversible root phenotypic plasticity under fluctuating soil physical conditions. *Environmental and Experimental Botany*, 188, 104494.
- ten Damme L., Schjønning P., Munkholm L.J., Green O., Nielsen S.K. & Lamandé M. 2021. Traction and repeated wheeling – effects on contact area characteristics and stresses in the upper subsoil. *Soil & Tillage Research*, 211, 105020.
- ten Damme L., Schjønning P., Munkholm L.J., Green O., Nielsen S.K. & Lamandé M. 2021. Soil structure response to field traffic: Effects of traction and repeated wheeling. *Soil & Tillage Research*, 213, 105128.
- Torres C.L., Keller T., Lima R.P., Tormena C.A., Lima H., Giarola N.F.B. 2021. Impacts of soil texture and crop species on permanent wilting of plants. *Geoderma*, 384, 114798.
- Weber L.L., Cavalieri-Polizeli K.M.V., Zimmermann G.G., Filho O.G., Tormena C.A., Keller T. & Jasper S.P. 2021. Impact of self-propelled sprayer traffic on Ferralsol physical properties in southern Brazil. *Journal of Soil Science and Plant Nutrition*, <https://doi.org/10.1007/s42729-021-00581-2>.
- Weih M., Hui L., Colombi T., Keller T., Jäck O., Vallenback P. & Westerbergh A. 2021. Evidence for magnesium-phosphorus synergism and co-limitation of grain yield in wheat agriculture. *Scientific Reports*, 11, 9012.

## 2020:

- Bahrami M., Naderi-Boldaji N., Ghanbarian D., Ucgul M. & Keller T. 2020. Simulation of plate sinkage in soil using discrete element modelling: Calibration of model parameters and experimental validation. *Soil & Tillage Research*, 203, 104700.
- Barbosa L.A.P., Keller T. & de Oliveira Ferraz A.C. 2020. Scale effect of aggregate rupture: Using the relationship between friability and fractal dimension to parameterise discrete element models. *Powder Technology*, 375, 327-336.
- Barbosa L.A.P., Munkholm L.J., Obour P.B. & Keller T. 2020. Impact of compaction and post-compaction vegetation management on aggregate properties, Weibull modulus, and interactions with intra-aggregate pore structure. *Geoderma*, 374, 114430.

- Etana A., Holm L., Rydberg T. & Keller T. 2020. Soil and crop responses to controlled traffic farming in reduced tillage and no-till: some experiences from field experiments and on-farm studies in Sweden. *Acta Agriculturae Scandinavica, Section B - Plant Soil Science*, 70, 333-340.
- Farahani E., Emami H., Fotovat A., Khorassani R. & Keller T. 2020. Soil available water and plant growth in relation to K:Na ratio. *Geoderma*, 363, 114173.
- Lima R.P., Keller T., Giarola N.B.F., Tormena C.A., Silva A.R. & Rolim M.M. 2020. Measurements and simulations of compaction effects on the least limiting water range of a no-till Oxisol. *Soil Research*, 58, 62-72.
- Meurer K.H.E., Barron J., Chenu C., Coucheney E., Fielding M., Hallet P.D., Herrmann A.M., Keller T., Koestel J., Lewan E., Or D., Parsons D., Parvin N., Taylor A., Vereecken H. & Jarvis N.J. 2020. A framework for modelling soil structure dynamics induced by biological activity. *Global Change Biology*, 26, 5382-5403.
- Meurer K.H.E., Chenu C., Coucheney E., Herrmann A.M., Keller T., Kätterer T., Nimblad Svensson D. & Jarvis N.J. 2020. Modelling dynamic interactions between soil structure and the storage and turnover of soil organic matter. *Biogeosciences*, 17, 5025-5042.
- Reiser R., Stadelmann V., Weisskopf P., Grahm L. & Keller T. 2020. System for quasi-continuous simultaneous measurement of oxygen diffusion rate and redox potential in soil. *Journal of Plant Nutrition and Soil Science*, 183, 316-326.
- Schjønning P., Lamandé M., Keller T. & Labouriau R. 2020. Subsoil shear strength – measurements and prediction models based on readily available soil properties. *Soil & Tillage Research*, 200, 104638.
- ten Damme L., Stettler M., Pinet F., Vervaeet P., Keller T., Munkholm L.J. & Lamandé M. 2020. Construction of modern wide, low-inflation pressure tyres per se does not affect soil stress. *Soil & Tillage Research*, 204, 104708.
- Williams H., Colombi T. & Keller T. 2020. The influence of soil management on soil health: an on-farm study in southern Sweden. *Geoderma*, 360, 114010.

