

# **GUIDELINES FOR THE SAMPLING OF SOIL HORIZONS FOR A SOIL REFERENCE COLLECTION**

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# **GUIDELINES FOR THE SAMPLING OF SOIL HORIZONS FOR A SOIL REFERENCE COLLECTION**

## **Introduction**

The description and investigation of a soil in the field will disclose much information and many conclusions can be drawn about its origin and properties by these observations alone.

For an accurate classification, evaluation, and prediction about its behaviour under management and interpretation of the genesis, measurements and determinations are needed that can only be carried out in a soil laboratory. For this purpose disturbed and undisturbed specimens representative for the specific horizons of the soil are collected from the surface down to the unchanged parent material.

In the present text, guidelines are presented for the sampling of these specimens for a soil reference collection. For the technique of sampling a soil monolith reference is made to Van Baren and Bomer (1979).

## **Selection of the sampling site and horizon delineation**

Soil samples for laboratory investigations should be taken from the site of the monolith and/or the location where the profile is described. When selecting the sampling site, the following points must be observed.

There is no substitute for a freshly made pit. Soils exposed in road cuts, ditches and other excavations that have been open for some time, have changed considerably during their exposition. The air and water movements in the soil have changed drastically, and chemical, physical and biological processes have modified the soil to a degree that the samples taken from these places can not be considered representative. In most cases a recent pit is therefore a pre-requisite. However, especially in the case of very deep tropical soils, deep road cuts offer advantages as they expose the soil down to a great depth and clearly show the variation in the horizons. If such a site is selected, at least 1 to 2 meter soil should be taken away before descriptions and sampling can be realized.

If dealing with an uncultivated soil, i.e. with undisturbed natural vegetation, the site should be selected at a place where the organic surface horizons are undisturbed, untrampled and not contaminated.

The pit should be dug in such a way that three walls of the pit are kept as much undisturbed as possible. The dug out soil material has to be placed only at one site and the soil surface of the other walls (including the soil surface and vegetation) must be protected against disturbance during the digging activities.

Careful inspection and description should precede the sampling. The pit should preferably have a size of about 100 cm x 200 cm and must be deep enough to include all pedogenetic

horizons and the upper part of the unchanged parent material. Depth of the pit normally does not exceed 2 meter. For very deep soils (e.g. Ferralsols) the deeper horizons should be studied and sampled by deep augering.

The profile face must be wide enough to allow the observation of the variations in horizon thickness. In a pit of 100 x 200 cm most soil horizon variations can be observed. In special cases, e.g. soils with a microrelief such as gilgai, this size will not be sufficient.

### **Procedures for sampling of soils**

Smooth down and clean the wall of the pit. It may be advantageous to leave the pit for a while as some features do not clearly appear until the soil has dried somewhat. Delineate recognizable horizons on the face by marking the boundaries with a knife. Be sure that the material within each horizon is homogeneous. If not, make subdivisions and delineate subhorizons or other well-defined bodies of distinct material within the horizon. Make notes of the depth, width and topography of the boundaries in the profile description.

Unfortunately, the delineation of soil horizons is an arbitrarily activity, there are no unambiguous guidelines for it. It is based upon the differences seen and felt by the soil surveyor. Major soil properties used to distinguish horizons are: colour, texture, structure and consistency, but other soil morphological properties can also be used. For the sake of simplicity and readability of the profile description, do not make too many subdivisions.

The following kinds of samples are required:

1. Bulk samples for particle size analysis and chemical and mineralogical determinations.
2. Bulk samples for soil fertility testing.
3. Undisturbed samples for micromorphological analysis.
4. Undisturbed samples for volumetric measurements and studies of moisture retention (pF).

#### **1. *Bulk samples for particle size analysis and chemical and mineralogical determinations***

These samples are used to determine the particle size distribution, chemical and mineralogical characteristics of each horizon or subhorizon, for the purpose of studying the variation and change of these properties with depth within the profile.

Consecutive sampling over the entire soil is needed. Samples should be taken of each horizon, covering the complete vertical sequence of horizons, including the unchanged parent material. The wall of the pit should be cleaned before sampling.

