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Phenotyping root function in wheat

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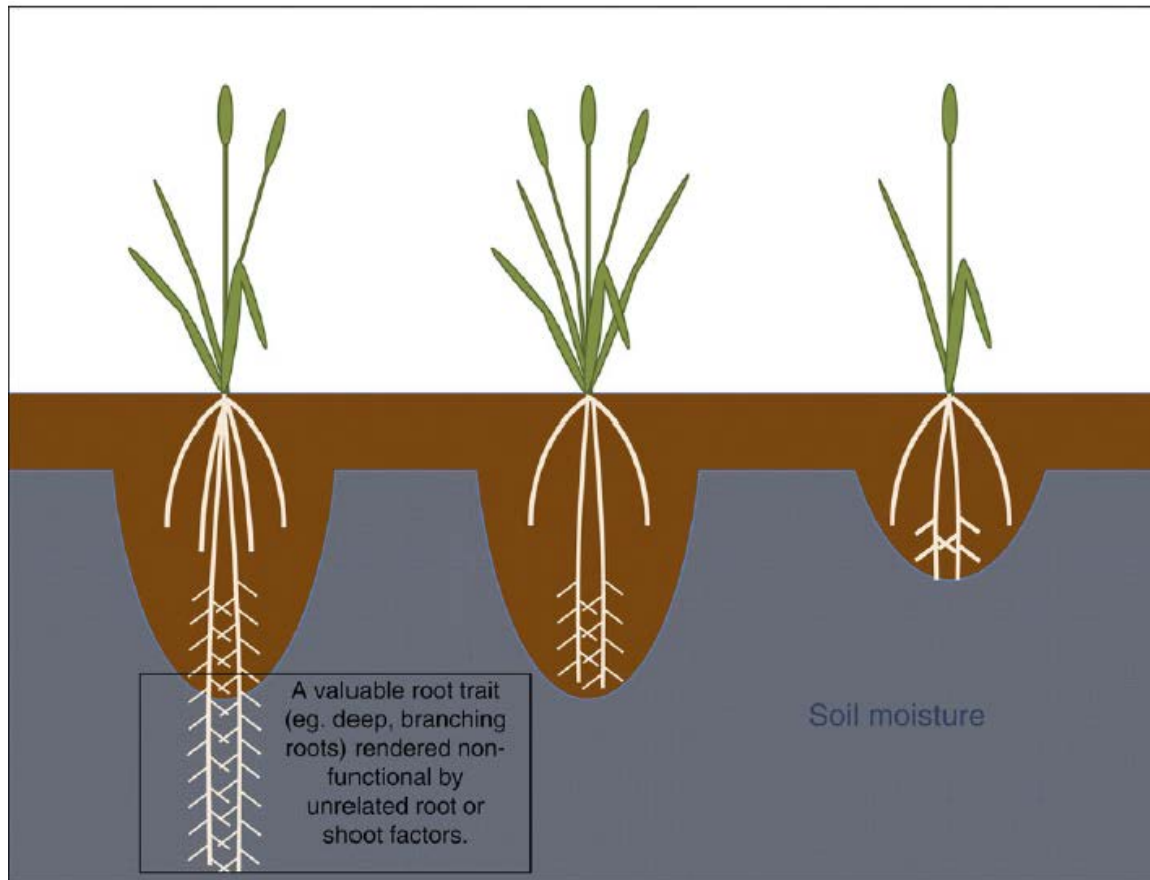
Aims

1. Apply EMI (electromagnetic induction) to wheat root phenotyping, so that water extraction profiles can be determined rapidly in field trials.
2. Compare data from our newly developed method with data from established and emerging methods (including the use of qPCR of soil-extracted DNA) for root phenotyping with the purpose of eliciting new insights on root function.
3. To compare QTLs from field measurements with those derived from more rapid laboratory measurements. We will explore the development of a new mapping population(s) to be generated specifically for yield in water limited UK environments.

