Geophysical Research Abstracts
Vol. 20, EGU2018-15849-1, 2018
EGU General Assembly 2018

Quantifying the ability of wild plant species to influence soil pore formation in the rhizosphere under a high compaction treatment using X-ray computed tomography.

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Soil compaction is a globally pervasive problem with recent estimates indicating that 33 million hectares of land in Europe are being directly degraded as a result of the phenomenon. Soil compaction typically occurs on agricultural land from the use of heavy farm machinery and the passage of animals. As a result it increases the rate of soil erosion, the risk of flooding as well as negatively affecting crop growth. Currently, deep tillage practices are used as a short-term solution to alleviate soil compaction in agricultural settings. However this exacerbates the risk of subsoil compaction, which tends to be persistent and difficult to alleviate. Plant species that are able to grow in heavily compacted soil may increase the number of pores helping to positively alter the soil structure. We analysed the root growth patterns of three wild plant species typically found growing on compacted soils; ribwort plantain (Plantago lanceolata), dandelion (Taraxacum officinale) and spear thistle (Cirsium vulgare). Plants were grown for 28 days in a sandy loam soil compacted to 1.8 g cm-3. X-ray computed tomography was used to non-destructively observe root architecture in situ and visualise changes in rhizosphere porosity with distance from the root surface at a resolution of 35 μm, at 14 and 28 days after sowing. Porosity was analysed within four incremental zones 0-70, 70-140, 140-280, 280-420 μm distance from the root surface. We observed significant differences in proportion of rhizosphere porosity between the three species, with the rhizosphere of Spear thistle plants being greatest. Across all species the porosity of the rhizosphere was greatest with immediate proximity to the root and decreased with distance from the root surface. This study indicates that roots can have a localised effect in increasing the formation of air filled pores in the rhizosphere resulting in structural alteration of the soil under a high compaction treatment.