# THE BRAZILIAN SYSTEM OF SOIL CLASSIFICATION

E. Klamt* and J.H. Kauffman**

March 1985



Contents Page



* Guest researcher at ISRIC, on leave from the Soil Science Department, Federal University of Rio Grande do Sul, Brazil, with CNPq Post-Doctoral fellowship Process no. 200303-84/AG

** Temporarily staff member ISRIC

1) FAO = The legend of the World Soil Map - volume I - FAO/Unesco, 1974
ST = Soil Taxonomy - USDA/SCS, 1975

**THE BRAZILIAN SYSTEM OF SOIL CLASSIFICATION**

E. Klamt* and J.H. Kauffman**

March 1985

Contents | Page



---

* Guest researcher at ISRIC, on leave from the Soil Science Department, Federal University of Rio Grande do Sul, Brazil, with CNPq Post-Doctoral fellowship Process no. 200303-84/AG

** Temporarily staff member ISRIC

1) FAO = The legend of the World Soil Map - volume I - FAO/Unesco, 1974
ST = Soil Taxonomy - USDA/SCS, 1975

# THE BRAZILIAN SYSTEM OF SOIL CLASSIFICATION

## 1. INTRODUCTION

Brazilian soil science is young. In early soil studies (before 1947) soils were mainly classified (grouped) in relation to parent material or geomorphological units. In 1947 national soil science and survey institutions were founded. A programme of reconnaissance soil surveys of Brazil started with the survey of the state of Rio de Janeiro in 1954.

For the soil map legend and the definition of soil classes the old USA soil classification system has been used.

The great group level was used to describe the soils in uniform cartographic units, however, depending on soils and region also higher or lower taxonomic classes were used.

At present about 70% of Brazil has been mapped at the exploratory-reconnaissance level and 30% at reco-level and a minor percentage at more detailed levels.

## 2. GENERAL CHARACTERISTICS OF THE SYSTEM

The National Soil Survey and Conservation Services (SNLCS-EMBRAPA) is at present coordinating the elaboration of the Brazilian system. Having taken the central concepts from the old USA system it has modified criteria, created subdivisions and intergrades during the numerous soil surveys. Although the 2nd approximation of the system has been published, it is not yet in conditions to be reproduced or transcribed, since it is still in development. The system was designed to include all the soils of Brazil, but it is an incomplete and open system, in which new classes may be incorporated. It is a multi-categorical and descending system. Its base is morphogenetic, since characteristics which express pedogenetic processes are used. For this purpose morphological, physical, chemical and mineralogical properties are used.

## 3. DIAGNOSTIC HORIZONS AND OTHER DIAGNOSTIC PROPERTIES

### 3.1 DIAGNOSTIC HORIZONS

The relative stable B-horizon was selected as diagnostic horizon in early stage. The definition of surface and subsurface diagnostic horizons were made in the early sixties, based on the 7th Approximation of the USA soil classification system. However, the Brazilian system passed through many changes and improvements. The diagnostic horizons presently used in Brazil and compared with the equivalent horizons of the FAO (1974) and Soil Taxonomy (1975) are represented in Table 1.

## 3.2 OTHER DIAGNOSTIC PROPERTIES

### Soil colour

Particularly in Latosols soil colour was used as an important criteria to define soil classes. At a regionale scale colour is associated (correlated) with other properties, such as iron oxides/hydroxides, magnetic susceptibility of the soil, land use, climatic conditions, geomorphology. At a nationale scale soil colour as a high level criteria is under discussion.

### Activity of clay (T)

The activity of clay refers to the CEC of the clay fraction. It is calculated from the CEC of the soil after subtraction of the contribution of organic carbon.
The following equation is used:

$$\text{CEC (100 g clay)} = \text{CEC (100 g soil)} - (4.5 \times \%C) \quad \times 100/\% \text{ of clay}$$

For more precise procedure, the graphic method proposed by Bennema (1966) should be used. Two classes of activity of clay are used:

Ta = soils with CEC $>$ 24 meq/100g clay, and
Tb = soils with CEC $<$ 24 meq/100g clay.

### High Al saturation (Allic)

The term "Allic" is used to define soil classes with Al saturation $>$ 50% and a minimum of 0.3 meq of exchangeable Al.
The formula:

100.Al/S+Al[2] is used to calculate it.

