SELECTION OF SITES FOR THE VERTISOLS NETWORK: DISTINCTION BETWEEN TYPES OF VERTISOLS

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Abstract

Particular attention must be paid to the selection of test sites for the Vertisol network if the results obtained are to be truly transposable from one region to another in the same country and from one country to another in the world.

To distinguish between different tropical Vertisols, it is advisable to use other criteria than the slope and soil colour criteria used in the classification systems (FAO, Soil Taxonomy, *C.P.C.S.*[1] *).*

The author recommends that priority be given to the following parameters: the soil moisture regime, the properties of the topsoil, the parent material and the risk of degradation. These are the characteristics that really distinguish between different tropical Vertisols, and they are often the main limiting factors for soil management. These propsals are based on soil mapping followed by detailed field studies in a semi-arid tropical zone.

Introduction

The establishment of a Vertisol network implies two main activities:

1. Selecting representative sites for measurement and experimentation.
2. Transposing the results obtained on these sites to other sites in the same country or elsewhere.

This second activity raises an important question. Are the Vertisols where we transpose the results the same type of Vertisol as those studied on the test sites? The

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[1] Commission de Pédologie et de Cartographie des Sols.

answer to this question seems simple, because Vertisols are the most easily recognizable of all the soils in the world. Consequently one might think that it would be easy to find representative sites and then to transpose the results obtained.

The reality is different. There are in fact several types of Vertisol, and they differ widely enough to make it necessary to distinguish between them before the test sites are chosen. When seeking to identify Vertisols and make correlations between them from one country to another, the currently recommended procedure is to adopt the Vertisol definitions given in the commonly used classification systems: FAO, *Soil Taxonomy*, and French C.P.C.S. This may seem to be an adequate method for drawing up a general world inventory of Vertisols; but given IBSRAM's ultimate objectives, we need a procedure for distinguishing between the different Vertisol categories and selecting the network's test sites. The criteria proposed here are based on a recent study made in Cameroon.

Country Background

Cameroon is a central African country covering 475 000 km^2 and has a population of approximately 10 million. It includes three main ecological zones: a densely forested humid equatorial zone in the south, a zone of high plateaux with savanna and forest in the centre, and a semi-arid topical zone in the north. The first two zones have mainly Ferralsols, while the Vertisols are to be found in the third zone.

North Cameroon

This province covers 100 000 km^2, and the annual rainfall varies between 600 and 1400 mm; a continuous dry season lasting 6 to 9 months alternates with a rainy season that fluctuates from year to year. The most extensive Vertisols are to be found between the 600 and 900 mm isohyets; beyond the 1100 mm and up to the 1400 mm isohyet, Vertisols occur only on highly basic rocks. The entire province has been mapped on various scales. Thus we know that Vertisols cover 1 200 000 ha, divided between 300 polygons on the 1:500 000 soil map. That represents 12% of North Cameroon's land area and 2.5% of the total country.

Identification of the Different Types of Vertisols in North Cameroon

Using the definitions of the classification system

Looking at the descriptions given by the different classification systems, Vertisols are defined as having the following characteristics:

- a 30% clay content, at least to a depth of 50 cm,
- shrinkage cracks 1 cm wide to a depth of at least 50 cm, and

- a gilgai microrelief or slickensides or wedge-shaped structural aggregates at depths of between 25 and 100 cm.

They are distinguished from each other in terms of the following features.

- the colour, with a chroma, moist, more or less than 1.5,
- the slope – gentle slopes or flat areas and depressions, and
- the rate of saturation of the exchange complex, by calcareous nodules (FAO system, 1985).

Table 1 shows the results we obtain for North Cameroon's Vertisols using these criteria.

In general, the keys provided by the classification systems are adequate for distinguishing Vertisols from the other soils of North Cameroon. In the field, the French C.P.C.S. system has been found to give slightly more satisfactory results than the two other systems, but none of the systems includes the most important parameters in its definitions, i.e. those which ultimately determine the management of tropical Vertisols. For example, the Pellic Vertisols category includes Vertisols which may differ very widely in their main limiting factors for land use – the control of flooding water for some, gully erosion for others. It is very surprising, then, to see that soil scientists only identify two types among the 1 200 000 ha of Vertisols in North Cameroon, when uneducated local farmers easily identify five or more types of Vertisols and give each a special name: "yaeres", "karal", "karal muskuari", etc.