#### 2019:

- Banerjee S., Walder F., Büchi L., Meyer M., Held A.Y., Gattinger A., Keller T., Charles R. & van der Heijden M.G.A. 2019. Agricultural intensification reduces microbiome complexity and the abundance of keystone taxa in roots. *ISME Journal*, 2019, 13, 1722-1736.
- Bennett J.M., Robertson S.D., Marchuk S., Woodhouse N.P., Antille D.L., Jensen T.A. & Keller T. 2019. The soil structural cost of traffic from heavy machinery in Vertisols. *Soil & Tillage Research*, 185, 85-93.
- Büchi L., Georges F., Walder F., Banerjee S., Keller T., Six J., van der Heijden M.G.A. & Charles R. 2019. Potential of indicators to unveil the hidden side of cropping system classification: Differences and similarities in cropping practices between conventional, no-till and organic systems. *European Journal of Agronomy*, 109, 125920.
- Colombi T. & Keller T. 2019. Developing strategies to recover crop productivity after soil compaction – A plant eco-physiological perspective. *Soil & Tillage Research*, 191, 156-161.
- Colombi T., Walder F., Büchi L., Sommer M., Liu K., Six J., van der Heijden M.G.A., Charles R. & Keller T. 2019. On-farm study reveals positive relationship between gas transport capacity and organic carbon content in arable soil. *SOIL*, 5, 91-105.
- Colombi T., Herrmann A.M., Vallenback P. & Keller T. 2019. Cortical cell diameter is key to energy costs of root growth in wheat. *Plant Physiology*, 180, 2049-2060.

- Herrmann A.M. & Colombi T. 2019. Energy use efficiency of root growth – a theoretical bioenergetics framework. *Plant Signaling & Behavior*, 14:12, 1685147.
- Holten R., Larsbo M., Jarvis N., Stenrød M., Almviik M. & Eklo O.M. 2019. Leaching of five pesticides of contrasting mobility through frozen and unfrozen soil. *Vadose Zone Journal*, 18:180201.
- Keller T., Hüppi R. & Leifeld J. 2019. Relationship between greenhouse gas emissions and changes in soil gas diffusivity in a field experiment with biochar and lime. *Journal of Plant Nutrition and Soil Science*, 182, 667-675.
- Keller T., Sandin M., Colombi T., Horn R. & Or D. 2019. Historical increase in agricultural machinery weights enhanced soil stress levels and adversely affected soil functioning. *Soil & Tillage Research*, 194, 104293.
- Lima R.P. & Keller T. 2019. Impact of sample dimensions, soil-cylinder wall friction and elastic properties of soil on stress field and bulk density under uniaxial compression test. *Soil & Tillage Research*, 189, 15-24.
- Löv Å., Larsbo M., Sjöstedt C., Cornelis G., Gustafsson J.P. & Kleja D.B. 2019. Evaluating the ability of standardised leaching tests to predict metal(loid) leaching from intact soil columns using size-based elemental fractionation. *Chemosphere*, 222, 453-460.
- Mossadeghi-Björklund M., Jarvis N., Larsbo M., Forkman J. & Keller T. 2019. Effects of compaction on soil hydraulic properties, penetration resistance and water flow patterns at the soil profile scale. *Soil Use and Management*, 35, 367-377.
- Obour P.B., Keller T., Jensen J.L., Edwards G., Lamandé M., Watts C.W., Sørensen C.G. & Munkholm L.J. 2019. Soil water contents for tillage: a comparison of approaches and consequences for the number of workable days. *Soil & Tillage Research*, 195, 104384.
- Obour P.B., Keller T., Lamandé M. & Munkholm L. 2019. Pore structure characteristics and soil workability along a clay gradient. *Geoderma*, 337, 1186-1195.
- Paradelo R., Eden M., Martínez I., Keller T. & Houot S. 2019. Soil physical properties of a Luvisol developed on loess after 15 years of amendment with compost. *Soil & Tillage Research*, 191, 207-215.
- ten Damme L., Stettler M., Pinet F., Vervaet P., Keller T., Munkholm L.J. & Lamandé M. 2019. The contribution of tyre evolution to the reduction of soil compaction risks. *Soil & Tillage Research*, 194, 104283.
- Vennik K., Kukk P., Krestein K., Reintam E. & Keller T. 2019. Measurements and simulations of rut depth due to single and multiple passes of a military vehicle on different soil types. *Soil & Tillage Research*, 186, 120-127.

