How do Deep Rooting Grasses affect Soil Micronutrients

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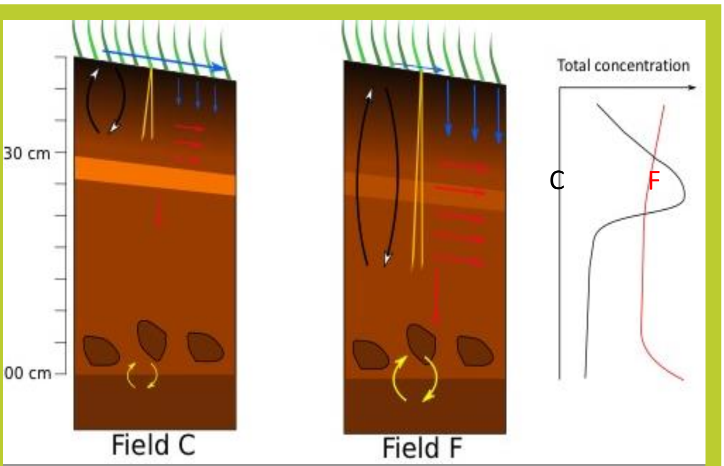
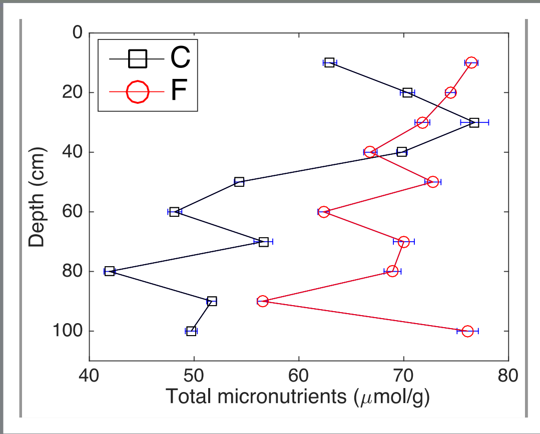
Micronutrients are an important part of human and non-human nutrition, but recent concerns have been raised about the declining levels of micronutrients in foods. Micro- and macronutrients are removed from soil as crops are harvested, but fertilisers typically only replace macronutrients N, P, K. Furthermore, most studies of soils only measure C, N, and P, and focus on the top 10-30 cm of the soil. However, the production of inorganic nutrients via chemical weathering happens predominantly at the rock-soil interface, well below this depth. The ultimate source of most micronutrients is from weathering of minerals, although additional sources include atmospheric deposition and deposition of sediments or solutes via erosive or fluvial transport.

Plants take up micronutrients through their roots. Deep rooting plants have been developed to increase C-sequestration and to adapt to changes in hydrological processes driven by climate change (i.e., flooding and drought), but it is not yet known how these grasses may influence the bioavailability or the distribution of micronutrients in soils. At the North Wyke Farm Platform, deep rooting grasses are grazed by sheep in several fields on heavy clay soil with an underlying shale layer. Their roots can potentially grow to 1 m depth, in contrast to conventional grasses which have rooting depths of approximately 30 cm.





As a 3rd year undergraduate research project for students on the Environmental Geoscience degree course in the School of Earth Sciences at the University of Bristol, 3-5 students per year examine the soil micronutrients and associated soil parameters (colour, moisture, pH, bulk carbon and nitrogen) in depth profiles (to 1 m) at the NWFP in a field (Longlands East), planted with deep-rooting *Festulolium loliaceum* (**F in the figures**), and in a nearby field (Longlands South) , planted with a conventional grass, *Lolium perenne* (**C in the figures**). The deep rooting grass was developed to increase infiltration of rain water, as a flood prevention mechanism. This project was completed in 2016-17.

Results suggest that the deeper rooting grass species causes an increase in porosity to the clay horizon, which encourages vertical and lateral leaching of some elements out of the soil profile. This effect was shown by a depleted mass transfer profile under the *Festulolium* grass compared to an enrichment horizon at the clay layer under the common grass. But despite greater leaching, micronutrient concentrations were greater under the deeper rooting grass, which can be attributed to more clay and organic carbon at depth, which complexation sites to retain micronutrient ions.

Accelerated rates of bedrock weathering due to an increase in organic acids, produced by a large root mass, may increase the input of micronutrients to the soil. Weathering of the Crackington shale formation would increase the clay fraction at depth, resultin in greater adsorption of micronutrients. Organic acids can also act to increase mobility and bioavailability of metal cations, whilst greater dissolved organic carbon can form complexes with metal cations, reducing their mobility so that they are less likely to be lost from the soil due to leaching. Therefore, the introduction of the *Festulolium* hybrid grass may not only provide flood control benefits by encouraging infiltration of water and drought resistance, it may also increase micronutrient concentrations within the soil.