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Short Communication Open Access

Study: How to choose the Topsoil

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Definition of Topsoil

Topsoil is the surface horizon of the soil that supports and nourishes the vegetation. It consists essentially of four main elements that are organic matter, clay, silt and sand. The proportion of each of these elements can be extremely variable, which indicates a wide variety of topsoil.

A plant is characterized by the essential presence of a multitude of living beings and a weight content of organic material ranging between 1% and 6%. When this content exceeds 6%, the land is considered organic substrate (compost, peat.), and when less than 1% organic matter, the soil is called "gross". Moreover, it must not contain elements that may prohibit the use of cleaning equipment. Topsoil often differs from gross underlying soil by a darker color due to the presence of humus.

Classification of Topsoil

By taking into consideration three levels of maintenance for the achievement of landscaping, topsoil is now classified into 3 categories as follows:

a) The upper topsoil particularly suitable for facilities treated and the level is high maintenance (mowing lawn performed frequently with helical blades).

b) Topsoil concerning current developments regularly maintained (regular mowing with a rotary blade mower or mowing).

c) The ordinary topsoil is more for non-rustic accommodation or poorly maintained. The third category of land the one being preferably saved for the seeded spaces according to the technique of hydraulic projection [1,2].

Structural cuts and thicknesses

The substrate consists of a single layer of material which can undergo various treatments (stoning, sieving ...) identifying from 1 to 2 distinct horizons (Figure 1).

It is possible to identify six different substrates cuts:

a) Land batch deep drainage. The total thickness of the substrate is 0.17 m minimum and maximum depth of the trenches inferior to 0.03 m.

b) Land deep drainage continuously. The thickness of the substrate is 0.20 m ± 2cm.

c) The total thickness of the substrate is measured after compaction, executed with the non-vibrating roller static load that does not exceed 2 Kg per centimeter generator.

Physical characteristics

See grading range: Figure 2

Physical requirements: The top 5 cm can only belong to the horizon 1. Figure 1 is an evaluation chart of substrates depending on the amount of walks.

a) Horizon 1: The characteristics of the substrates are:

- D < 20 mm.
- Elements apparent on surface D < 10 mm.
- Less than 30% of the elements exceed 2 mm.

The 0/2 mm fraction of the soil must contain:

- Less than 8% of elements inferior to 2 µm.
- Less than 25% of elements inferior to 50 µm.

The coefficient of permeability K (NF P90-107), measured in saturated medium, before the commissioning of the grass field established should be greater than 5 ms 10^{-6}. -1.

b) Horizon 2: Substrate characteristics are:

- No greater than 80 mm element.
- Less than 5% of elements greater than 50 mm.
- Less than 20% of elements greater than 31.5 mm.
- Less than 50% of elements greater than 2 mm.

The 0/2 mm fraction of the soil must contain:

- Less than 8% of elements lower than 2 µm.
- Less than 25% of elements inferior to 50 µm.

The coefficient of permeability K (NF P90-107), measured in saturated medium, before the commissioning of the grass field established should be greater than 5 ms 10^{-6} m.s $^{-1}$.

c) Horizon 3: This horizon is formed by the unamended topsoil used for producing horizons 1 and/or 2.

Physical amendment: In order to have the above characteristics, it is necessary to correct the texture of the topsoil by thoroughly mixing it with sand. Sand amendment must have the following characteristics:

- D < 4 mm.
- Equivalent sand ≥ 50 (NF P 18-598).
- The grading curve of sand is chosen according to the topsoil, active lime content < 15% (NF X 21-106).