Horizons, apparently homogeneous, may have properties not visible in the field that change with depth within the horizon. It is therefore wise to subdivide horizons thicker than 50 cm and sample these subhorizons separately. In some cases, transition zones between two horizons should also be sampled separately. These zones should be identified in the profile description.

However, as indicated above, horizon delineation is an arbitrary activity. In rather homogeneous soils (e.g. Ferralsols/Oxisols) with a depth of 5 meters or so it is advisable to limit the distinction of horizons to 3 or 4 main soil layers. Careful inspection of these horizons may reveal that a further subdivision is needed, based upon minor differences. In such a case it is suggested to describe in detail the 3 or 4 main layers, to carry out a sub-sampling of the horizons, and to describe the minor differences separately as remarks.

If the soil shows a pronounced horizon of illuvial clay, the samples should be taken at short intervals in order to characterize the change of texture with depth, e.g. for an abrupt textural change.

Separate samples are also taken in the case of very heterogeneous horizons, e.g. tongues, coarse mottles and concretions or other well-defined bodies of distinct material within the horizon.

Stony soils present particular problems. In practice most or all of the stones are removed in the field and the fine earth is sampled. It is very important however to estimate the percentage of coarse fragments and to describe their petrology. The stones are sampled separately for mineral investigation.

The representative samples of 1 kilogram are taken from the entire thickness of the horizon or subhorizon. It is advantageous to start sampling from the lowest horizon and subsequently continue upward. A sample tray, small hand shovel, knife, etc. are convenient tools for the purpose.

Sample bags should be waterproof, preferably made of sturdy plastic foil to avoid moisture loss during the period of transport to the laboratory. Profile number and depth of the sample should be clearly marked on, preferably, plastic labels. Two labels are preferred, one inside the bag, the other outside. To prevent the plastic bags from tearing, two bags can be used when the samples have to be transported over long distance.

Suggested further reading on this topic, see Landon (1984) and USDA (1951).

## 2. *Bulk samples*

Soil fertility testing is carried out on a selection of the collected soils via the 'double-pot experiments'. It is a practical and relatively inexpensive way to assess the natural fertility of the surface layer. Furthermore, this test uses only about 5 kg of soil.

To obtain the 5 kg bulk sample, collect 25 subsamples of about 200 g each from a circular area around the pit, e.g. with a radius of about 25 m. The samples should be taken in a random pattern and to a depth of about 20 to 30 cm. A good judgment of the collector will result in a representative sample, since he should take care that no clearly different subsamples are collected.

The samples should preferably be put in two bags of 2½ kg each. Sample bags should be waterproof, preferably made of very sturdy plastic foil to avoid moisture loss during the period of transport to the laboratory. Profile number and depth of the sample should be clearly marked on the labels. Two labels are preferred, one inside the bag, the other outside. To prevent the plastic bags from tearing, two bags can be put into one larger bag which is made of thicker plastic foil.

3. *Undisturbed samples for micromorphological analysis*

*of individual horizons*

These samples are required for the preparation of microscopic specimens (thin sections) to study the microstructure and other features on microscopic scale. It is of the utmost importance that the soil material for these specimens is not disturbed.

Specially made steel boxes of 15 x 8 x 5 cm with two lids are used. One box covers a depth of 15 cm. In order to obtain a coverage of the entire profile, it is desirable to have at least 5 samples, taken at various depths. At least one sample is taken from each horizon, <sup>if possible</sup> including the transition to the overlying or underlying horizon. See figure 'suggested scheme for collecting samples for thin section', adapted from FitzPatrick (1984).

Horizons which are apparently homogeneous, may have properties not visible in the field, that - on microscopic scale - change significantly with depth within the horizon. Horizons thicker than 50 cm must therefore be sampled at several depths.

If dealing with virgin or uncultivated soils, the organic surface layers and the upper 15 cm of the mineral soil must be included in full to characterize the humus form or the nature of the soil surface.

Samples are also required from the parent material or the underlying unchanged substratum. In the case of hard rock it is sufficient to take a few representative fragments.

When needed, samples can also be taken of hard-setting topsoils. In this case, the box is vertically pressed into the soil after a layer of cotton wool or thin foam sheet with a thickness of 0.5 to 1 cm has been put on the soil surface to prevent the breaking-up of the phenomenon. It is also possible to use a thin layer of plaster of Paris for this purpose.