### Base saturation (V)

Equivalent definition as in ST and FAO.
Eutrophic refers to V $>$ 50%, dystrophic is V $<$ 50%

### Sodic

Sodic refers to E.S.P.[3] $>$ 15% in the lower part of the B or C horizon.

---

2) Al extracted with 1N KCl in meq/100g soil
S is sum of exchangeable cations, in meq/100g soil
3) ESP = Exchangeable Sodium Percentage

Solodic

Solodic refers to E.S.P. between 6 and 15%.

Saline

Saline indicates the presence of salts, expressed by an EC[4] > 4mS.

Carbonatic

Carbonatic refers to soils with more than 15% $CaCO_3$, but without a Calcic horizon.

Abruptic

'Abruptic' refers to an abrupt textural change from the A to B horizon. If the A horizon has < 20% clay, the clay increase in a distance of 7.5 cm should be 100% and if the A horizon has > 20% clay, the clay increase in 7.5 cm should be of 20% in absolute value (as 22% to 42%).

Textural classes

The textural class of the B horizon is used for subdivision, i.e. heavy clay > 60% clay, clayey 35-60, medium 15-35, sandy < 15%, silty >50% silt.

Other properties

Gilgai, slickensides, clay skins, (para) lithic contact, durinodules, plinthite, drainage and soil reaction as defined in ST or the soil survey manual are also used as diagnostic properties.

Phases

Although most soil survey performed in Brazil are at the reconnaissance or more general level and the adequate taxonomic units at these levels are far from soil series, phases of relief, substratum, natural vegetation, rock outcrops and concretions has been used.

Intergrades

Frequently termed as "latosolic" (Cambisols, Terra Roxa Estruturada, and Red yellow Podzolic), "cambic" (Latosols), "podzolic" (Latosols, Cambisols); "vertic" (Planosols, Non-calcic Brown) and others, are used to indicate integration between groups of soils.

---

4) ECs = electrical conductivity of a saturated soil past

## 4. SOIL CLASSES AND THEIR DEFINITIONS

As no final/official publication on the Brazilian system exists yet, Table 2 has been prepared to show in a simplified version the system as it is in use.

The legend of the 1:5.000.000 scale soil map of Brazil (EMBRAPA-SNLCS, 1981) as well as the publication "bases for reading soil maps" (EMBRAPA-SNLCS, 1981) form the base for Table 2. Other publications used are listed in the annex literature, numbers 2, 3, 4, 5, 6, 7, 8, 9, 11, and 13. The diagnostic properties for further subdivision of classes on a lower level are given as well. The system on the lower levels is "open", no established lower class definitions are given.

Some examples of how these diagnostic properties on a lower level are used in soil surveys:

Example 1. A red yellow latosol with a thick dark organic carbon rich surface horizon with > 50% aluminium saturation in the diagnostic horizon, clayey texture, vegetation of subtropical humid forest and found on undulating slope would be classified as:

Red Yellow Latosol Humic Allic clayey phase humid subtropical forest undulating relief.

Example 2. A greyish brown podzolic soil with > 50% base saturation and parts of the profiles presenting rock structure and high concentration of weatherable minerals, cation exchange capacity after correction for organic carbon  24 meq/100g of clay (Ta), abrupt textural change, moderate A horizon, medium texture at the B horizon, vegetation of tropical forest and gently undulating slope, would be classified as:

Greyish Brown Podzolic Eutrophic Cambic Ta, abruptic moderate A sandy/medium texture phase tropical forest gently undulating relief.

Example 3. A Rendzina with clayey texture and occurring under semi deciduous subtropical forest and rolling relief is classified as:

Rendzina Clayey phase semi deciduous subtropical fores rolling relief.

In this case, since the type of surface diagnostic horizon (Chernozemic A) and the high base saturation and high activity of clay are properties used to define the soil class, they cannot be used for further subdivisions of classes in lower categorical levels.

## 5. CORRELATION BETWEEN SOIL CLASSES OF BRAZILIAN, FAO AND ST SYSTEMS

A correlation between Brazilian, FAO, ST soil classification systems has been made, based on the classification of about 400 soil profiles described and classified in Brazilian soil survey reports.

