Assessing and remediating soil structural degradation

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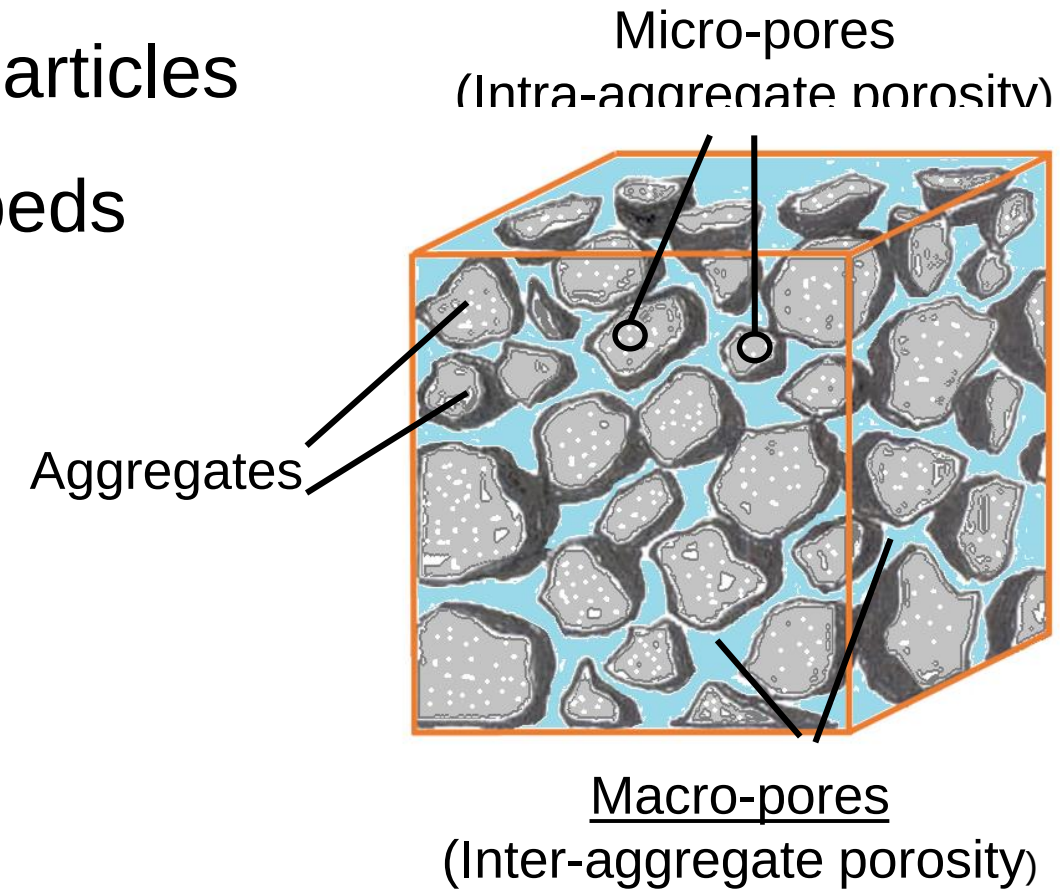
Presentation overview

- The importance of Soil Structure
- How to assess Soil Structure on tillage soils?
- How to interpret the results?
- What remediation options are available?

