1.3 | SOIL CLASSIFICATION

INTRODUCTION

Many different soils occur in nature, which can be differentiated on the basis of their colour, clay content and depth. Crops exhibit different growth responses on different soils, being "good" on some soils and "poor" on others. General common terms are used to indicate differences between soils, such as red, yellow, sandy, clayey, fertile, shallow and so forth. Although these terms attempt to classify the characteristics or the productivity of soils, they are not based on a formal set of norms or criteria. A soil on the Highveld might be described as shallow, whereas it could be considered to be a deep soil in the Western Cape. It is therefore important to classify soils in such a way that there is a unanimous understanding between advisers and farmers alike. To achieve this, soils are classified in a formal system as is done with plants and animals.

Classification entails the grouping of identifiable types in a formal system. In the case of animals, the morphological and anatomical characteristics of the adult individuals are used for grouping. Although two individuals of the same species (the lowest formal unit for the grouping of animals) may not be identical in all respects, the characteristics defined as common to that species, are essentially the same.

Since soils do not exist as discrete individuals as is the case with animals, their classification is more complex. The biggest challenge in soil classification is the recognition of distinctive boundaries between different soils , or soil forms. Due to continuous changes in soil forming factors, a classification system must accommodate the gradual transition between individual soil types. If the soils are identifiable, then the boundaries between them can be distinguished.

Depending on their purpose, different soil classifications may be used. If, for instance, the need is limited to classifying soils according to their capabilities of supporting a specific crop, then only a limited number of soil characteristics important to that specific crop need to be taken into consideration. However, such a technical classification has limited applicability and cannot be used for other applications.

The more specific the classification is, the more comprehensive the range of soil properties used must be. A natural or scientific classification system is the most comprehensive system which can be used to group a large number of entities. Morphological, chemical and physical properties are used in the classification of soils.

Since no universal classification system existed that could be used for the identification and mapping of South African soils, a local system called the Binomial System (MacVicar et al., 1977) was developed. This system groups soils into soil forms (higher level) and soil series (lower level). Soils are referred to on a comparative basis as is the case with plants and animals, for example the genus (higher level) and the species (lower level) for maize are *Zea mays*, and that for the springbok *Antidorcas marsupialis*. An example for the naming of a homogenous red soil with poor structure, and highly leached clay, is Hutton form Balmoral series.

USE OF SOIL CLASSIFICATION

The classification of soil must only be considered as an aid to be used in the planning of crop production. It is also important to take certain other factors into account when evaluating the suitability of soil for the production of specific crops. To determine the potential of a crop on a certain soil other factors not included in the classification must also be considered. These include chemical conditions, nutrient status, soil depth, texture, rainfall, type of terrain and many others. In particular, the specific soil and climatological requirements of the crop must be taken into consideration.

Taxonomic system for South Africa

Since the first publication in 1977, our knowledge of South African soils has developed to such an extent that changes were necessary. The revised system, known as the *Taxonomic System for South Africa* (MacVicar et al., 1991), essentially remains very simple, with two main categories or levels of classes: the soil form (higher level), and a lower, more specific level called the soil families. The series category of 1977 has fallen away.

CLASSIFICATION PROCEDURE

The procedure that must be followed according to this system, is as follows:

- demarcating the master horizons in the profile;
- identifying the diagnostic horizons;
- determination of the soil form according to a key;
- identifying the family characteristics;
- determining the soil family; and
- determining the texture class of the A-horizon, and adding it to the name or code of the family.

MASTER HORIZONS

The development of genetic horizons as opposed to deposits or riverine stratification, is traditionally accepted as the nucleus of soil formation. Soil forming processes have a tendancy to differentiate the materials on which they interact (rocks and several types of loose sediment) into horizons.

The organisation and reorganisation of materials as a result of soil development follows a pattern which (generally) can be used in the identification of a few master horizons.

The following letter symbols are used to indicate the master horizons:

O - Organic horizons at the soil surface.

A - Dark-coloured mineral horizon at the soil surface or below an O-horizon.

E - Light-coloured mineral horizon beneath an O- or A-horizon with less clay, iron oxides and organic material than the overlying horizon.