REVIEW PAPER

Traits and selection strategies to improve root systems and water uptake in water-limited wheat crops

A.P. Wasson¹, R.A. Richards¹, R. Chatrath², S.C. Misra³, S.V. Sai Prasad, G.J. Rebetzke¹, J.A. Kirkegaard¹, J. Christopher⁵ and M. Watt^{1*}

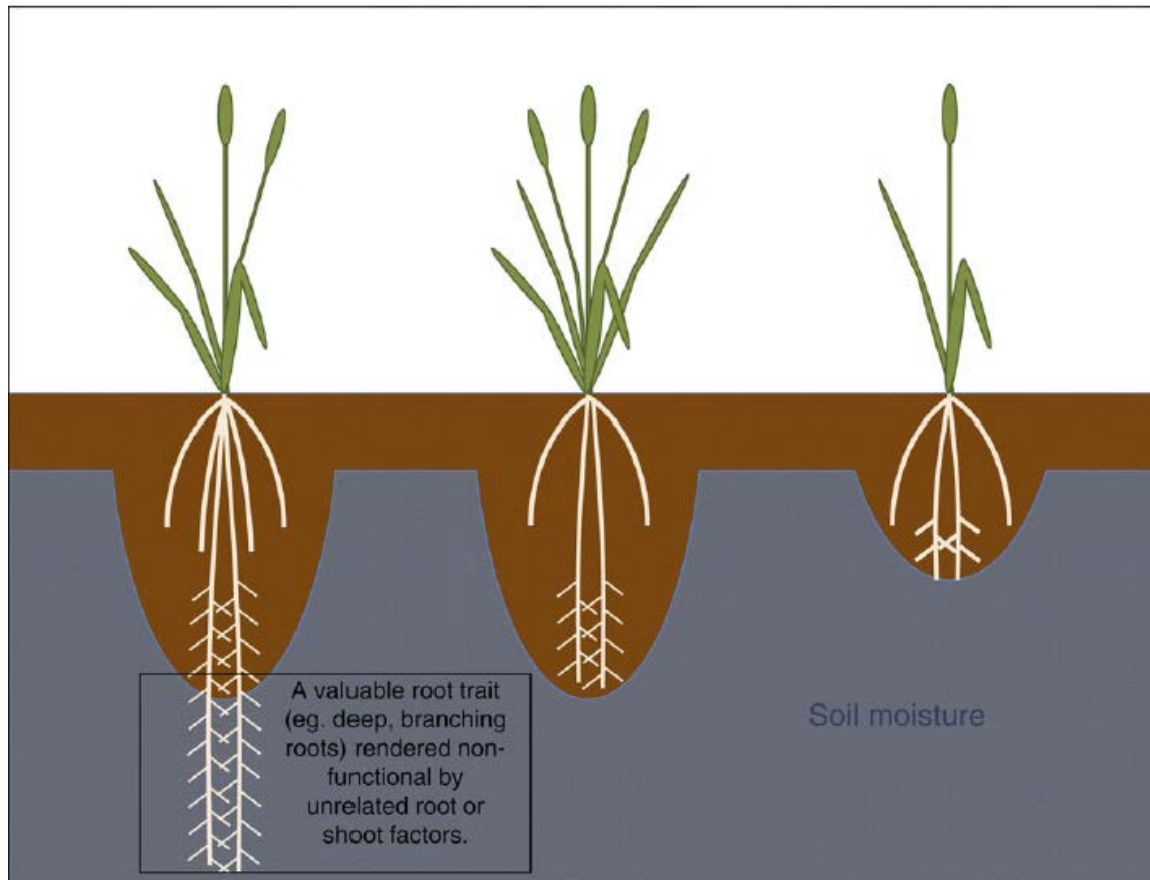


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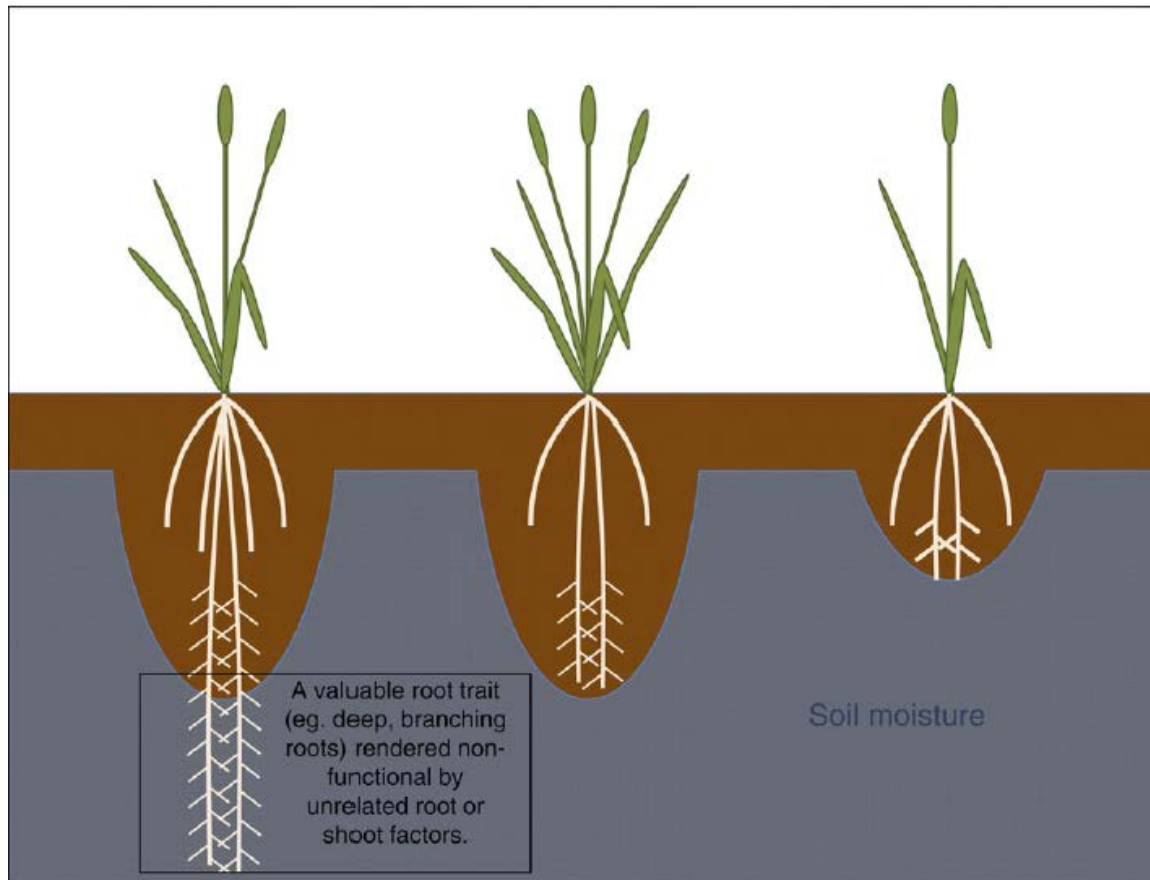
High-throughput techniques for the direct evaluation of root systems in the field do not yet exist