#### 2018:

- Blomquist J., Simonsson M., Etana A. & Berglund K. 2018. Structure liming enhances aggregate stability and gives varying crop responses on clayey soils. *Acta Agriculturae Scandinavica, Section B – Soil & Plant Science*, 68, 311-322.
- Bölenius E., Wetterlind J. & Keller T. 2018. Can within-in field yield variation be explained using horizontal penetrometer resistance and electrical conductivity measurements? Results from three Swedish fields. *Acta Agriculturae Scandinavica, Section B - Plant Soil Science*, 68, 690-700.
- Colombi T., Torres L.C., Walter A. & Keller T. 2018. Feedbacks between soil penetration resistance, root architecture and water uptake limit water accessibility and crop growth - a vicious circle. *Science of the Total Environment*, 626, 1026-1035.

- Farahani E., Emami H. & Keller T. 2018. Impact of monovalent cations on soil structure. Part II. Results of two Swiss soils. *International Agrophysics*, 32, 69-80.
- Farahani E., Emami H., Keller T., Fotovat A. & Khorasani R. 2018. Impact of monovalent cations on soil structure. Part I. Results of an Iranian soil. *International Agrophysics*, 32, 57-67.
- Fell V., Matter A., Keller T. & Boivin P. 2018. Patterns and factors of soil structure recovery as revealed from a tillage and cover-crop experiment in a compacted orchard. *Frontiers in Environmental Science*, 6, 134.
- Getahun G.T., Kätterer T., Munkholm L.J., Parvage M.M., Keller T., Rychel K. & Krichmann H. 2018. Short-term effects of loosening and incorporation of straw into the upper subsoil on soil physical properties and crop yield. *Soil & Tillage Research*, 184, 62-67.
- Hellner Q., Koestel J., Ulén B. & Larsbo M. 2018. Effects of tillage and liming on macropore networks derived from X-ray tomography images of a silty clay soil. *Soil Use Management*, 34, 197-205.
- Holten R., Bøe F.N., Almvik M., Katuwal S., Stenrød M., Larsbo M., Jarvis N. & Eklo O.M. 2018. The effect of freezing and thawing on water flow and MCPA leaching in partially frozen soil. *Journal of Contaminant Hydrology*, 219, 72-85.
- Lima R.P., Silva A.P., Giarola N.F.B., Silva A., Rolim, M. & Keller T. 2018. Impact of initial bulk density and matric suction on compressive properties of two Oxisols under no-till. *Soil & Tillage Research*, 175, 168-177.
- Lundin O., Myrbeck Å & Bommarco R. 2018. The effects of reduced tillage and earlier seeding on flea beetle (*Phyllotreta* spp.) crop damage in spring oilseed rape (*Brassica napus* L.). *Crop Protection*, 107, 104-107.
- Löv Å., Cornelis G., Larsbo M., Persson I., Sjöstedt C., Gustafsson J.P., Boye K. & Kleja D.B. 2018. Particle- and colloid-facilitated Pb transport in four historically contaminated soils - Speciation and effect of irrigation intensity. *Applied Geochemistry*, 96, 327-338.
- Naderi-Boldaji M., Kazemzadeh A., Hemmat A., Rostami S. & Keller T. 2018. Changes in soil stress during repeated wheeling: A comparison of measured and simulated values. *Soil Research*, 56, 204-214.
- Romero-Ruiz A., Linde N., Keller T. & Or D. 2018. A review of geophysical methods for soil structure characterization. *Reviews of Geophysics*, 56, 672-697.
- Sandin M., Piikki K., Jarvis N. & Larsbo M. 2018. Consolidation and surface sealing of nine harrowed Swedish soils. *Soil & Tillage Research*, 181, 82-92.
- Sandin M., Piikki K., Jarvis N., Larsbo M., Bishop K. & Kreuger J. 2018. Spatial and temporal patterns of pesticide concentrations in streamflow, drainage and runoff in a small Swedish agricultural catchment. *Science of the Total Environment*, 610-611, 623-634.
- Ulén B., Larsbo M., Koestel J., Hellner Q., Blomberg M. & Geranmayeh P. 2018. Assessing strategies to mitigate phosphorus leaching from drained clay soils. *Ambio*, 47, 114-123.