In table 3A results are presented for the first level soil classes. In table 3B results are presented for the Latossolos subclasses. The number of profiles classified according to a specific class is presented in brackets after the class name in table 3B. The number was omitted when just one profile has been classified in a class.

A reasonable comparison can only be made on the first level (table 3A). For instance, most of the Latosols of Brazilian system fit into the Ferralsol unit of FAO World Soil Map legend and into the Oxisol order of Soil Taxonomy.

Comparison on the second level is already difficult and confusing (table 3B). A wide scattering of classes was observed when the Brazilian types of Latossolos were classified on the second level of FAO and on suborder and great groups of Soil Taxonomy. A similar scattering was observed in other classes, a.o. Red Yellow Podzolic, Terra Roxa Estruturada, Reddish Brunizem and Litossolos.

This scattering is inevitable as criteria for subdivision on the second or lower levels are different. E.g., for the Latossolos the colour with iron oxide content is used in the Brazilian system; while presence of plinthite, an umbric A horizon low CEC and colour are used in FAO system; moisture regime on second level, and presence of gibbsite or plinthite, base saturation, CEC, etc. on third level are used in the Soil Taxonomy.

## 6. THE BRAZILIAN SYSTEM IN PRACTICE - TOPICS OF DISCUSSIONS

In this paragraph the applicability of the Brazilian system for soil surveying, soil evaluation and scientific work will be discussed mainly on typical tropical soils.

### Soil mapping

The high level classification of soils in the field is remarkable quickly done and showing a reasonable uniformity. This is probably caused by the fact that not a rigid classification key procedure is followed but still a quick "central concept" approach.

The central concepts of a Latosol, a Podzolico or a Terra Roxa Estruturada in terms of morphology are rather well memorized and serves as a reference base for the soil surveyor. (The latosol being very deep with little horizonation and a very weak macrostructure, the Podzolico being not very deep with clear horizonation due to colour and textural differentiation, and the Terra Roxa Estruturada with a well developed blocky structure.)

The naming of intergrades is simple but the procedure is subjective and results will probably be more heterogeneous.

In the comparison of soil profiles on country or world scale, it appears for instance that soil colour at present in use as a differentiating criterium on a high level is discussable.

The large degree of freedom in coining/characterizing a soil on a lower level is also an advantage for soil mapping on a regionale scale.

For soil mapping on a regionale scale the FAO and ST system has disadvantages:

- FAO: having only two taxonomic levels
- rigid key procedure, creating high risk for conflicting results
- necessity for standardized analytical data

## Soil Evaluation

The classification system is based, besides the profile morphology, on chemical characteristics. Therefore, soil evaluation on chemical characteristics can be reasonably executed. Physical soil evaluation is weak, being not based on measured or observed characteristics but realized in a presumed generalized way. For instance (simplified), Latossolos having favourable physical characteristics; Podzolicos having less favourable rooting possibilities and being more erodable; and Terra Roxa Estruturada having good rooting possibilities but erodable, etc..

The land capability classification based on the morphological and chemical properties, due to the large scale of maps, is adequate for regional planning. In some regions the soil survey informations have been transfered to extension agencies and used for agricultural development, but as a hole they are subutilized.

## Scientific work

As already indicated above it seems that the advantages of the system at present is more in mapping soils distribution on a regional scale than being a system which make comparison and correlation on country or world scale possible.

For instance, the colour and iron oxides content for subdivision of the Latossolos in the highest level is from the genetic viewpoint a weak grouping criterium, since colour is more related to the type of iron oxide. Even though iron oxide rich Latossolo Roxo presents a very strong small granular structure, which is sometimes described as "coffee powder" structure, most physical and chemical properties are not related to the type and content of iron oxides.

On a routine base the 'ataque sulfurico' ( total analysis of elements by dissolution with $H_2SO_4$) is executed. The results and the derived Ki and Kr[5] values are however very little used in the system. There is a need to check on a large number of profiles, the usefulness of this analysis for classification purposes.

The 'CEC corrected for organic matter' (T value) is very little used as a classification criteria, e.g. further subdivision of the Latossolos.