The quality and quantity of amendments are determined on the results basis of the granulometric analysis of the topsoil. The substrate must be homogeneous; this homogeneity is assessed by measuring

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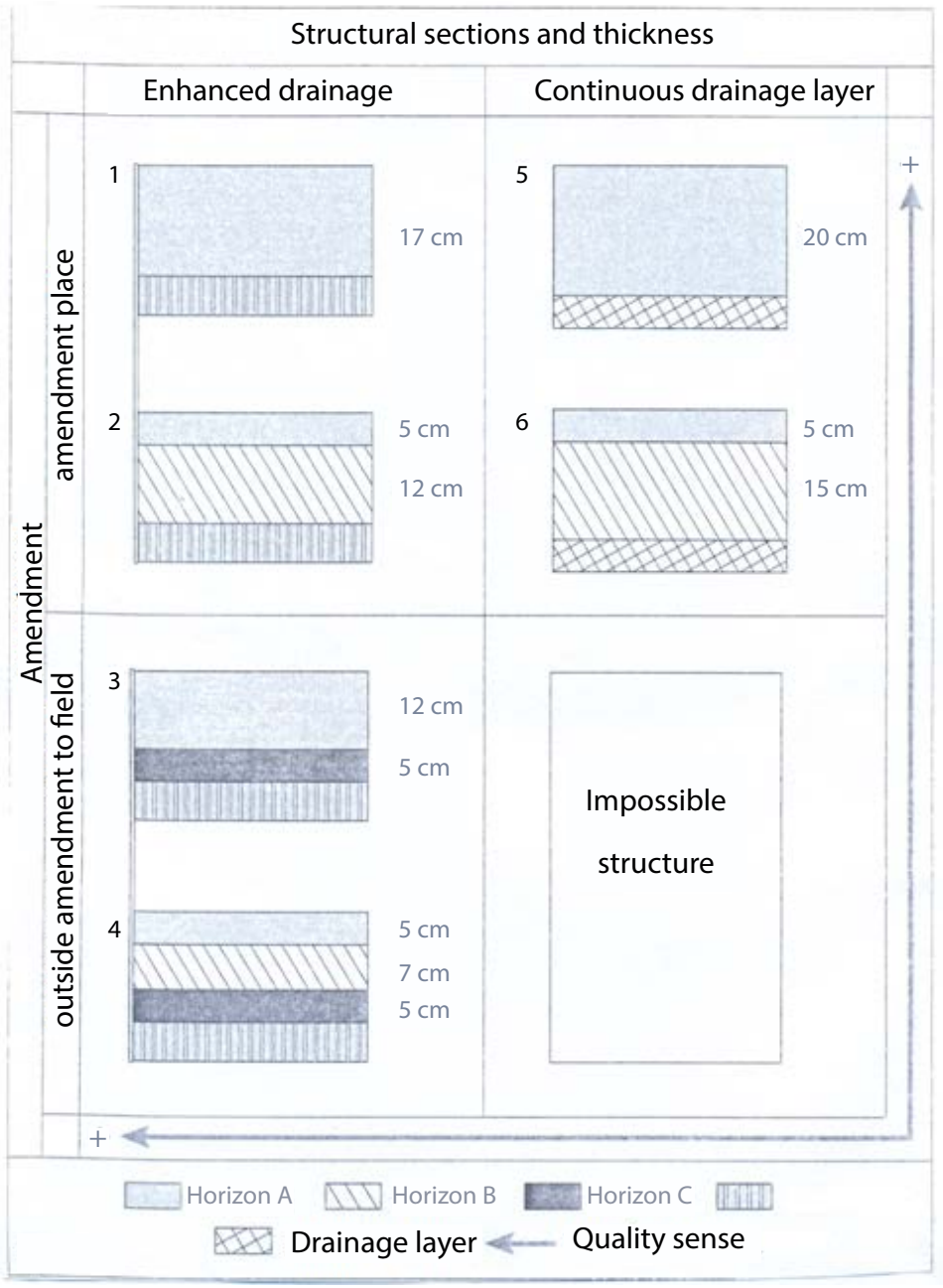

Figure 1: Identifying thickness from 1 to 2 distinct horizons.

the permeability in place. In deep land drainage, physical amendment must be made on the entire thickness of the topsoil. This implies that the mixture is done outside of the field.