B - Mineral horizon between an A/E- and a C/R-horizon in which clay, iron oxides, organic material and/or lime have accumulated, with or without the development of structure.

C - Unchanged, unconsolidated material or weathered rock.

R - Solid rock formation.

G - Mineral horizon beneath an A- or E-horizon with visible grey colouring due to reduction under wet conditions.

DIAGNOSTIC HORIZONS

Also see Figure 1.3.1.

Master horizons only contain information about the position in the profile and the general nature of the processes that took place, for example, the accumulation of organic matter and the development of soil structure. There are, for example, B-horizons that exhibit totally different properties, and are therefore completely different from each other, except for those characteristics which determine that they are B-horizons. These more specific characteristics of master horizons are very important, and are used for the definition of diagnostic horizons.

Diagnostic topsoil horizons
Five surface horizons (organic, humic, vertic, melanic and orthic) have been defined as diagnostic by virtue of the presence of such prominent characteristics such as abnormally high organic carbon, wetness, swelling capacity, dark colours and high base status, or the absence thereof (in the orthic horizon).

Diagnostic subsoil horizons and material

Diagnostic subsoil horizons occur below the diagnostic topsoil horizons, and a part thereof must be within 1 500 mm of the soil surface. Twenty-five diagnostic subsoil horizons and materials have been defined according to:

- the relative position they occupy in the soil profile,
- colour in respect of homogeneity and dominant hue,
- presence of mottles or concretions,
- grade and type of structure development,
- hardening due to lime, silica or iron oxides,
- accumulation of organic matter,
- signs of wetness, and
- signs of immature development such as layered deposits or weathered rock.

The properties of the 25 diagnostic subsoil horizons and materials can be summarised as follows:

- E-horizon: crumbly, sandy with light grey colours due to wetness or podzolisation.

- G-horizon: firm, clayey with light grey colouring due to wetness.

- Red apedal B-horizon: weaker than moderate structure with a homogenous red colouring, non-calcareous.

- Yellow-brown apedal B-horizon: weaker than moderate structuring with a homogeneous yellow-brown colour, non-calcareous.

- Red structured B-horizon: moderate to strongly structured with a homogenous red colour.

- Soft plinthic B-horizon: notable accumulation of iron in the form of mottles or concretions; not continuously hardened.

- Hard plinthic B-horizon: accumulation of iron oxide to the extent that the whole horizon is hardened.

- Prismacutanic B-horizon: clayey horizon with prismatic structure, strong upper transition and clear accumulation of clay as clay cutans on the prismas.

- Pedocutanic B-horizon: clayey horizon with moderate to stronger developed block structure and clear cutans.

- Lithocutanic B-horizon: non-continuous, weaker than moderate structured horizon that transitions to weathering rock.

- Neocutanic B-horizon: weaker than moderate structured, nonhomogenous coloured horizon, developing from unconsolidated material; non- calcareous.

- Neocarbonate B-horizon: weaker than moderate structured, non-homogeneous coloured horizon developing from unconsolidated materials; calcareous.
- Podzol B-horizon: dark subsoil due to accumulation of organic matter, with or without iron and/or aluminium.
- Regic sand: wind-blown sandy material, with immature development.
- Stratified alluvium: texturally layered deposits, demonstrating immature development.
- Placic pan: thin hard layer cemented by a combination of iron/manganese and organic material.
- Dorbank: silica cemented hard bank.
- Saprolite: weathering rock.
- Soft carbonate horizon: horizon in which the morphology is dominated by lime; not continuously hardened.
- Hard bank carbonate horizon: lime-cemented hard bank.
- Unconsolidated material with signs of wetness: material beneath a pedocutanic or podzolic B-horizon, with signs of wetness.
- Unconsolidated material without signs of wetness: material beneath a pedocutanic or podzolic B-horizon, without signs of wetness.
- Unspecified material with signs of wetness: material under a red or yellow-brown apedal B-horizon, or neocutanic or neocarbonate B-horizon, with signs of wetness.
- Hard rock: continuous, unweathered hard rock.
- Man-made deposits: man-made deposits of soil material.