---

5) Ki = $SiO_2/Al_2O_3$

Kr = $SiO_2/Al_2O+Fe_2O_3$

Table 1. - Equivalences between diagnostic horizons of FAO, Soil Taxonomy and Brazilian system of soil classification and specific criterion used in Brazil

| Systems of classification | | | Specific or additional criterion |
|---|---|---|---|
| FAO | Soil Taxonomy | Brazilian | used in Brazilian system |
| | - Surface Diagnostic Horizons - | | |
| Mollic A | Mollic Epipedon | Chernozemic A | equivalent definitions |
| Umbric A | Umbric Epipedon | Proeminent A | equivalent definitions |
| - | Anthropic " | Anthropic A | equivalent definitions |
| Histic A | Histic " | Turfoso A | equivalent definitions |
| Ochric A | Ochric " | Moderate A | equivalent definitions, but excludes horizons with properties of weak A horizon |
| - | - | Weak A | surface horizon with $< 0.58\%$ organic carbon, light colours with dry values 5 and without development of structure or weak structure |
| - | - | Humic A | corresponds to the richer in organic carbon and thicker segment of umbric epipedon |
| | - Subsurface diagnostic horizons - | | |
| Argillic B | Argillic horizon | textural B | equivalent definitions, but textural gradient or the ratio of clay content of B horizon/A horizon is: a) $> 1.5$ if A horizon has $> 40\%$ clay; b) $> 1.7$ if A horizon has 15 to 40% clay; c) $> 1.8$ if A horizon has $<$ 15% clay. When the B horizon presents well developed blocky or prismatic structure and/or clay skins, the former textural gradient is not required |
| Natric B | Natric horizon | Natric B | equivalent definitions |
| Spodic B | Spodic horizon | Spodic B | equivalent definitions |
| Cambic B | Cambic horizon | Incipient B | similar definitions, but to distinguish from Latosolic B, should have weatherable minerals, CEC of clay $> 13$ me/100g after correction for organic carbon, silt/clay ratio $> 0.7$; $SiO_2/Al_2O_3$ ratio $> 2.2$ and 5% or more by volume of rocks fragments or saprolite |

Table 1. (continuation)

| Systems of classification | | | Specific or additional criterion |
|---|---|---|---|
| FAO | Soil Taxonomy | Brazilian | used in Brazilian system |
| | | - Subsurface diagnostic horizons - | |
| Oxic B | Oxic horizon | Latosolic B | similar definitions, but the Latosolic B is at least 50 cm thick; has a silt/clay ratio < 0.7; CEC of the clay fraction after deduction of the contribution of organic matter is < 13 meq/100g of clay; $SiO_2/Al_2O_3$ ratio (Ki) of the clay fraction < 2.2 normally less than 2.0; very strong, very small to small granular structure or weak to moderate subangular blocky; great stability of aggregates, with high degree of flocculation and low content of water dispersable clay |
| Plinthite | Plinthite | Plintic horizon | Presence of plinthite as defined in Soil Taxonomy in more than 25% by volume, in a layer of 15 cm thick or more |
| - | - | Gley horizon | similar to hydromorphic properties of FAO system. Is a subsurface horizon with gleyic properties, as: 1) dominant neutral (N) hues or bluer than 10Y; 2) saturation of water at some period of the year, or artificially drained, with evidence of reduction processes or of reduction and segregation of iron reflected by: a) mottles of chromas 2 or less, b) if mottles are not present and the value is > 4, the chroma is ≤ 1 and if the value is 4 or more, chroma 1 or less |
| Albic E | Albic horizon | Albic horizon | equivalent definition |
| Calcic horizon | Calcic " | Calcic " | equivalent definition |
| - | Petrocalcic horizon | Petrocalcic horizon | equivalent definition |
| Sulfuric horizon | Sulfuric horizon | Sulfuric horizon | equivalent definition |
| - | Salic horizon | Salic horizon | equivalent definition |
| - | Fragipan | Fragipan | equivalent definition |
| - | Duripan | Fragipan | equivalent definition |

