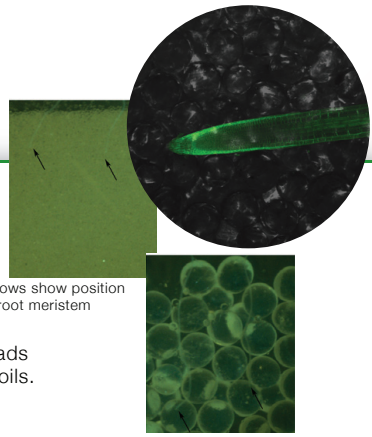
Defining the soil for controlled environments and in the field -SCRI examples

Blair McKenzie
Paul Hallett
Glyn Bengough
Tracy Valentine

Increasing Precision

Increasing Scale

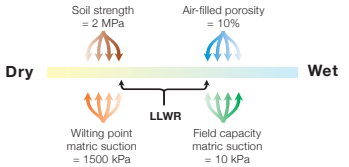
In vitro growth analysis

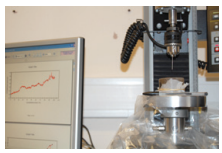


Arrows show position of root meristem

- We use model plants such as Arabidopsis grown in sterile nutrient media and glass beads to explore root / soil physical interactions.
- Large glass beads inhibit root growth by forcing roots to grow around, mimicking stony soil.
- Smaller glass beads impede roots at the tip - roots are forced to push beads aside in order to grow, mimicking the physical conditions in more sandy soils.
- Confocal laser scanning microscopy and image analysis allows detailed investigation of these interactions.

Soil as a growing media

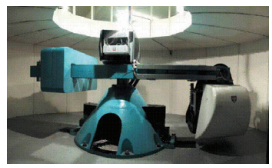


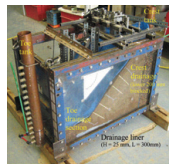


- In wet soil root growth may be limited by poor drainage and inadequate oxygen supply.
- In dry soil root growth may be limited by lack of water and soil strength.
- The least limiting water range (LLWR) combines these into a single index of soil physical quality.
- We use the LLWR to characterise soil used as growing media for experiments under controlled environments.

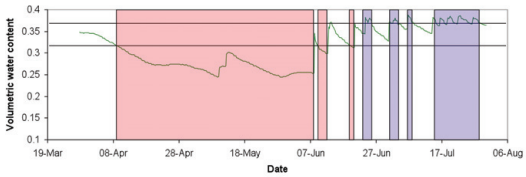
Centrifuge testing (in collaboration with Geotechnical Engineering, University of Dundee)

- Physical modelling on slope reinforcement by vegetation.
- At 20 x gravity, 1m model behaves like 20 m slope.
- Controlled environment and high resolution water measurements.





Field scale



Red = mechanical impedance; Blue = hypoxia
Physical stresses limiting barley root growth
(28cm depth, sandy loam, SCRI, 2007)

- In the field roots experience different physical stresses throughout a season.
- We relate the Field scale to Soil as a growing media using the same LLWR concept.
- We study and quantify the physical stresses (oxygen, water and strength) on root growth.
- We seek to understand how roots respond physiologically to these stresses.