

# Quantifying and alleviating deep seated compaction in arable soils

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## **Risk factors for subsoil compaction**





## Is subsoil compaction cause for concern?







![](_page_4_Picture_5.jpeg)

![](_page_5_Picture_0.jpeg)

## **Identification and alleviation**

![](_page_5_Picture_2.jpeg)

# 250 mm

![](_page_5_Picture_4.jpeg)

![](_page_5_Picture_5.jpeg)

Subsoil structural quality (Ssq) assessment of a soil layer SubVESS Flowchart

a) Mottl	ling E	b) Strength	b) Porosity	c) Roots	e) Aggregates	Ssq Subscil quality
Aldre.	Ja-3a No monting or many diffue (faint) mothes	1b-2b Easily fragmented with fingers	1d Many small pores (# 2mm) throughout, includes loose sand	1c-2c Roots growing through- out	1e Rounded friable aggregates	5sq1 Friable with high porosity and features. Good drainage and aeration.
			2d As for 1d, but occasional lata porous zones		2e Uniform, small scale roughness due to sub-angular aggregates	Ssq2 Firm with slightly less porosity and fiszures than 5sq1, but with only a small effect on rooting. If present, mottling due to anaerobism is minus-
A State		3b Difficult to penetrate with knile and slices keep their shapes after breakage	3d Visible ponosity mostly outside aggregates as cracks, isolated pones and earthworm holes, acting as bypass pores	3c Roots mainly in cracks and worm channels	Be Large-Scale angular roughness with angular aggregates	Ssq3 Some compaction as either natural or man- made pans among angulas or weak-grained structures If present, mottling due to anaerolskim is faint.
	Less title dense here coloured tenso Accurate tenso Accurate tenso Accurate tenso Accurate tenso Accurate tenso	4b-5b Fragments are difficult	4d Very tew small pores and cracks visible on broken surfaces (c 5/100 cm²)	4c Roots can be distorted	4e Dense with a mixture of angular aggregates and poorly visible structure. Knile marks visible. Includes single grain structures	Ssq4 Compact or large scale structures. Large aggregates, oossibly prismatic, laminated or single grained. If poor drainages, grey colours, motiles few and well- defined.
Anti Multer Med. Capit		and are angular wedges	Sd No pores or few, blocked channels	Sc No roots	Se Simpolih unbroken face very dense, No visible structure. Fragments tough (clay). Knife marks visible	SSQ5 Massive or structureless. Dense structural units with smooth, unbrowen faces, possibly laminated. If pour drainage, colour mostly grey, with very few wolf- defined motifes.

![](_page_5_Picture_8.jpeg)

## Plant roots as soil engineers

![](_page_6_Picture_1.jpeg)

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Roots modify soil structure

- Improve infiltration
- Penetrate dense layers

Governing traits able to be selected through plant breeding

#### **Root Output Example**

Root Count	20		
Total Root Length	424.29 mm		
Total Root	98.94 mm <sup>3</sup>		
Volume			
Total Root Area	707.35 mm <sup>2</sup>		

#### **Deep rooted cover crops experiment**

![](_page_7_Figure_1.jpeg)

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## **NIAB STAR experiment**

#### Continuous winter Wheat

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#### 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

![](_page_9_Picture_0.jpeg)

### NIAB STAR results so far...

#### **Penetration Resistance**

![](_page_9_Figure_3.jpeg)

#### **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

![](_page_9_Picture_7.jpeg)

![](_page_10_Picture_0.jpeg)

- 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

![](_page_10_Picture_8.jpeg)

![](_page_11_Picture_0.jpeg)

## Lateral thinking...

![](_page_11_Picture_2.jpeg)

![](_page_11_Picture_3.jpeg)

![](_page_11_Picture_4.jpeg)

![](_page_11_Picture_5.jpeg)