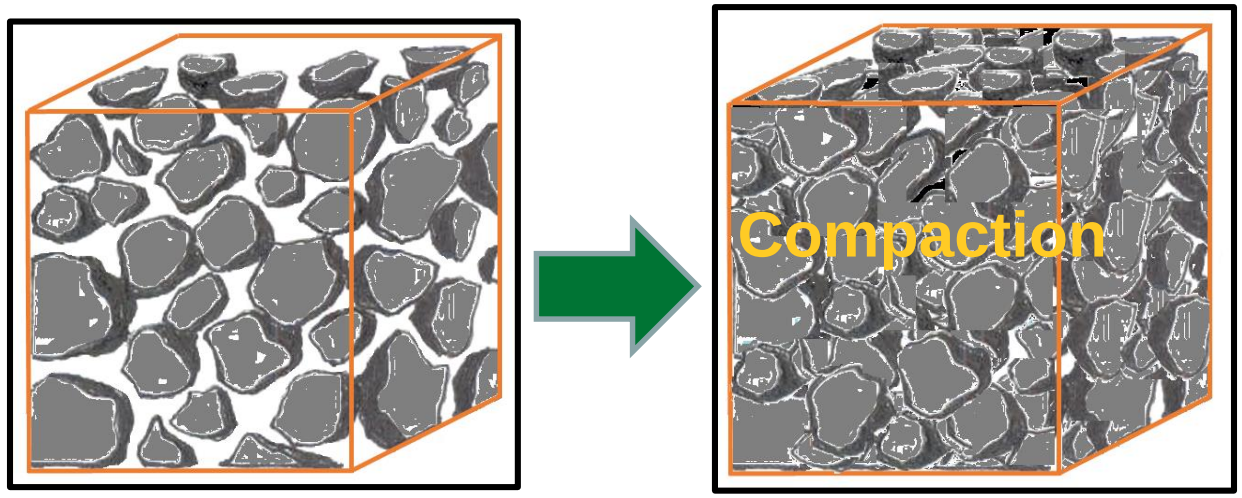
Soil Structure

- The arrangement of individual particles into larger units or aggregates/peds
- Affects
  - Water movement
  - Aeration
  - Heat transfer
  - Porosity



Soil Structure: Influenced by

- Weathering processes
- Activities of living organisms
- Organic Matter
- Liming
- Tillage operations
- Trafficking- machinery and livestock



Assessment of soil structural quality

- VESS- Visual Evaluation of Soil Structure
- Visual and tactile assessment
- Rapid, easily interpreted, equipment
- Double Spade Method (DS) – mini-profiles

  in soil pits to 40 cm depth

Soil Assessment using the Double Spade Method - Video

Aggregate size

Generally, the larger the aggregates, the poorer the soil structural quality.

Good Quality

Predominantly small

Moderate Quality

A mixture of sizes

Poor Quality

Predominantly large

Aggregate shape

The sharper (more angular) the aggregates, the poorer the structural quality.

Good Quality

Predominantly round

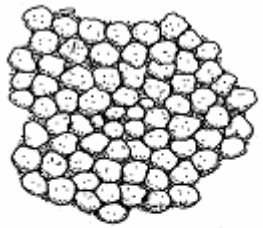
Moderate Quality

Rounded but with edges

Poor Quality

Predominantly sharp/angular

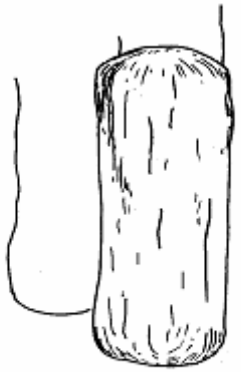
Different structural shapes



Granular

Subangular Blocky

Angular Blocky



Columnar

Prismatic

Platy

Aggregate Strength

Assess how easy it is to break, first between your finger and thumb, then with one hand.

Good Quality

Easy to crumble between finger and thumb

Moderate Quality

Firm but fairly easy to break with one hand

Poor Quality

Difficult to break with one hand

Aggregate Porosity

Break aggregates open and examine the porosity within. If aggregates too small (i.e. aggregates 1 to 2 cm in width) it is a sign of good porosity for the entire layer.

Good Quality

Many pores and cracks

Moderate Quality

Limited pores or cracks

Poor Quality

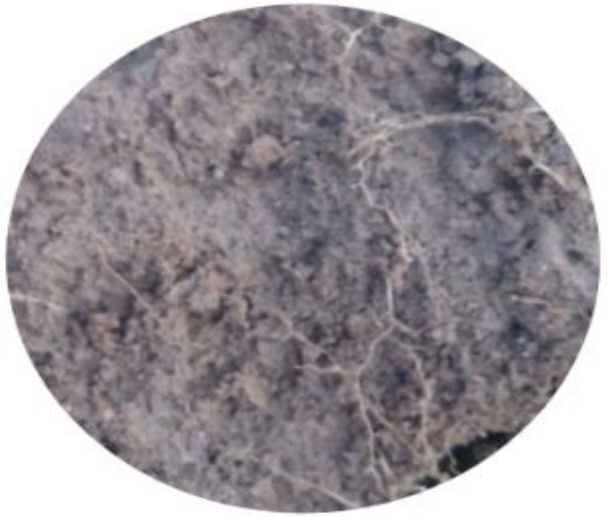
No pores or cracks

Rooting

Assess root growth within the layer and within aggregates. Fibrous roots should be able to grow unrestricted through the soil layers and aggregates.