Note: In some special cases where topsoil requires a strong sandy amendment, this may be done for for economic and technical reasons, specific operations defined by a laboratory or a consulting firm specialized in sport floors.

Other physical property requirements: The soil must be permeable; in fact, the permeability is related to the texture that is the size distribution [3]. Various studies and researches have shown that the following standards must be met:

a) Amount of clay in soil < 8%.

b) Amount of clay + silt in the soil should not be > 25%, this means that you have to choose a sand within the acceptable zone of texture triangle (Figure 2).

c) Plasticity index Ip ≤ 8.

d) The liquidity index ≥ 20.

Chemical characteristics

The requirements concerning the fraction of 0/2 mm on a substrate thickness of 0.12 m are:

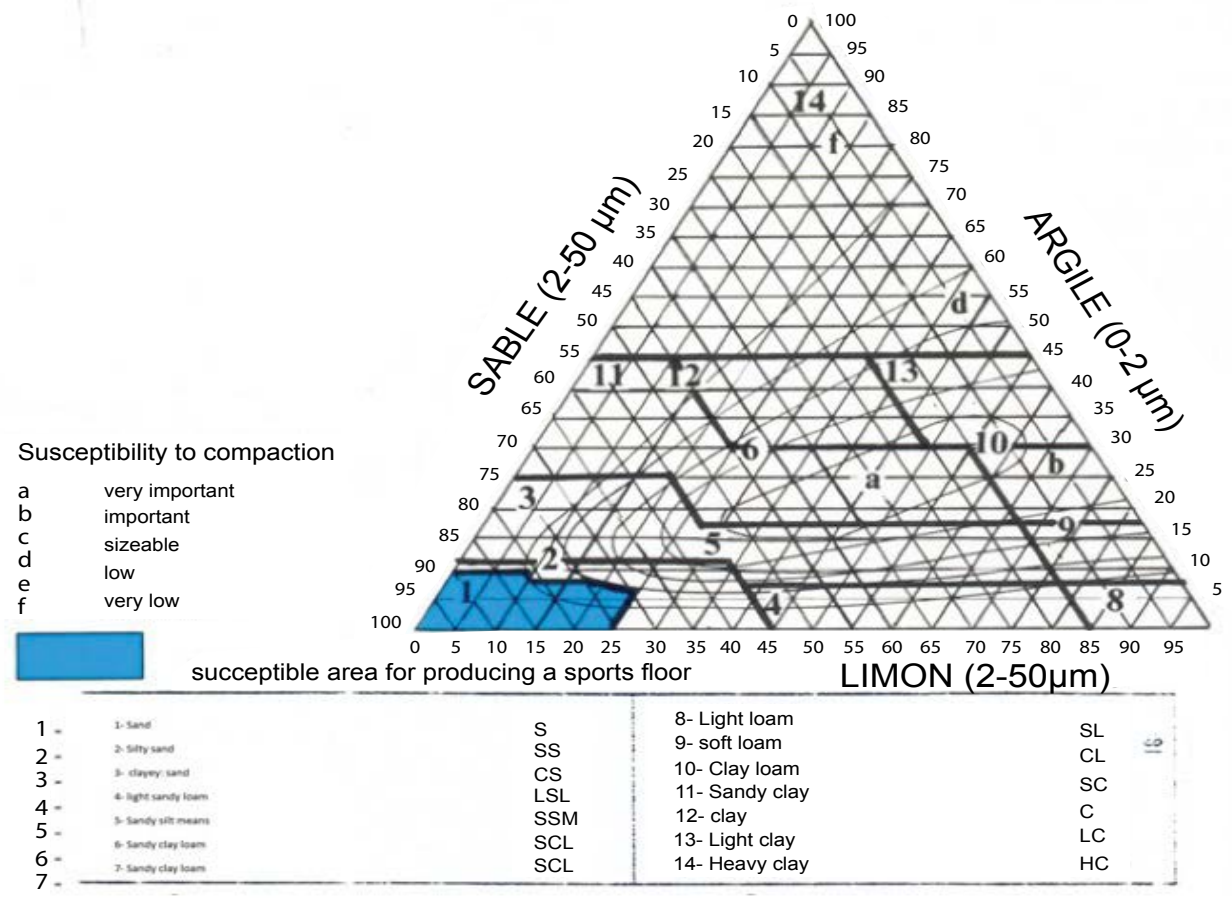

Figure 2: Grading thickness.