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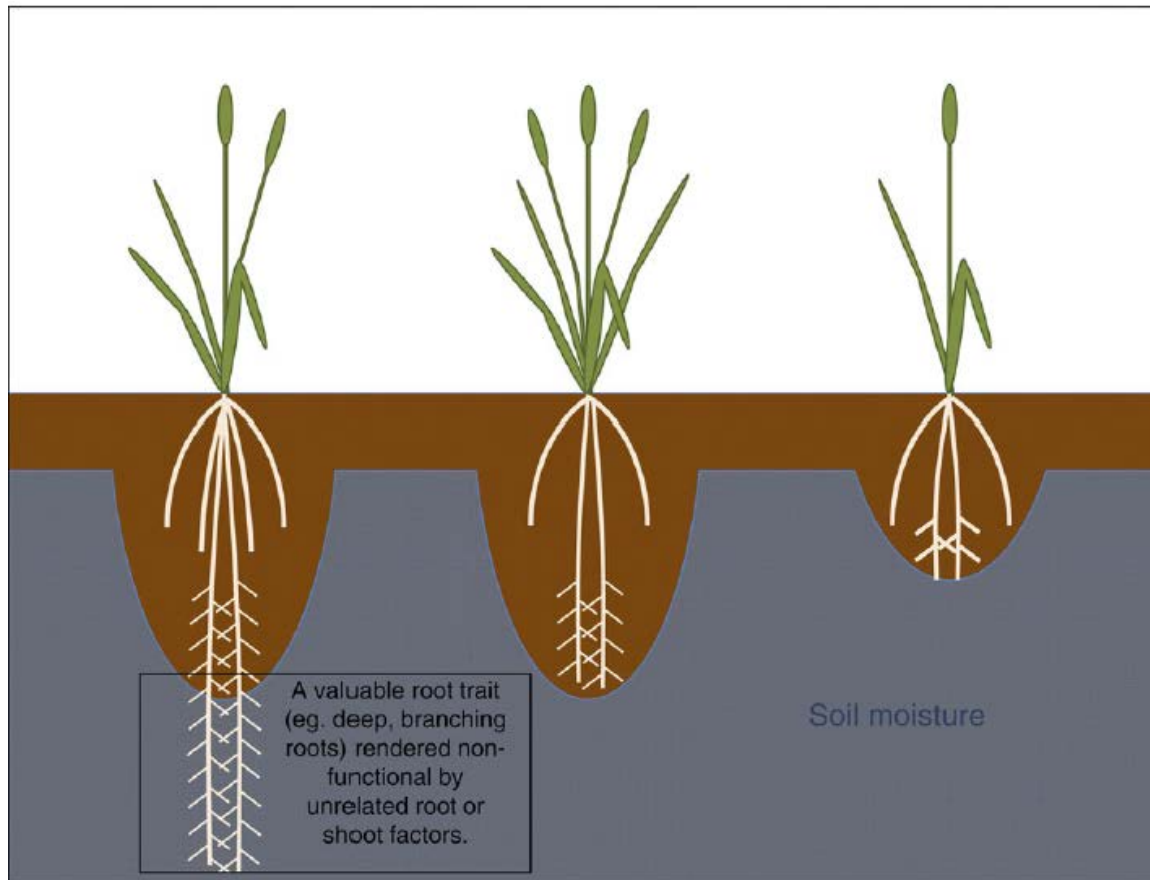


Indirect methods of root phenotyping

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Rate of surface drying

Depth of soil drying detected

Field methods

Electrical resistivity tomography (ERT)

Provided a 2D or 3D image of resistivity from measurements made using electrodes in contact with the soil.



Electromagnetic induction (EMI)

Also called “terrain conductivity” – gives a measurement of electrical conductivity integrated over some depth, measured without contact with the soil.



