New study highlights key role soil structure plays in water uptake by crops

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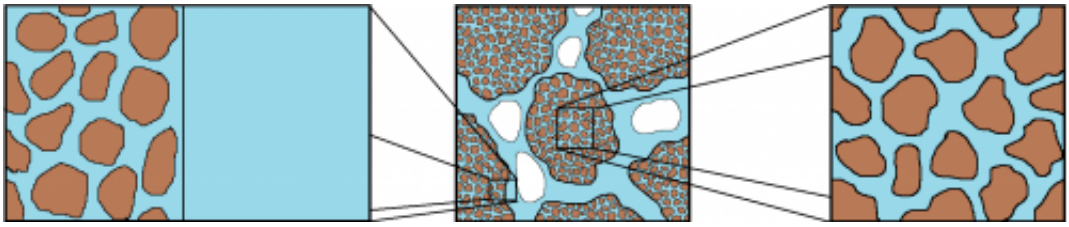

The attached image shows the boundary of the soil aggregate (left), the bulk soil geometry comprising of a collection of aggregates (middle) and the internal pore structure of the soil aggregate, which is composed of a selection of soil particles (right). The soil particles are shown in brown, the water in blue and the air bubbles in white.

The increased global consumption of food means that there is an increasing yield gap between crop production and crop usage. To help tackle this issue, a team of scientists from the University of Southampton has used advanced mathematical modelling techniques to understand the precise role soil structure plays in water uptake.

Modelling of flow in soil and uptake of water by plants is essential both for understanding and optimising agricultural processes which, in turn, provides the means to maximise crop yield. The team used the University's IRIDIS High Performance Computing Facility to study the effect of different geometrical features within the soil and used these models to measure how these features affect the overall hydraulic

properties.

In order to measure the flow of water through soil, they first had to examine the flow of water around a single soil particle. Next they looked at the flow properties of a collection of soil particles, known as a soil aggregate. This multi-scale approach captured the underlying geometry through a series of targeted computer simulations.

The researchers found that the flow properties near the surface of the aggregates are a key factor which determines the overall flow properties in soil. The flow properties of the soil aggregates are effectively determined by the intra-aggregate pore. The relatively small size of these pores renders the aggregates as almost completely impermeable. However, near the aggregate surface these pores act to increase the size of the (much larger) inter-aggregate pores and results in a much larger flow throughout the bulk soil.

Co-author Dr Keith Daly, a Research Fellow in Engineering and the Environment at the University of Southampton, says:

"The models developed in this work will be used to develop an understanding of flow in different soil types. This, in turn, will be used to develop optimal soil treatments to increase plant-water uptake and, hence, crop yield.. This will be of particular importance for the 30 per cent of UK wheat which is grown on drought prone land."

The study, which was funded by the Biotechnology and Biological Sciences Research Council (BBSRC) and the Royal Society University Research Fellowship, is published in the journal *Proceedings of the Royal Society A*.

More information: rspa.royalsocietypublishing.or … .1098/rspa.2013.0383

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