Table 2 - Key to soil classes of high level in use at present and diagnostic properties used for further subdivision of the classes in lower categorical levels

| Soil classes of high level | Diagnostic properties for subdivision of classes of high level |
|---|---|
| A. Mineral soils, non hydromorphic, with latosolic B horizon below any diagnostic A horizon except turfoso (histic) A, and: | - Humic A (Humic) or criptohumic A horizon (criptohumic = presence of high amounts of organic carbon, but with light colours); |
| 1) dusky red to dark red colors, high concentration of $Fe_2O_3$ (>18%), high magnetic susceptibility and efervescence with $H_2O_2$ **Latossolo roxo** (dusky red Latosol) | - Base or Al saturation (Eutrophic, Dystrophic, Allic)<br>- Presence of plinthite (not satisfying definition of Plinthic B horizon), concretions, cohesiveness of soil mass (plinthic, concretionary, cohesive) |
| 2) Dusky red to dark red colours, medium to high concentration of $Fe_2O_3$ (9-18%) when texture is clayey or $\%Al_2O_3/\%Fe_2O_3$ >1.0 and < 2.0 when of medium texture and without magnetic susceptibility and no effervescence with $H_2O_2$ **Latossolo Vermelho Escuro** (dark red Latosol) | - Intergradational properties (Podzolic, cambic)<br>- Types of A horizon (Proeminent, moderate ....)<br>- Textural class<br>- Phases of vegetation and relief |
| 3) Yellow red colour, medium to low concentration of $Fe_2O_3$ (<9%) when of clayey texture or $\%Al_2O_3/\%Fe_2O_3 > 2$ when of medium texture **Latossolo Vermelho Amarelo** (Yellow Red Latosol) | |
| 4) Yellow colours, low concentration of $Fe_2O_3$ and developed from materials poor in bases and iron **Latossolo Amarelo** (Yellow Latosol) | |
| 5) Latosols with brown colours, found in regions of cold and humid climate and high altitude **Latossolo Bruno** (Brown Latosols) | |
| 6) Latosols with very high content of $Fe_2O_3$ (> 35%) **Latossolo Ferrifico** (Ferrific Latosols) | |

Table 2 - (continuation)

| Soil classes of high level | Diagnostic properties for subdivision of classes of high level |
|---|---|
| B. Mineral soils, with textural B horizon, low activity clay, low textural gradient between B/A, moderate to strong prismatic or blocky structure, clay skins on peds and:<br><br>1) Developed from basic rocks, dusky red to dark red colours, high $Fe_2O_3$ content, high magnetic susceptibility and effervescence with $H_2O_2$<br>**Terra Roxa Estruturada**<br><br>2) Not developed from basic rocks, dark red colours, lower content of $Fe_2O_3$, low magnetic susceptibility and effervescence with $H_2O_2$<br>**Terra Roxa Estruturada Similar**<br><br>3) Developed from basic rocks, brown colours<br>**Terra Bruna Estruturada**<br><br>4) Not developed from basic rocks, brown colours<br>**Terra Bruna Estruturada Similar** | - Base or Al saturation<br><br>- Intergradational properties (Latosolic)<br><br>- Type of A horizon<br><br>- Textural class<br><br>- Phases of vegetation and relief |
| C. Mineral soils with textural B horizon, mostly with abrupt textural change<br><br>1) B horizon with yellow to red colour, well drained soils<br>**Podzolico Vermelho Amarelo**<br>(Red Yellow Podzolic)<br><br>2) Greyish brown colour, somewhat poorly to poorly drained<br>**Podzolico Bruno Acinzentado**<br>(Greyish Brown Podzolic)<br><br>3) With Plinthite in B horizon, buth not satisfying the requisites to a Plinthic B horizon<br>**Podzolico Plintico**<br>(Plinthic Podzolic) | - Base or Al saturation<br><br>- Presence of fragipan<br><br>- Intergradational properties (Latosolic, Cambic)<br><br>- Activity of clay (Ta and Tb)<br><br>- Type of A horizon<br><br>- Textural class<br><br>- Phase of vegetation and relief |

Table 2 - (continuation)

