

Soil compaction vulnerability

Compaction means an increase in soil density, and it produces negative effects in the form of reduced permeability and root growth. In the case of farmland, the economic impact of this form of soil degradation as a result of lower crop yields is by no means negligible (Gosselin 1986).

Soil compaction vulnerability depends on the farm machinery used and the soil's water content at the time the machinery is driven over it. The soil textures that are most sensitive to compacting are those that are rich in clay. The soil characteristics that have been selected for the general assessment model are organic matter content, surface layer texture and drainage class (Table 1).

Table 1. Soil compaction vulnerability assessment model

Drainage						
Very rapidly drained to well-drained		Nil to low				
Moderately well drained to imperfectly drained Poorly to very poorly drained Very poorly drained	Organic soils Peaty	Nil to low				
	Peaty (fibric and mesic)	Nil to low				
	Peaty (humic)	Moderate				
Moderately well to imperfectly drained	Mineral soils Texture class of A horizon*	Organic carbon content of A horizon				
		Low (<1.7%)	Moderate (1.7-4%)	High (4-9%)	Very high (9-17%)	
		Nil to low				
		Moderate	Nil to low	Nil to low	Nil to low	
Poorly to very poorly drained	1 and 2 3 4 and 5	High	Moderate	Nil to low	Nil to low	
		1 and 2	Moderate	None to low	Nil to low	Nil to low
		3	High	Moderate	Nil to low	Nil to low
		4 and 5	High	High	Moderate	Nil to low

*See definition of texture classes in Table 2
Adapted from Martin and Nolin 1991

Table 2. Definition of texture classes

Class	Texture	Definition
1	Coarse	Coarse sand (CS), medium sand (S), fine sand (FS), very fine sand (VFS) and loamy sand (CLS, LS, FLS) (e.g. La Présentation series)
2	Medium coarse	Very fine loamy sand (VFSL) and coarse to fine loamy sand (CLS, LS, FLS) (e.g. Rougemont series)
3	Medium	Very fine sandy loam (VFSL), loam (L) and silty loam (SiL) (e.g. Ste-Rose series)
4	Medium fine	Sandy clay loam (SCL), clay loam (CL) and silty clay loam (SiCL) (e.g. Du Jour series)
5	Fine	Sandy clay (SC), clay (C), silty clay (SiC) and heavy clay (HC) (e.g. Providence series)
P	Peaty	Peaty surface layer ($\geq 17\%$ organic C) (e.g. Nobel series)

Agriculture Canada 1976, Day and McMenamin 1983

Soils are less vulnerable to compaction if subsurface drainage is in place: 58.5% of drained soils display low vulnerability, compared to 34% for soils that are not drained, and 18.9% display high vulnerability compared to 41.9% for soils that are not drained. Clay soils are characterized by high compaction vulnerability (e.g. Providence series). Coarse-textured soils are least vulnerable (e.g. Massueville series).

The map shows the extent of the problem and the importance of adapting tillage practices on the basis of soil vulnerability. Compaction during spring ploughing appears to be inevitable, owing to the fact that soils are frequently water-saturated and the fact that farmers have to sow as early as possible. In the fall, one preventive measure would be to plough before soil moisture is too high. Including shorter-season crops in the rotation significantly reduces the risk of compaction.