Example results

Electrical imaging at the Woburn site



Example results

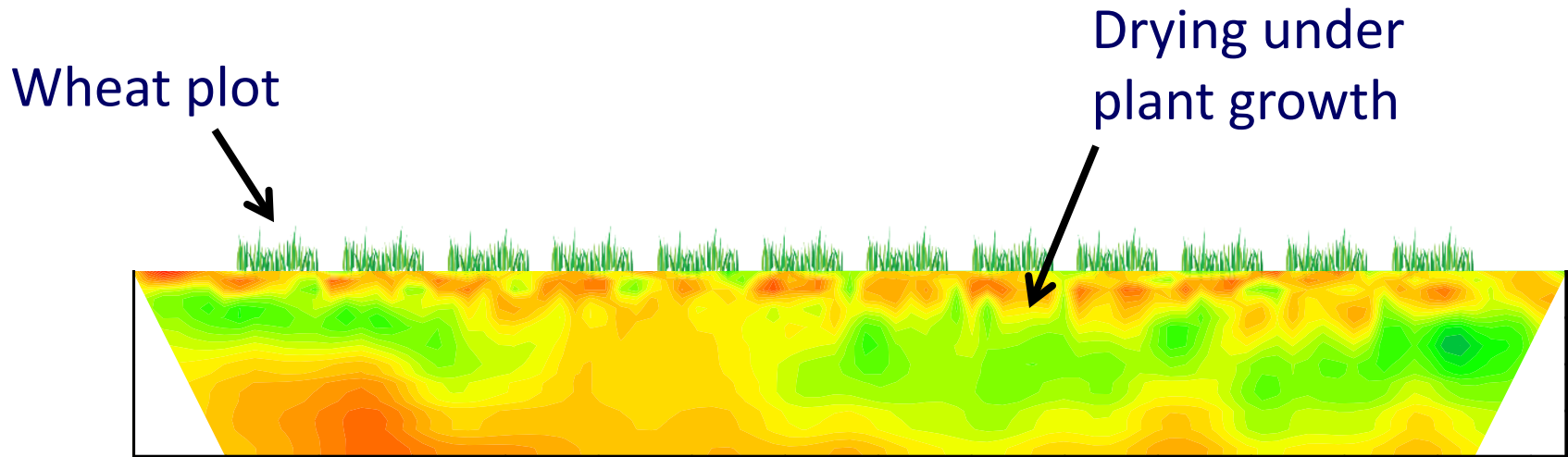
Electrical imaging at the Woburn site



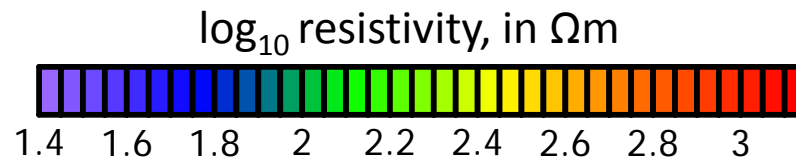
Example results

Electrical imaging at the Woburn site

Rain fed (unirrigated results)



19-April-2011

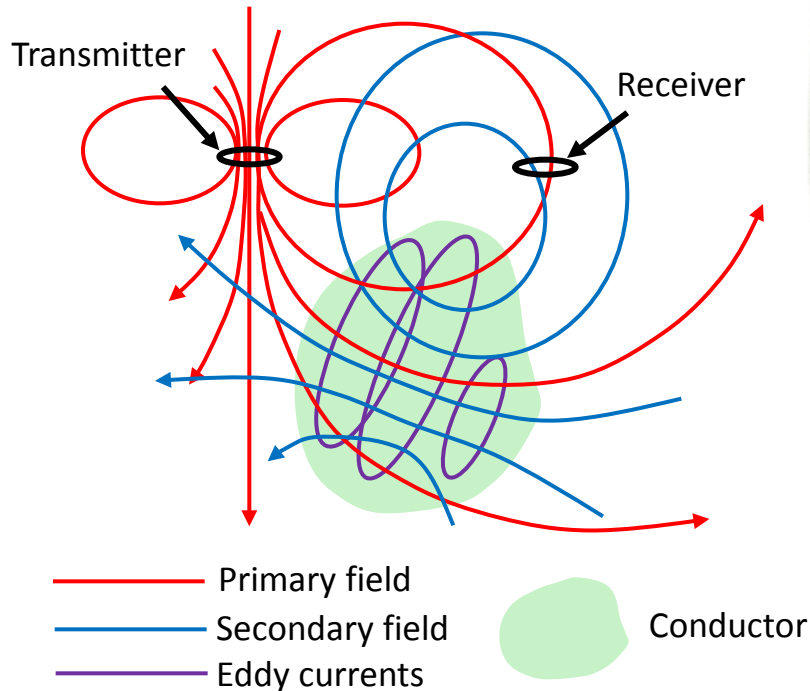


Electromagnetic Induction (EMI)

