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# Getting more from the core: studying mature root system traits in the field.

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The productivity of existing agricultural land must be improved if global food requirements are to be met without agricultural land further encroaching on natural ecosystems degrading the services they provide. Better capture and use of the water and nutrients of the subsoil would improve the productivity and efficiency of many agricultural production systems and will also reduce risks of environmental damage (reducing leaching, eutrophication, and salinization). However in many agro-ecosystems subsoil resources are underutilised by crops, even where the crop would benefit from and can access them. Improved understanding of the development of root systems into subsoil may explain this perplexing phenomenon, but the technologies and approaches to characterise the root systems are lacking.

Root systems have been neglected in cereal breeding efforts because they are difficult to work with, but, with many of the "easy" gains having been made, root systems are receiving increasing attention. Root system constraints can be limiting for water uptake and efficiency, even in high yielding environments. Pre-breeding efforts have focused on root traits in the laboratory, but these are not reflective of mature root systems in the field. We have reversed the approach, and have been developing the techniques necessary to phenotype roots in the field. Our studies have lead us to favour direct measures of root systems using soil coring, instead of indirect measures of root performance. We have been improving the throughput of soil coring and have developed a system that allowed us to identify genotypes with root traits that are superior to commercial varieties in wheat.