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Quantification of grass roots induced effects on soil structural development using X-ray Computed Tomography

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Abstract

Grasslands comprise an important land use in the UK, accounting for 35% of all land cover and over 70% of farmed land. They are becoming more multifunctional with an increasing need to consider the pivotal role of their management in river basin corridors and their role in rainfall-runoff processes which have a significant influence on flood and diffuse pollution events. Plant breeders can potentially design new grass cultivars using conventional breeding techniques by selecting traits that have beneficial effects on soil hydraulic functioning. These may enable increasing the hydraulic conductivity and storage capacity of poorly draining soils therefore meeting production requirements alongside providing ecosystem services. This study is part of a newly formed interdisciplinary project team of plant geneticists, soil scientists and hydrologists aiming to test the hypothesis that grasses can be genetically selected to reduce the hydrological energy of grassland dominated catchments.

In this paper, grass cultivars with improved root penetration through wax layers were selected for assessing the temporal biophysical changes to soil hydraulic function-

ing. X-ray Computed Tomography (CT) (Benchtop 160Xi, X-tek Ltd) was used to quantitatively assess the temporal soil structure development promoted by grass roots. Perspex tubes (7 cm diameter and 25 cm height) pre-packed with a poorly drained clay loam (Hallsworth series) from Devon, UK, were used to grow the grass cultivars for four months and scanned at frequent intervals during growth. Imaging software packages were used to measure important soil physical parameters including apparent soil porosity, pore size distribution, pore shape and connectivity. Undisturbed soil columns were also collected from field plots where the same grass cultivars were growing in a randomized block design and scanned. An attempt was made to quantify root morphology in a non-destructive manner using X-ray CT. Results demonstrated some grass cultivars had greater potential to reduce runoff by increasing water percolation.