



TI-test: A simple spade method to encourage more farmers and advisors to assess soil structure

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Outline

- Context, aim and approach
- Description of the TI-test and how it is used
- Discussion and conclusion



Context, aim and approach

General context of soil structure assessment

- Soil structure maintenance: one of the 4 key ecosystem functions of agricultural soil health (Kibblewhite *et al.* 2008)
- Methods to assess soil structure needed to help scientists, advisors and farmers assess and manage soil health (Mueller *et al.* 2013)
- Two main types of visual methods (Emmet Booth *et al.* 2016) :
 - ✓ **Profile methods** (SOILpak, Le Profil Cultural, SubVESS...): best for a detailed and comprehensive assessment of soil structure at specific field location
 - ✓ **Spade methods** (VSA, VESS, ISARA...): best for quick diagnosis and wide spatial evaluation



Soil structure assessment in France

- Methods mainly used:

Le Profil Cultural
(Gautronneau & Manichon 1987;
Boizard *et al.* 2017)



Mini 3D soil profile
(Tomis *et al.* 2019)



ISARA
(Peigné *et al.* 2019)



VESS
(Ball *et al.* 2007;
Guimaraes *et al.* 2011)



- But soil structure assessment by advisors and farmers remains rare



How to encourage more farmers and advisors assess
soil structure and more frequently to improve decision
making?

Aim and approach

- Aim: to develop a simple spade method that can be widely used by both advisors and farmers to encourage soil structure assessment
- Criteria to consider:
 - ✓ **Quick** to set up and suitable for **non-experts**
 - ✓ **Accurate** for **tillage decision making**
 - ✓ **Consistent** with **other methods used in France**
- Development decisions:
 - ✓ Use of 'Le Profil Cultural' soil structure description criteria
 - ✓ Inspiration and simplification of the ISARA test (Peigné *et al.* 2019)
 - ✓ Integrating the latest developments of 'Le Profil Cultural' (Boizard *et al.* 2017)
 - ✓ Enabling an equivalent Sq score using the VESS method (Guimaraes *et al.* 2011)




Description of the TI-test and how it is used

Main steps of the test




- Step 1: sampling (not specific)
- Step 2: soil structure description
 - ✓ Spatial arrangement of clods and aggregates on the entire trench
 - ✓ Type of porosity within clods and aggregates after breaking the trench
 - => Several horizons can be distinguished
- Step 3: soil structure assessment and decision making



Spatial arrangement of clods and aggregates

Observation	Structural type	Visual example	Interpretation
The soil does not stand on the spade and disintegrates into fine aggregates	O - Open (fine aggregates)		High porosity, no compaction
The soil stands on the spade, breaking up into decimetric clods with a few fine aggregates after taking the soil sample	B - Bloc (decimetric clods)		Compacted (or very dry clayey) soil fragmented by deep tillage
The soil stands on the spade in a massive block with no fine aggregates even after taking the soil sample	C - Continue (massive monobloc)		Severe compaction with no structural porosity OR Non-tilled soil re-consolidated over time (little structural porosity)

Type of porosity within clods and aggregates

Observation	Structural type	Visual example	Interpretation
High structural porosity, with visible aggregates and rough surface	Porous (Gamma γ)		No compaction, high porosity clods or aggregates
Low porosity limited to some cracks and/or earthworm burrows or casts, smooth faces	Compacted and partially regenerated: -Phi ϕ => cracks in all directions, -Platy P => horizontal cracks, - Δb => Δ with burrows or casts		Compacted clods being regenerated under the influence of weathering or biological activity
No porosity visible to the naked eye, smooth faces	Compacted (Delta Δ)		Clod resulting from severe compaction

Soil structure assessment for each horizon

		Type of porosity within clods and aggregates		
		Porous (Gamma Γ)	Compacted and partially regenerated (Phi ϕ , Platy P or Δb)	Compacted (Delta Δ)
Spatial arrangement of clods and aggregates	O - Open (fine aggregates)	Or	O ϕ , OP, O Δb	Unlikely to occur
	B - Bloc (decimetric clods)	B Γ	B ϕ , BP, B Δb	B Δ
	C - Continue (massive monobloc)	C Γ	C ϕ , CP, C Δb	C Δ

Favourable soil structure

Moderately favorable soil structure

Very poor soil structure

Sq score equivalence

		Type of porosity within clods and aggregates		
		Porous (Gamma Γ)	Compacted and partially regenerated (Phi ϕ , Platy P or Δb)	Compacted (Delta Δ)
Spatial arrangement of clods and aggregates	O - Open (fine aggregates)	O Γ => 1*	O ϕ , OP, O Δb => 2*	Unlikely to occur
	B - Bloc (decimetric clods)	B Γ => 2*	B ϕ , BP, B Δb => 3*	B Δ => 4*
	C - Continue (massive monobloc)	C Γ => 3*	C ϕ , CP, C Δb => 4*	C Δ => 5*

- ✓ Notes 1 to 5 are the equivalent Sq scores of the VESS method
- ✓ Based on qualitative equivalence in the description of structural states
 - ✓ It facilitates (i) quantitative analysis of the test and (ii) the comparison of the results using different methods

TI-test & decision making



- Example of a successful implementation for the choice of adapted tillage to optimize winter oilseed rape establishment (Cadoux *et al.* 2019):

		Type of porosity within clods and aggregates		
		Porous (Gamma Γ)	Compacted and partially regenerated (Phi ϕ , Platy P or Δb)	Compacted (Delta Δ)
Spatial arrangement of clods and aggregates	O - Open (fine aggregates)	No-till preferable	No-till preferable	Unlikely to occur
	B - Bloc (decimetric clods)	No-till preferable	No-till possible only if compaction below 10cm	Tillage required on the observed compaction depth
	C - Continue (massive monobloc)	Tillage or no-till possible	Tillage required on the observed compaction depth	

Discussion and conclusion

VESS

Le Profil Cultural



Mini 3D soil profile

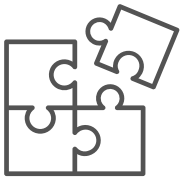


ISARA



TI-test

Same soil structure description criteria



Simplicity considering the time, expertise and equipment required

- ✓ TI-test completes a panel of methods using the same soil structure description criteria, offering a degree of simplicity and comprehensiveness
- ✓ It's linked to the widely adopted VESS method
- ✓ It enables a direct link to tillage advice



Thank you for your attention!

