Quantifying and alleviating deep seated compaction in arable soils

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5th March 2019

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Risk factors for subsoil compaction

85% surface area trafficked

65% surface area trafficked
Is subsoil compaction cause for concern?
Identification and alleviation

0 mm

250 mm

1000 mm
Plant roots as soil engineers

Roots modify soil structure
- Improve infiltration
- Penetrate dense layers

Governing traits able to be selected through plant breeding

**Root Output Example**

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Root Count</td>
<td>20</td>
</tr>
<tr>
<td>Total Root Length</td>
<td>424.29 mm</td>
</tr>
<tr>
<td>Total Root Volume</td>
<td>98.94 mm$^3$</td>
</tr>
<tr>
<td>Total Root Area</td>
<td>707.35 mm$^2$</td>
</tr>
</tbody>
</table>
Deep rooted cover crops experiment

- **Topsoil** (SCL, 6.2% OM)
  - Depth: 300 mm
  - Theta access: Ø 250 mm
- **Subsoil** (SL, BS 8601 <2% OM)
  - Depth: 1000 mm

**Crop Dry Biomass (g)**

- **Radish**
  - Bulk Density: 1.2 g cm\(^{-3}\)
  - Bulk Density: 1.4 g cm\(^{-3}\)
  - Bulk Density: 1.6 g cm\(^{-3}\)

- **Oat**
  - Bulk Density: 1.2 g cm\(^{-3}\)
  - Bulk Density: 1.4 g cm\(^{-3}\)
  - Bulk Density: 1.6 g cm\(^{-3}\)
NIAB STAR experiment

Continuous winter Wheat

Alternate cover crop

- Treatments repeated 12 years
- NIAB management and data
- Penetration resistance (800 mm)

Plough (250 mm)

Deep non-inversion (250 mm)

Shallow non-inversion (100 mm)

- EC Moisture Probes (1000 mm)
- Undisturbed soil cores (800 mm)
- Yield and crop quality
NIAB STAR results so far…

Penetration Resistance

Undisturbed Soil Cores

800 mm depth cores - 200 mm layers

Texture: PSD and OM
Structure: BD, X-Ray CT
Porosity: water retention, conductivity
Aggregate stability: wet sieving
Roots – dry root mass
Next steps…

1. Deep rooted cover crops experiment
   - Spring Barley
   - Soil and crop measurements

2. NIAB STAR experiment
   - Further data collection dependant on results of current analysis

3. Detection of subsoil compaction
   - Calibrate penetration resistance and soil moisture using X-Ray CT scanning
Lateral thinking...