Transmitter creates primary electromagnetic field

GPS tracks location

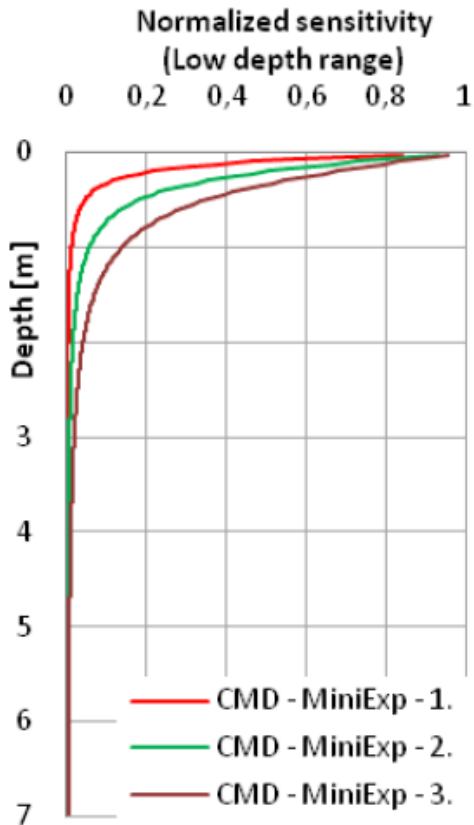
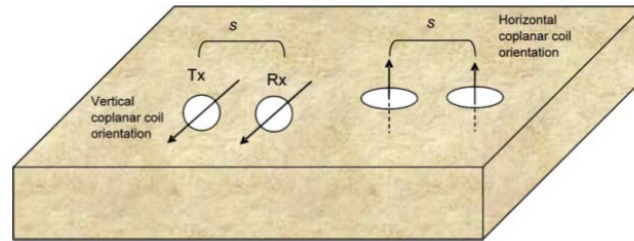
Data logger



Receiver measures secondary field created in the ground (which is a function of the electrical conductivity of the ground)

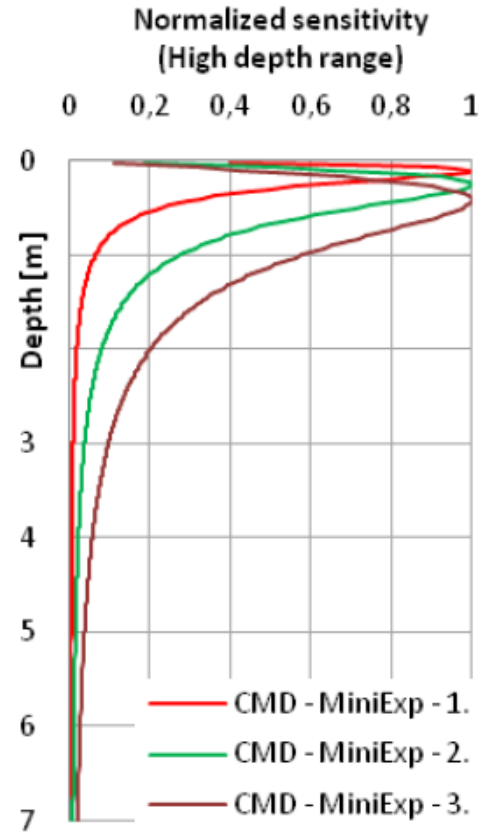
Electromagnetic Induction (EMI)