Using other parameters

To distinguish Vertisols from other soils, we continue to use the criteria which were listed above, i.e. textural and structural properties, shrinkage cracks, etc. A Vertisol always consists of a single horizon, and in Cameroon we have called this the Sv horizon, S being more or less synonymous with "cambic" and v expressing the vertic feature. The Sv horizon contains organic matter in its upper part, except where the soil is eroded.

To differentiate between one Vertisol and another and to choose representative sites for study, we have selected other parameters. These have been chosen on the basis of soil-mapping results, detailed catena studies, and observations of farming practices in the region.

Six parameters have been selected:

1. The landscape (and not merely the slope): alluvial plains or pediments,
2. The pedoclimate and hydrologic regime: dry or humid pedoclimate, with flooding or without flooding,
3. The parent material: recent or old clayey alluvia, acid crystalline rocks, basic rocks, limestone, argillite or marl.
4. The other soils and horizons associated with the Vertisols in the landscape: Fluvisols, Planosols, Cambisols, Regosols, etc.
5. The properties of the topsoil (0-25 cm) with regards to tillage: microrelief, cracks, clay content, structure.
6. The level of potential degradation: topsoil degradation, gully erosion.

Table 1. Types of Vertisols in North Cameroon.

FAO system 1975, revised 1985	*Soil Taxonomy*		C.P.C.S., France					
VERTISOLS (soil units)	VERTISOLS	Order	VERTISOLS					Class
Pellic Eutric	USTERTS	Suborder	TOPOMORPHIC			LITHOMORPHIC		Subclass
	Pellusterts Chromusterts	Groups	coarse	fine medium	Topsoil with structure	fine medium	coarse	
Chromic Calcic								Groups
	typic typic	Subgroups	–	–	typic	–	–	Subgroups
			–	–	gleyic	–	–	
			–	–	sodic	–	–	

Table 2. Characteristics of Vertisols in North Cameroon.

Landform	Parent material and pedoclimate	Associated soils (FAO)	Properties of the topsoil	Level of potential degradation	Primary limiting factor for management	Type / Area in ha
Vertisols of alluvial plains	o recent deposits > 3000 yrs BP o clays, silty clays o pedoclimates: humid o flooding: >5 mths.	o Gleysol o Fluvisol	o very large cracks (5-10 cm) o pronounced gilgai 50-80% clay o medium structure (under grassland)	Very low to low	Water control	1 490 000 ha
	o old deposits 300-10 000 BP o sandy & silty clays o pedoclimate: humid to dry o flooding: < 3 mths.	o Gleyic Solonets o Eutric Planosol o Albic Luvisol (Gleysol)	o large cracks (1-6 cm) o slight gilgai o 40-60% clay o coarse or fine structure	Medium to high Topsoil degradation	Water-balance deficit (years of low rainfall) and risk of topsoil degradation	2 450 000 ha
Vertisols of pediments	o alkaline or acid crystalline rocks o pedoclimate: dry o no flooding	o Gleyic Solonetz o Sodic Planosol o Albic Luvisol	o small cracks o slight gilgai or no gilgai o 20-40% clay o medium or massive structure	Very high Topsoil degradation and gully erosion	Topsoil Degradation	3 80 000 ha
	o basic rocks and limestone o pedoclimate: dry o no flooding	o Chromic Cambisol o Eutric Cambisol	o no cracks or small cracks o no gilgai o 30-45% clay o fine structure	Low	Water-balance deficit	4 30 000 ha
	o argilite, marl o pedoclimate: dry o no flooding	o Regosol o Fluvisol	o large cracks (3-5 cm) o slight gilgai or no gilgai o 60-70% clay o coarse structure	High Gully erosion	Gully erosion	5 20 000 ha