a) PH (H_2O): reference value 6.5, tolerance 5.5 to 6.5.

b) Organic matter (OM): 0.5 < MO < 3%.

c) Carbon/nitrogen (C/N): 10 < C/N < 14.

d) Cationic exchange capacity (CEC): 50 meq/Kg < CEC < 50 meq/kg.

e) Phosphoric Anhydride (P_2O_5) 0.10 % to 0.25 %.

f) Potassium Oxide (K_2O): 0.10 % to 0.25 %.

g) Magnesium Oxide (MgO): 0.075 % to 0.15 %.

Prior soil analysis defines the corrections to the topsoil to achieve the requirements of the substrate defined above:

Teneur in organic matter: Being subject to the action of living creatures, the organic material will be transformed on the one hand into Nitrogen directly usable by the plant; and on the other hand, into a more stable material, the mold, which will form with the clay the absorbent complex. The latter plays a key role in soil because it governs most of the physical and chemical properties. Determination of organic content is cut in by the determination of organic carbon. Carbon/Nitrogen approximate ratio information on the conditions of evolution of organic matter and thus on the overall biological activity of the soil [4-7].

Teneur in limestone: Limestone, with its calcium ions, acts on the soil structure by producing flocculent clays organic matter and therefore contributes to the formation of clay-humus complex. It also influences the pH: a land containing limestone is generally neutral or basic. First, the total dose of limestone is measured, when the proportion thereof exceeds 10%, then the dosage of the active limestone (more soluble in the water) is also done. When the rate of active calcium is high, it must be taken into consideration for the choice of seeds.

PH: PH reflects the acidity or alkalinity of the soil. For pH < 6.7 the earth is called acid. For pH > 7.3, the earth is called basic or alkaline. When the pH is between 6.7 and 7.3, the land is neutral. Soil pH has a significant influence on the assimilation of nutrients. Its knowledge is very important for the choice of the plant species and to determine the nature of the fertilizer needed accordingly.

Teneur in total nitrogen: Nitrogen is an essential element in plant nutrition because it is essential for the formation of proteins and amino acids, the determination of total nitrogen is of little interest in establishing fertilization, given the fact that plants absorb nitrogen in nitrate form above (NO_3^-), but the knowledge of its content is a useful information on the value of the ratio carbon/nitrogen and thus the decomposition of organic matter.

Teneur in phosphorus pentoxide: Phosphorus P is the second essential element of plant nutrition, it promotes root development and contributes to the growth of all organs, and the assay is performed by two methods: the Joret Hebert method for the basic soil and method Dyer for acidic or neutral soils.

Teneur in potassium: Potassium (K) promotes in particular chlorophyll assimilation, the role of potassium is very complex and particularly critical for improving the resistance of grass diseases.

Teneur in magnesium: Magnesium (Mg) is the senior partner of Calcium and to a lesser extent phosphorus. It takes part in the formation of chlorophyll and plays an important role in the absorption of phosphorus.

PH correction: If a correction is necessary, the thickness of the amended layer has to be less than 0.12m. The quality and quantity of correction amendments are determined in accordance with the results of the chemical analysis of the topsoil. Calcium and magnesium amendments must be used in accordance with current standards (NF U 44-001). The need for an optional fractionation depends on the amount and the products used.

Organic amendment: In the case a correction were necessary, the thickness of the amended layer has to be inferior to 0.12 m. The quality and quantity of correction amendments are based on the results of the chemical analysis of the topsoil. The organic amendment amount is expressed as a percentage of organic on a dry matter.