SOIL FORMS

A soil form is a class at the higher level of grouping, and is defined by a unique vertical succession of diagnostic horizons and materials (Figure 1.3.1). The number of soil forms increased from 43 in the 1977 edition to 73 in the revised 1991 edition. A form is referred to by a place name (e.g. Hutton, Estcourt). Most of the form names in the 1977 edition have been retained in the revised edition, with new names having been given to the additional soil forms.

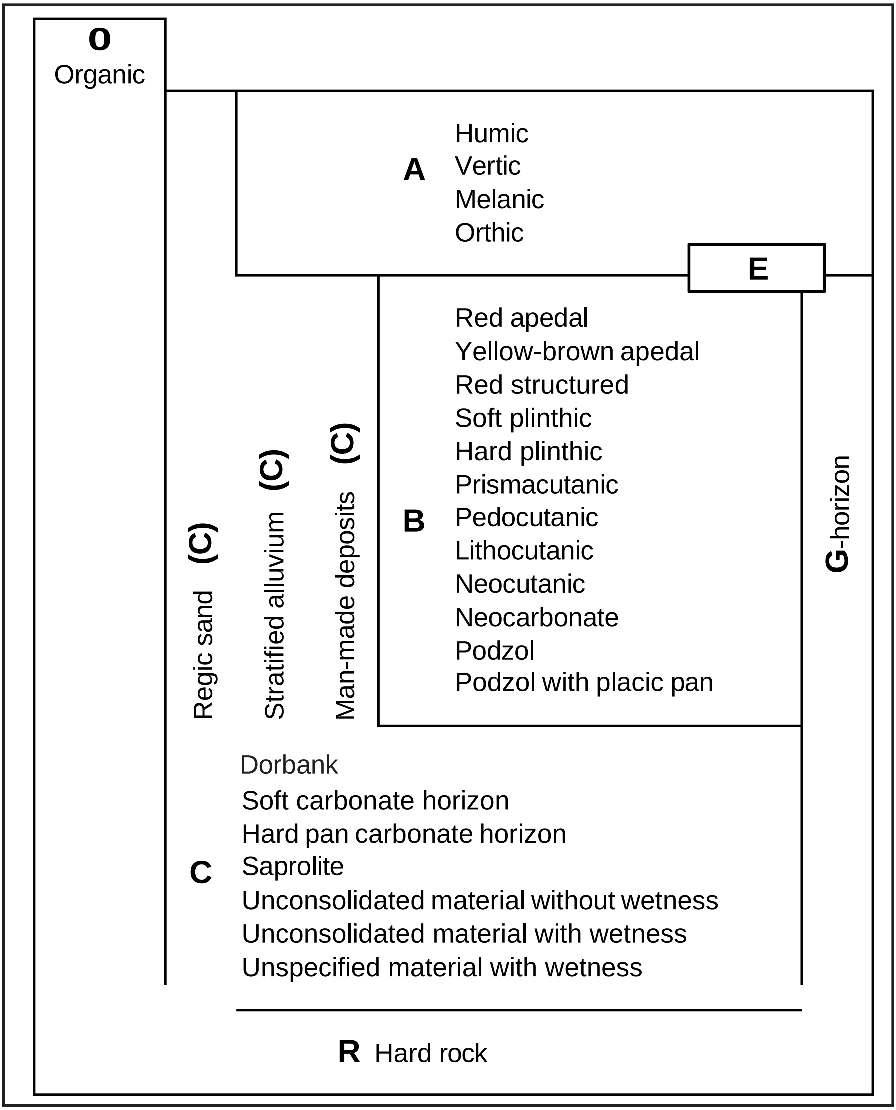

Figure 1.3.1. Diagnostic horizons and material
(Source: Soil classification: A Taxonomic system for South Africa, Dept of Agricultural Development, Pretoria, 1991)

SOIL FAMILIES

Since soil classification is used for a variety of purposes, it is important to reduce the variation which occurs within soil forms. This is achieved by separating soil forms into two or more families.