#### 2017:

- Vennik K., Keller T., Kuk P., Krestein K. & Reintam E. 2017. Soil rut depth prediction based on soil strength measurements on typical Estonian soils. *Biosystems Engineering*, 163, 78-86.
- Shi P., Sigurdur T., Keller T., Keller M. & Schulin R. 2017. Soil aggregate breakdown in a field experiment with different rainfall intensities and initial soil water contents. *European Journal of Soil Science*, 68, 853-863.

- Colombi T., Kirchgessner N., Walter A. & Keller T. 2017. Root tip shape governs root elongation rate under increased soil strength in wheat. *Plant Physiology*, 174, 2289-2301.
- Naderi-Boldaji M., Bahrami M., Keller T. & Or D. 2017. Characteristics of acoustic emissions from soil subjected to confined uniaxial compression. *Vadose Zone Journal*, 16(7) doi: 10.2136/vzj2017.02.0049.
- Guimarães R.M.L., Keller T., Lamandé M. & Munkholm L.J. 2017. Guest Editorial: special issue on visual soil evaluation and soil compaction research. *Soil & Tillage Research*, 173, 1-3.
- Guimarães R.M.L., Lamandé M., Munkholm L.J., Ball B.C. & Keller T. 2017. Opportunities and future directions for visual soil evaluation methods in soil structure research. *Soil & Tillage Research*, 173, 104-113.
- Keller T., Colombi T., Ruiz S., Manalili M.P., Rek J., Stadelmann V., Wunderli H., Breitenstein D., Reiser R., Oberholzer H.-R., Schymanski S., Romero-Ruiz A., Linde N., Weisskopf P., Walter A. & Or D. 2017. Long-term soil structure observatory for monitoring post-compaction evolution of soil structure. *Vadose Zone Journal*, 16(4), doi: 10.2136/vzj2016.11.0118.
- Schjønning P., McBride R.A., Keller T. & Obour P.B. 2017. Predicting soil particle density from clay and soil organic matter contents. *Geoderma*, 286, 83-87.
- Colombi T., Braun S., Keller T. & Walter A. 2017. Artificial macropores attract crop roots and enhance plant productivity on compacted soils. *Science of the Total Environment*, 574, 1283-1293.