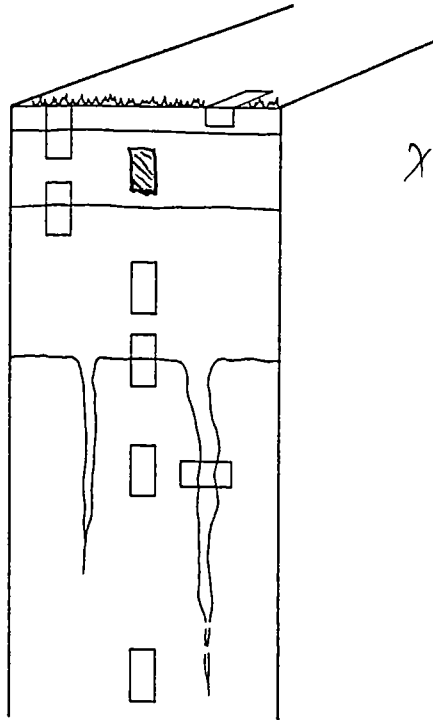
The sampling is carried out with the standard-size (15 x 8 x 5 cm) metal boxes, provided with a pin in one of the edges. The box is usually used in a vertical position and, as a convention for later identification of the orientation, with the pin in the top left side. If taken otherwise, indicate the top with an arrow and the word 'top' on the sides of the box.

The open side of the box is pressed carefully into the profile wall, simultaneously digging and cutting away the surrounding soil material with a knife. Great care should be taken, so that the material inside the box remains undisturbed. If roots are encountered these should not be pulled out but carefully cut with a sharp knife or scissors to avoid drag or movement inside the box. Stony soils may create unsurmountable problems. In this case a smaller box (e.g. of 5 x 5 x 5 cm) could be used.

When the bottom of the box is level with the face of the profile, the box can be removed and after carefully cutting away the superfluous material with a sharp knife, the box is closed. Use a rubber band or adhesive tape to secure the lids.

X The country code, profile number and depth in cm <sup>and the TOP side of the sample</sup> should be marked on the sides of the box, not on the lids.

Suggested further reading on this topic, see Bullock et al. (1985) and Murphy (1986).



Suggested scheme for collecting samples for thin sections.

#### 4. *Undisturbed samples for volumetric measurements and studies of moisture retention (pF)*

The selection of horizons to be sampled should be done with restraint, since the analysis is time-consuming. Preferably, only the important, clearly different horizons should be sampled. The topsoil (say between 5 and 25 cm) should be sampled, 2 to 3 horizons of the subsoil are in most cases sufficient for the characterization of the whole soil.

Specially made steel rings with a specific volume must be used for these samples.

The soil should preferably be at field capacity. If the soil is too dry, place rings on filter paper, towel paper or cloth on horizontal soil surfaces and fill the rings with water. After penetration of the water, the cores can usually be taken. In some cases, e.g. stony soils, core sampling is virtually impossible.

Proceed as follows:

Drive or press the sampler with pF ring into either a vertical or horizontal soil surface far enough to fill the ring (not too far as then the soil might be compressed in the confined space of the sampler). Slow driving or pushing is preferred to hammering as this may disturb the structure of the soil. If hammering cannot be avoided, use a piece of wood between hammer and sampler.

Carefully remove the sampler and ring with its contents. A shovel, alongside and under the core, may be needed sometimes to remove the sample without disturbance. Trim the soil extending beyond each end of the core with a straight-edged knife or sharp spatula. Take care that not too much soil is trimmed resulting in a "hollow" sample: the surface should be flat. Put the lids on the core. If possible, seal the lids with tape.

Take at least three samples per horizon; if a core is disturbed during sampling or when stones or too many rocks are present, take a new core.

### **Sample list**

The samples should be accompanied by a detailed sample list. An example of such a list is annexed.

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For comments on this text or further information, please contact:

International Soil Reference and Information Centre

P.O. Box 353

6700 AJ Wageningen

THE NETHERLANDS

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ISRIC Wageningen

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