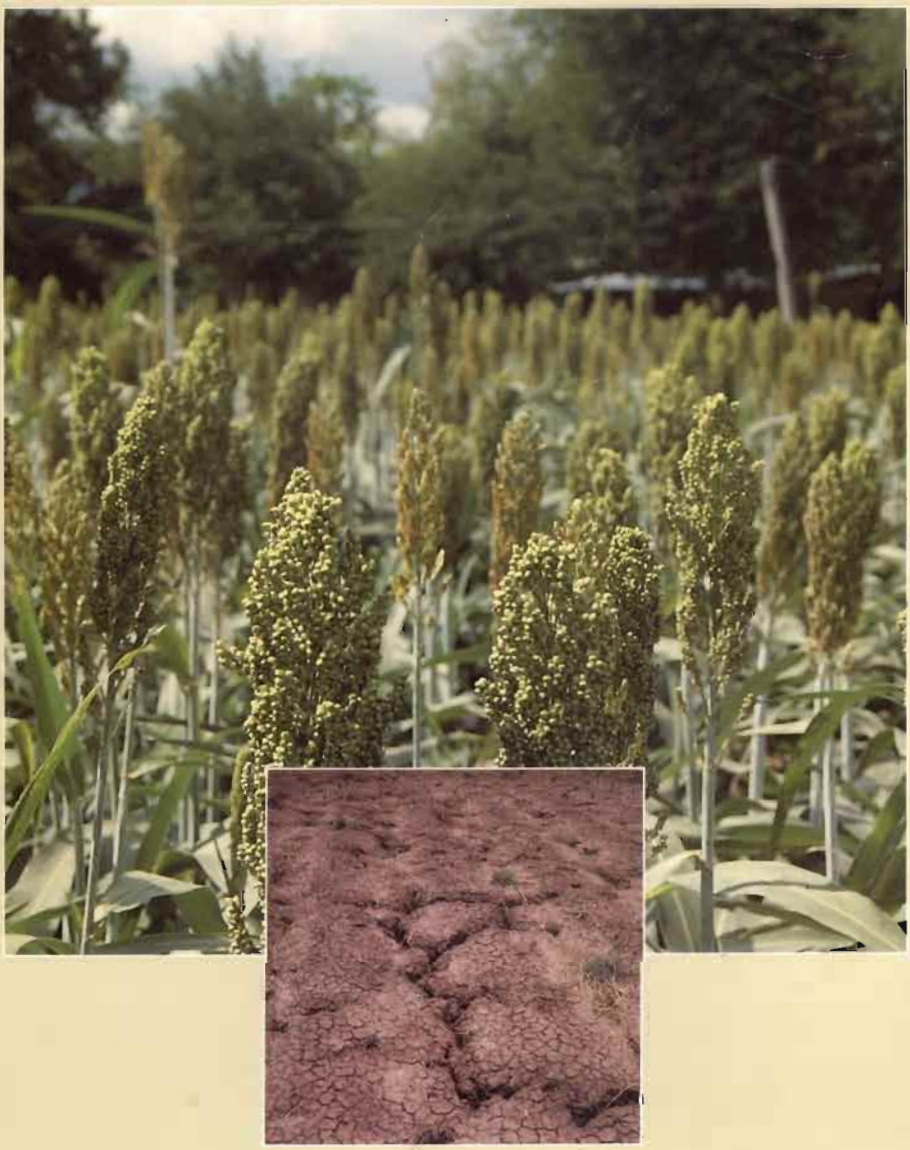
Along these lines, we have distinguished five main types of Vertisols in North Cameroon: two types in the alluvial plains and three types on the pediments. Their characteristics are shown in Table 2.

It should be noted that Vertisols of types 2 or 5, for example, include both Pellic and Chromic Vertisols, Chromusterts and Pellusterts. Also, an examination of Table 2 shows that the moisture regime, the properties of the topsoil, the parent material and the risk of degradation take precedence over colour and slope of terrain as characteristics of a tropical Vertisol.

Recommendations

The results obtained from a test site on type 1 Pellic Vertisols could not be transposed to type 5 Pellic Vertisols, for example. Similarly, the results obtained with type 4 Chromic Vertisols could not be transposed to type 2 Chromic Vertisols. This means that soil scientists in the Vertisol network should not restrict themselves to the classification system criteria, either in selecting sites in the first place, or subsequently when they are making correlations between the Vertisols of different African countries or between African Vertisols and those of other continents in the semi-arid zone (India, Uruguay and Argentina, for example). As a matter of general policy, IBSRAM should pay special attention to the correlation between the test sites of the Vertisol network.

Management of Vertisols under Semi-Arid Conditions



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