The materials used must comply with health regulations, NF U 42-000 standards; NF U 44-061, NF U 44-071; or be approved by the Ministry of Agriculture Urban composts and sludge treatment works of urban waste water shall not be used.

Fertilization correction: In case it was necessary to fix the substrate, the time of implementation of the fertilizer depends on the nature of the used products including their potential leaching. The fertilizer should be incorporated in the first centimeters of the substrate. The quality and quantity of fertilization is based on results of the chemical analyzes of the topsoil. The need for an optional fractionation depends on the amount of used product. Fertilizers used must bear the words' low in chlorine" and must comply with NF U 42-001 standards NF U 42-002, NF U 42-0002-2; NF U 42-00.-13, NF U 42-003-2 and be as well be approved by the Ministry of Agriculture.

Special substrates: Special substrates are used in order to obtain a high permeability and good resistance to compaction of the soil, but these features cannot be obtained at the expense of the water holding capacity and he shear surface. The high permeability obtained allows them to be classified in the category of continuous surface drainage (Figure 3).

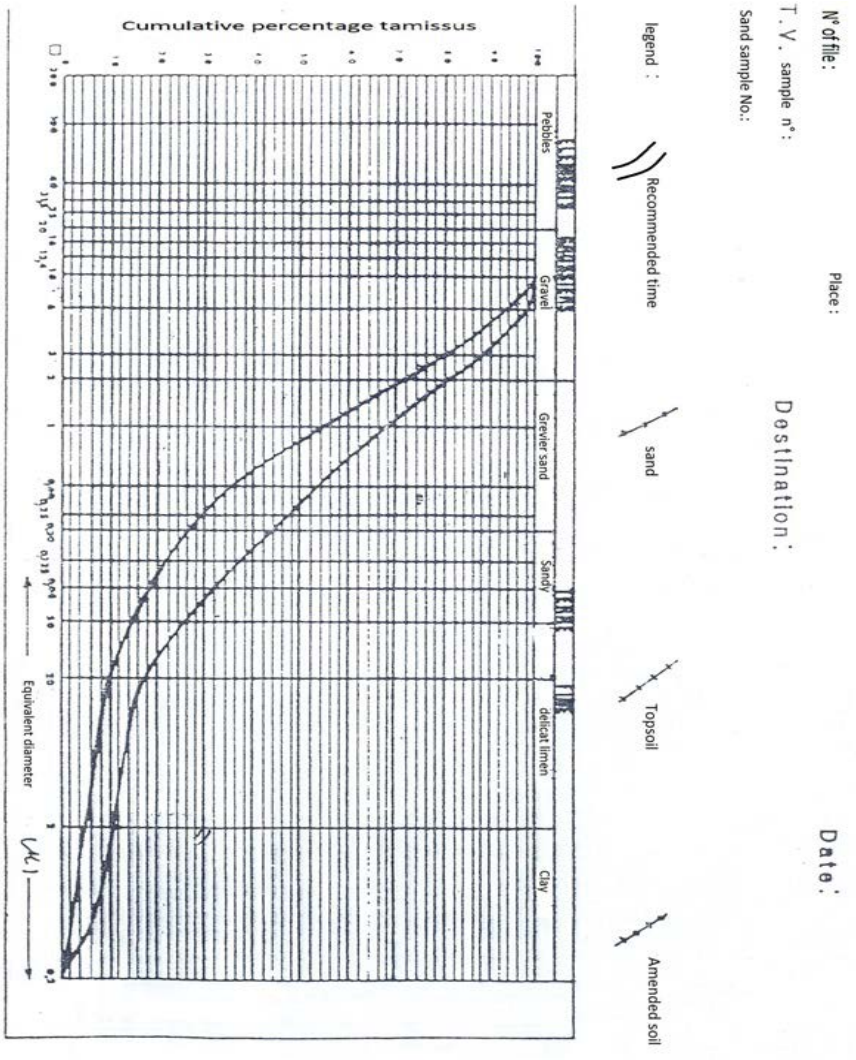

Figure 3: Graph of different soils.

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