diamond

Food

CASE STUDY

How does the structure of soil affect plant root growth?

With global food demands growing, maximising crop yield is of critical importance. Soil structure is one of the most important environmental factors affecting root architectural development and consequently plant yield.

Despite the criticism associated with prolonged use, tillage improves the structure of soils for good early root establishment as it breaks down large clumps of soil into smaller aggregates and individual particles to ensure good seed-soil contact in the seedbed as well as an ideal pore network for root growth. To ensure the best possible plant yield, in addition to having the optimum tillage, other soil management practices need to promote optimal root growth.

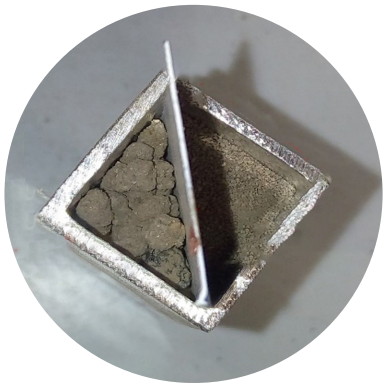
The University Of Sheffield.

The Challenge

Soils often have variable composition and aggregate size which can influence plant yield. In order to determine ideal soil tilth required for plant growth, there is a need to characterise the response of roots to different structures.

Studies to date have primarily focused on the effect of soil compaction rather than soil aggregate size in influencing root configuration. Non-invasive techniques were needed to examine the root structures within different soil matrices without disturbing the root systems.

The Solution



A team from the University of Sheffield worked with scientists from Diamond and ISIS to conduct complementary X-ray and neutron imaging experiments of plants in different soils.

X-ray imaging at I12 was key to understanding inter- and intra-aggregate pores within the soil with neutron imaging used to map 3D root architectures in wheat seedlings in soil. The experiments showed how variable aggregate size affects the early root architectural establishment in wheat plants.

The Benefits

The non-destructive imaging experiments allowed the team to understand the structural differences between the soil structures and understand how these differences affect root growth. They showed that root growth is improved in smaller macro-aggregates compared to larger aggregates. The findings may have implications for soil cultivation with soils containing finer macroaggregates (finer tilth) being recommended for the better establishment of wheat plants growing in well-watered sandy loam soils.

"The high resolution imaging made possible by the I12 beamline provided us the exciting opportunity to explore as yet unclear interactions between wheat and soil aggregates. We collaborated with Diamond and the ISIS Neutron and Muon Source facility to utilise the complementary nature of X-ray and neutron imaging thus enhancing our understanding of wheat productivity. Our results are a contribution to the plethora of data available that has the potential to enable improved agricultural productivity to feed an ever growing population."

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