Good Quality

Many growing throughout



Moderate Quality

Fewer but within aggregates

Poor Quality

Distorted, restricted or no roots

Soil colour and smell

Indicate the drainage status of the soil. Soil should smell earthy but poor drainage can cause foul or putrid smells and is a sign of poor structural quality. Mottling in the profile indicates impeded drainage

Good Quality

No orange or blue/grey zones

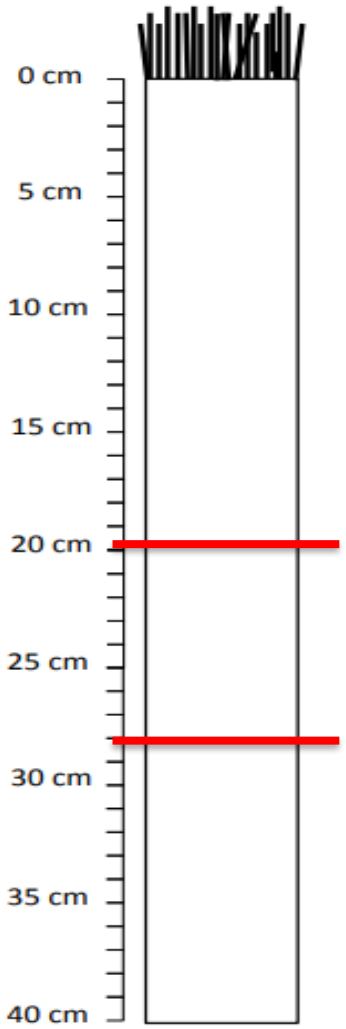
Poor Quality

Orange or blue/grey zones

Double Spade Method

Sample Point
Lane field

Record the position of structural layers below



A Penetration Resistance

	Layer 1	Layer 2	Layer 3
1 Easy to insert trowel / knife	✓		
2 *Intermediate value*			✓
3 Requires some force to insert trowel / knife			
4 *Intermediate value*			
5 Requires considerable force to insert trowel / knife		✓	

B Redox Morphology

	Layer 1	Layer 2	Layer 3
1 No mottling evident			✓
2 *Intermediate value*	✓	✓	
3 Distinct orange mottles present			
4 *Intermediate value*			
5 Grey / blue zones present			

C Aggregate / Fragment Size

	Layer 1	Layer 2	Layer 3
1 Aggregates predominantly small (< 3 cm)			
2 *Intermediate value*	✓		
3 Aggregates predominantly large (> 5 cm)			✓
4 *Intermediate value*		✓	
5 No aggregation, only fragments from a solid block obtainable (or single grain)			

D Aggregate / Fragment Shape

	Layer 1	Layer 2	Layer 3
1 Predominantly rounded (can include granular)			
2 *Intermediate value*	✓		
3 Mixture of sub-angular and angular			✓
4 *Intermediate value*		✓	
5 Predominantly angular with smooth faces (or single grain)			

E Intra-aggregate porosity

	Layer 1	Layer 2	Layer 3
1 Many fine pores visible	✓		
2 *Intermediate value*			
3 Some cracks and fissures visible			✓
4 *Intermediate value*		✓	
5 No pores, cracks or fissures visible			

F Rupture Resistance

	Layer 1	Layer 2	Layer 3
1 Crumbles easily between forefinger and thumb	✓		
2 *Intermediate value*			
3 Requires one hand to break			✓
4 *Intermediate value*			
5 Requires considerable effort or two hands to break		✓	

G Rooting

	Layer 1	Layer 2	Layer 3
1 Roots unrestricted and growing throughout	✓		
2 *Intermediate value*			
3 Roots few, restricted or distorted			
4 *Intermediate value*		✓	✓
5 No roots evident			

Layer Scores

	Score Total		Layer Score
Layer 1	10	÷ 7 =	1.4
Layer 2	28	÷ 7 =	4
Layer 3	19	÷ 7 =	2.7