| Soil classes of high level | Diagnostic properties for subdivision of classes of high level |
|---|---|
| D. Mineral soils with a spodic B horizon<br>1) Non hydromorphic<br>**Podzol**<br>2) Hydromorphic<br>**Podzol Hidromorfico**<br>(Hydromorphic Podzol) | - Base or Al saturation<br>- Type of A horizon<br>- Textural class<br>- Phase vegetation and relief |
| E. Mineral soils with a Chernozemic A horizon, high activity clay, mostly with reddish colour and:<br>1) Cambic B horizon<br>**Brunizem**<br>2) Textural B horizon<br>**Brunizem Avermelhado**<br>(Reddish Brunizem) | - Textural class<br>- Phases of vegetation and relief |
| F. Mineral soils with a textural B horizon, high activity clay, reddish colour, moderate to strong prismatic or blocky structure, proeminent A horizon, high Al saturation<br>**Rubrozem** | - Intergradational properties (Cambic, Latosolic)<br>- Textural class<br>- Phases of vegetation and relief |
| G. Mineral soils with a reddish textural B horizon, high activity clay, normally with eutrophic weak or moderate A, with or without a calcic or carbonatic horizon<br>**Bruno não Calcico**<br>(Non Calcic Brown) | - Intergradational properties (Litholic, Planosolic, Vertic)<br>- Type of A horizon<br>- Textural class<br>- Phases of vegetation and relief |
| H. Mineral soils, hydromorphic, with a textural B horizon, mostly with abrupt textural change, occur on level to gently undulating surfaces<br>**Planossolo**<br>(Planosol) | - Plinthic or Solodic properties<br>- Base or Al saturation<br>- Activity of clay<br>- Type of A horizon<br>- Phases of vegetation and relief |

Table 2 - (continuation)

| Soil classes of high level | Diagnostic properties for subdivision of classes of high level |
|---|---|
| I. Mineral soil, mostly hydromorphic, with a natric B horizon, abrupt textural change, high activity clay **Solonetz Solodizado** (Solodized Solonetz) | - Base saturation or presence of soluble salts<br>- Presence of fragipan<br>- Type of A horizon<br>- Textural class<br>- Phase of vegetation and relief |
| J. Mineral soils with a salic horizon, with enrichment of soluble salts at the surface horizon **Solonchakos solos salinos indiscriminados** (Indiscriminated saline soils) | - Geomorphic surface in which saline soils are found as: "mangrove", ocean coast |
| K. Mineral soils with an incipient (cambic) B horizon, well to imperfectly drained **Cambissolo** (Cambisol) | - Intergradational properties (Latosolic, Vertic) or Humic horizon<br>- Base or Al saturation<br>- Activity of clay<br>- Type of A horizon<br>- Textural class<br>- Phases of vegetation, substratum and relief |
| L. Mineral soils with a plinthic B horizon, low activity clay, hydromorphic, mostly with abrupt textural change **Laterita hidromorfica** (Groundwater laterite) | - Base or Al saturation or soluble salts (solodica)<br>- Presence of fragipan<br>- Type of A horizon<br>- Textural class<br>- Phases of vegetation and relief |
| M. Mineral soils with a gley horizon, hydromorphic, weak textural gradient between horizon and:<br>1) Thick, dark surface horizon, with high organic carbon content **Gley Humico** (Humic Gley)<br>2) Lighter in colour and lower content of organic carbon in surface horizon **Gley Pouco Humico** (Low Humic Gley)<br>3) Sulfuric horizon **Gley Thiomorfico** (Thyomorphic Gley) | - Base or Al saturation<br>- Activity of clay<br>- Type of A horizon<br>- Textural class<br>- Phases of vegetation and relief |

Table 2 - (continuation)

| Soil classes of high level | Diagnostic properties for subdivision of classes of high level |
|---|---|
| N. Mineral soils with 30% or more of clay, with cracks in some periods of the year, slickensides or compression surfaces **Vertissolo** (Vertisols) | - Carbonatic or calcic horizon<br>- Type of A horizon<br>- Phases of vegetation and relief |
| O. Weakly developed mineral soils, without subsurface diagnostic horizon, hydromorphic or not | |
| 1) AR or AC horizon sequence, with underlying unweathered or wethered rocks **Litossolo** (Lithosols) | - Presence of a Humic A horizon, base or Al saturation, activity of clay, type of A horizon, textural class, phases of vegetation, substratum and relief |
| 2) AC horizon and developed from saprolite or pediment deposits or other reworked material **Regossolo** (Regosols) | - Base or Al saturation, presence of fragipan, type of A horizon, textural class and phases of vegetation and relief |
| 3) AC horizon sequence and developed from quartzic sands and:<br>a) Non hydromorphic **Areias Quartzosas** (Quartzic Sands)<br>b) Hydromorphic **Areias Quartzosas hidromórficas** (Hydromorphic Quartzic Sands) | - Base or Al saturation, type of A horizon and phases of vegetation and relief |
| 4) AC horizon sequence, with Chernozemic A horizon and weathered from limestone **Renzina** | - Textural class, phases of vegetation and relief |
| 5) AC horizon, developed from fluvial sediment, which shows stratification **Solos Aluviais** (Alluvial Soils) | - Base or Al saturation, activity of clay, type of A horizon, textural class and phases of vegetation and relief |
| P. Hydromorphic soils developed from organic material **Solos Orgânicos** (Organic Soils) | - Presence of sulfur (Thyomorphic), base or Al saturation and phases of vegetation and relief |