This gives us 6 possible depths of investigation



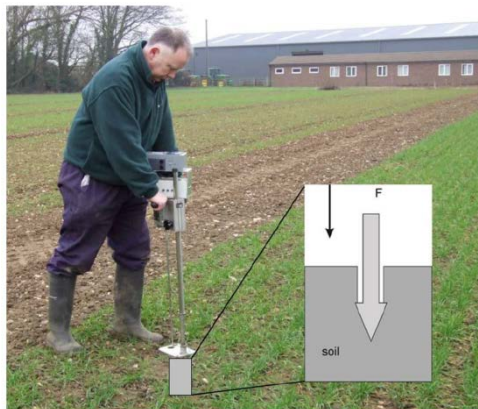
0.25m
0.5m
0.9m

0.5m
1.0m
1.8m

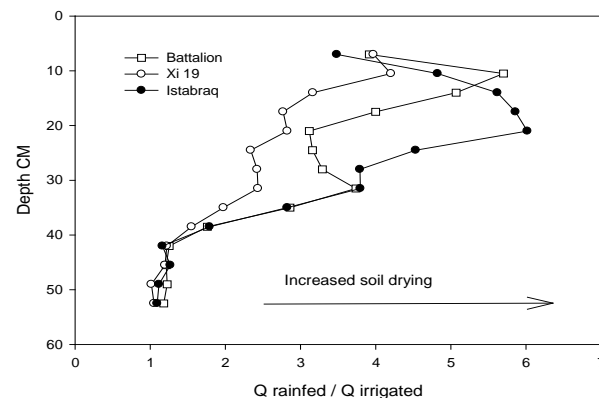


Other proposed field methods

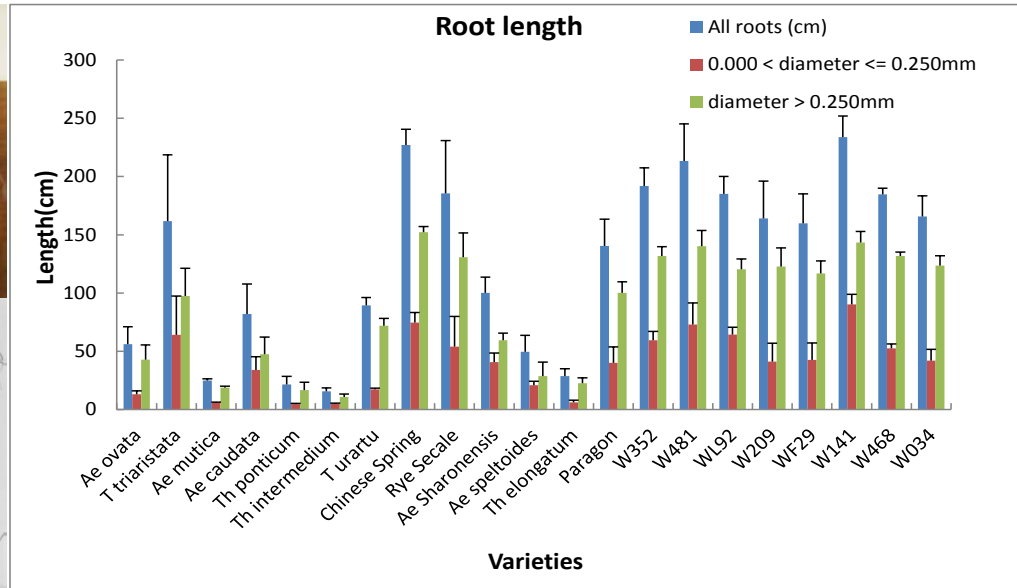
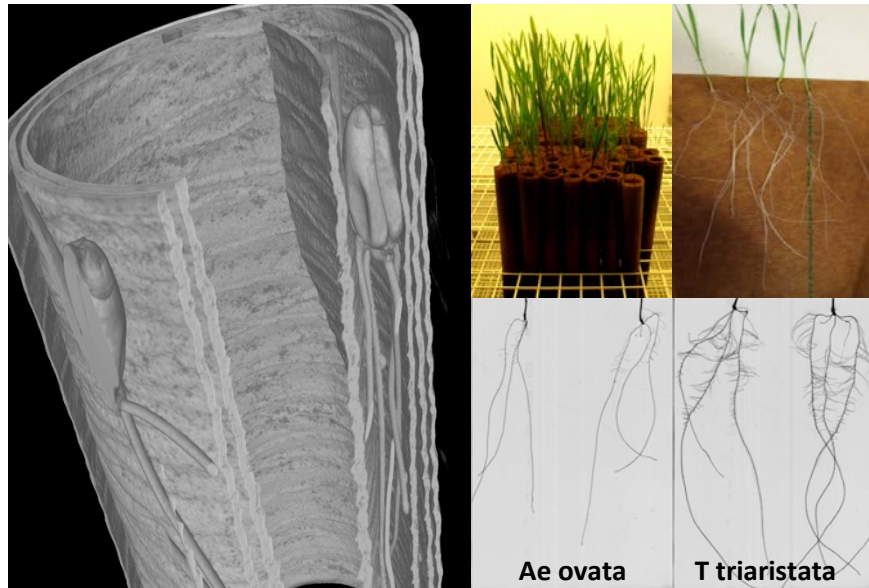
- Penetrometer



- Manual sample to confirm inferred differences
- Glass tubes on selected wheats
- Development of an approach similar to “shovelomics” for wheat
- The use of qPCR of soil-extracted DNA
- Soil water profiles



'Cigar roll'-screening of seedling roots



Summary

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