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Scoring the profile

Layer Scores

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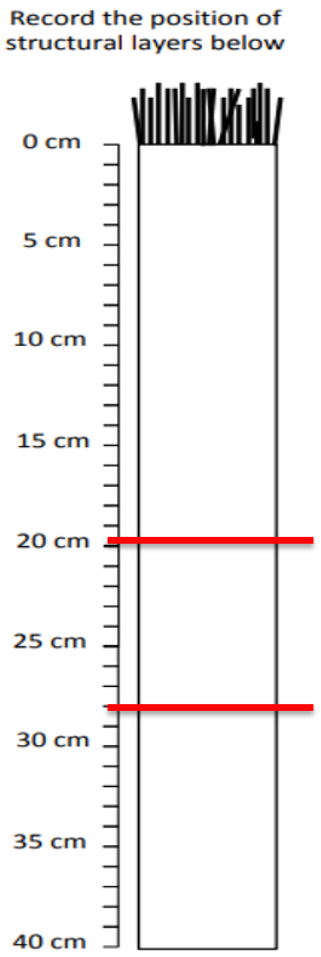


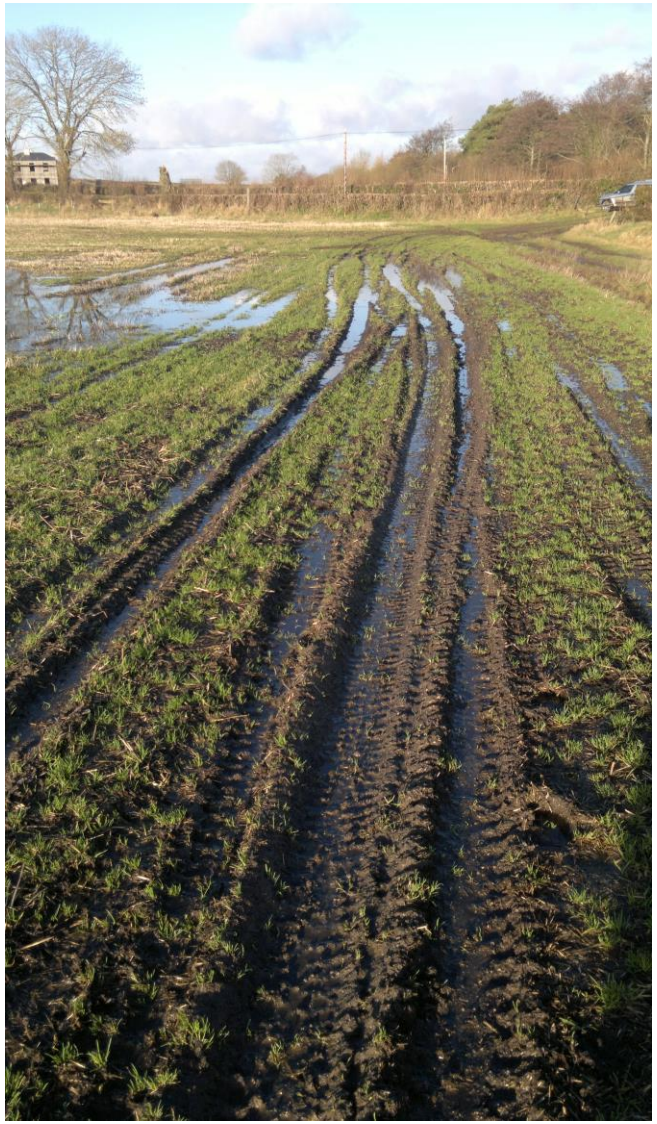
- Layer score x layer depth
  - Layer 1: 1.4 x 20 cm = 28
  - Layer 2: 4.0 x 8 cm = 32
  - Layer 3: 2.7 x 12 cm = 32.4
- Total layers and divide by total profile depth to give profile Structural quality (Sq) score
  - 92.4 ÷ 40 cm= Sq 2.31

Results

- Score 1- Friable
- Score 2- Intact
- Score 3- Firm
- Score 4- Compact
- Score 5- Very compact

Prevention

- Minimise traffic (livestock and machinery) when soils are soft and wet
- Timing and depth of cultivation/ploughing
- Off-set machinery load with lower tyre pressure, IF/ VF tyres, increased tyre width, dual tyre systems or tracks
- Control traffic to contain compaction to limited areas of the field



Remediation

- Time- weathering
- Cover crops- canopy and root penetration
- Crop rotation
- Addition of organic matter
- Lime application on acid mineral soils
- Alternate plough depth

Mechanical intervention

- If compaction is between 25-45cm
- You must know where the compact layer lies and it's depth- around the field
- Soil must be dry at depth
- Manage traffic- do not recompact

Summary

- Soils structure is the cornerstone of soil health
- Double spade method- easy and accurate way to assess soil structure
- Preventing damage is best option for maintaining productive soils
- Mechanical intervention is a last resort

Thank you for your attention!