The following sets of properties, which are not used in the definition of a form, are used to differentiate between soil families:

- Continuous black cutans in prismacutanic B-horizons.
- Crumbly and firm C-horizons.
- Degree of leaching i.e. dystrophic, mesotrophic, eutrophic.
- Dark and light-coloured A-horizons overlying the E-horizon in Fernwood form.
- Dark, red and other colours in vertic A-horizons and in pedocutanic B-horizons occurring below melanic A-horizons.
- Thin and thick humic A-horizons.
- Bleached orthic A-horizons.
- Grey and yellow E-horizons.
- Hard and soft lithocutanic B-horizons and saprolite.
- Calcareous horizons and layers.
- Luvic B-horizons.
- Material found beneath organic O-horizons.
- Red and non-red colours in B-horizons and stratified alluvium.
- Ortstein hardening of podzolic B-horizons.
- Podzolic characteristics beneath a diagnostic yellow-brown apedal B-horizon.
- Sub-/fine angular and medium/coarse angular structures in pedocutanic B- and red structured B-horizons.
- Presence and absence of laminates in the E-horizon of Fernwood form.
- Signs of wetness.
- Fibrous and humified organic material.

The variation allowed within a class or family level is therefore narrower than the variation at form level. The family is therefore a more specific concept than the form.

All 404 soil families have a place name and a code. Because no two families within the classification system have the same name, a family can be referred to by either the form or family name. For example all dystrophic soils of the Hutton form in which the clay increases from the A- to the B-horizon, can be referred to as Hutton Kelvin, or merely the family name Kelvin or the code Hu 1200.

The last step in the classification of a soil is to determine the texture of the topsoil, and to add this to the name or code of the family, e.g. Hu 1200 fine sandy loam.

SOIL TEXTURE CHART

The soil texture chart (Figure 1.3.2) shows the different texture classes.

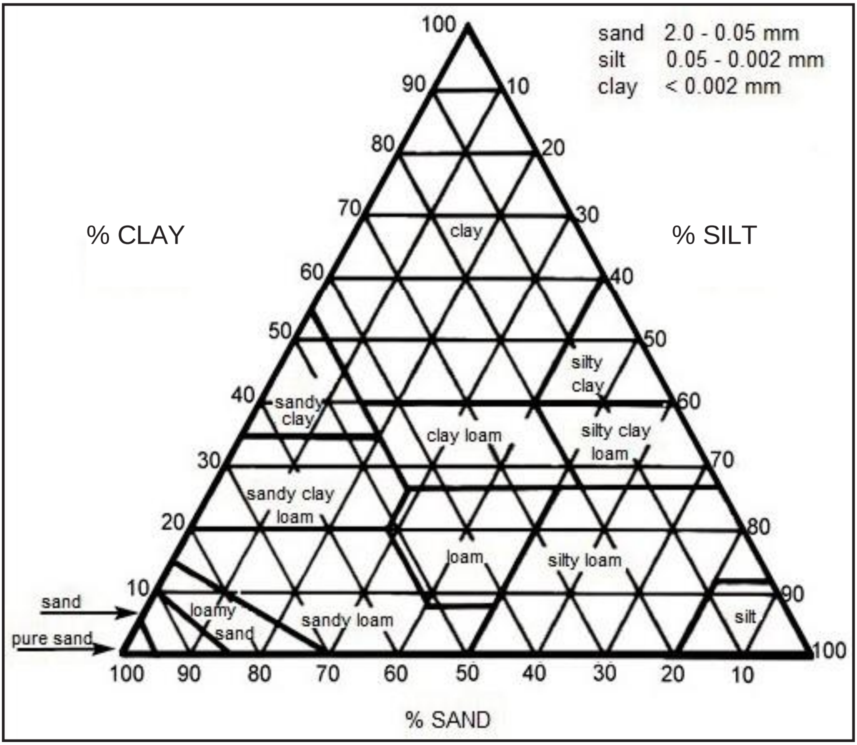

Figure 1.3.2. Soil texture chart
(Source: Soil classification, Dept of Agric Development, Pretoria, 1991)

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FURTHER INFORMATION

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