COMPACTION OF AGRICULTURAL AND FOREST SOILS

SOILS Focus 2

Compaction is a phenomenon whereby the soil structure is deteriorated by mechanical pressure, mainly due to the passage of heavy machinery. It can reduce agricultural yields, affect the vitality of forest stands and reduce the infiltration capacity of stormwater, resulting in increased risks of erosion, flooding and surface water pollution.

Variable sensitivity to a non-reversible phenomenon

The behaviour of the soil is elastic up to a certain pressure threshold, beyond which the rearrangement of the constituents means that it is no longer possible to restore the initial porosity. This threshold, called the preconsolidation pressure, varies from soil to soil. It is lower if the soil constituents are fine[1], if the soils are poorly structured, poor in organic matter (OM) and damp (between October and March in general). For a given soil, the risk of compaction increases with the axle load and the number of times machinery drives over it, but decreases with increasing speed and decreasing contact pressure (wider and/or less inflated tyres). It can also vary depending on the tools used; poorly sharpened ploughshare, for example, increase the risk. Natural phenomena (freeze-thaw cycles, wetting-drying cycles, bioturbation) favour slow restoration[2] but their effects diminish rapidly with depth. In agricultural soils, conventional tillage (ploughing) makes the compaction reversible on the surface but not at depth (> 30 cm) where a compacted horizon ("plough pan") tends to form.

Risks that can be mapped

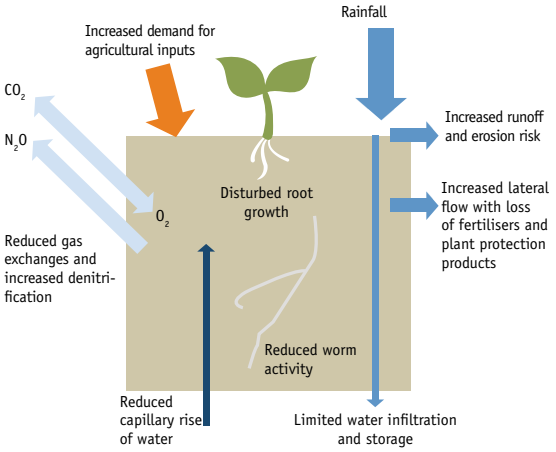
Empirical relationships make it possible to estimate preconsolidation pressure from soil properties. On this basis, compaction sensitivity classes in deep horizons (40 cm) have been attributed to Walloon soils. Overall, the most sensitive areas are the loamy, slightly stony, soils of the central part of the Ardenne, and the northern part of the north-eastern Ardenne[3]. However, these estimated sensitivities may mask significant variations in the field. Maps of compaction risk classes can also be produced for a given moisture content, load and type of tyre.

Prevention rather than cure

Prevention is based on: (i) technical adaptations (tyre pressure regulation system facilitating the adjustment of tyre pressure on the road and on the soil, wide tyres, caterpillar tracks, etc), (ii) the optimal organisation of work (taking into account the soil moisture content in planning, limiting loads and crossings over the soil, etc.), (iii) the adaptation of methods (minimum ploughing, onland ploughing, controlled traffic farming limiting the compaction to specific soil strips, forestry partitions, etc.), (iv) control over the physical state of soils (sufficient level of OM, possible drainage, the use of covering crops, etc.)[4].

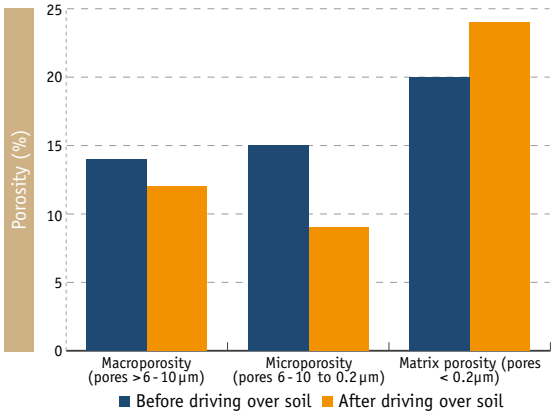
[1] Decreasing sensitivity of clayey soils to loamy soils, then sandy; decreasing sensitivity if stony load | [2] 5 to 40 years in forests depending on the type of soil and the level of compaction (ULg-GxABT, 2013a) | [3] → Map 42 | [4] See good practice guidelines (ULg-GxABT, 2013b, 2013c) and www.prosensols.eu/fr/

Fig. SOILS Focus 2-1 Effects of compaction on the functioning of agricultural soil



SOERW 2017 – Source: According to Vlaamse Landmaatschappij

Fig. SOILS Focus 2-2 Example of the impact of a passing skidder* on the porosity of a Walloon soil under forest**.



* *Timberjack TJ810D*
** *Distribution of porosity at a depth of 40 cm in the Rulles forest (beech wood on stony loam with schisto-phyllatory load and favourable natural drainage)*

SOERW 2017 – Source: ULg-GxABT