Table 3A - Tentative correlation between soil classes of high level of Brazilian, FAO and Soil Taxonomy systems

| Brazilian | FAO | Soil Taxonomy |
|---|---|---|
| Latossolos | Ferralsols | Oxisols |
| Podzolico Vermelho Amarelo (red yellow podzolic) | Acri-, Luvi-, Nitosols | Ulti-, Alfisols |
| Terra Roxa Estruturada (structured red earth) | Nitosols | Alfi-, Ulti-, Mollisols |
| Brunizem avermelhado (reddish Brunizem) | Phaeozem/Kastanozem/ Chernozem Luvisol | Alfi-, Mollisol |
| Cambissolo | Cambi-, Fluvisol | Inceptisol |
| Vertissolo | Vertisols | Vertisols |
| Litossolos | Phaeozem, Lithosols Rankers, Cambisols | Inceptisols, Entisols |
| Regossolos | Rego-, Cambisols | Entisols |
| Areias quartzosas (Quartz sands) | Areno-, Regosols | Entisols, Inceptisols |
| Solos aluviais | Fluvisols | Entisols |
| Solos orgânicos | Histosols | Histosols |
| Laterita hidrómorfica | plinthic Acri-, Luvi-, Ferralsols | plinthic-, aquic-, oxi-, ulti-, Alfisols |
| Glei | Gleysols gleyic Luvi-, Acrisols | aquic Incepti-, Molli-, Entisols |

Table 3B - Tentative correlation between subclasses of Brazilian Latossolos soils and FAO and Soil Taxonomy systems

| Brazilian system | FAO World Soil Map legend | Soil Taxonomy |
|---|---|---|
| Latossolo Roxo<br>(Dusky Red Latosol) | Rhodic(10), Humic(3),<br>Acric, Ferralsol | Haplorthox(6); Acr orthox(4)<br>Ustox; Eutr orthox(4), Ustox |
| Latossolo Vermelho Escuro<br>(Dark Red Latosol) | Rhodic(8), Humic(4),<br>Acric(3) orthic(2) Ferralsol | Hapl orthox(6) Ustox(2)<br>Humox; Acr orthox(4) ustox(2);<br>Eutr orthox ustox |
| Latossolo Vermelho Amarelo<br>(Yellow Red Latosol) | Orthic(19), humic(16),<br>xanthic(7), Acric(2),<br>plinthic Ferralsols and<br>Dystric Nitosols(2) | Hapl orthox(20) ustox(4)<br>Humox(3); Acr orthox(12)<br>Ustox(5) humox(3);<br>Sombri humox(2) orthox;<br>Umbri orthox(7); Torrox(2);<br>Eutrustox |
| Latossolo Bruno<br>(Brown Latosol) | Humic Ferralsol(4) | Haplo Humox (2)<br>Acro Humox (2) |
| Latossolo Ferrifico<br>(Ferrific Latosol) | Humic Acric Ferralsol | Acro Humox |

**LITERATURE**

Baldwin, M., Kellog, C.E. and J. Thorp. Soil classification. In: Soil & Man. United State Department of Agriculture. Yearbook of Agriculture, 979-1002, 1938.
Bennema, J. Report to the Government of Brazil on classification of Brazilian Soils. FAO, Report EPTA, 2127, 1966.
Bennema, J. and Camargo, M. Esboço parcial da segunda aproximação de classificação de solos brasileiros. Subsidios à VI Reunião Técnica de Levantamento de Solos. Divisão de Pedologia e Fertilidade do Solo. Ministério da Agricultura, Rio de Janeiro, 1964.
Brasil, Ministério de Agricultura. Comissão de Solos. Levantamento de Reconhecimento dos Solos do Estado do Rio de Janeiro e Distrito Federal. Rio de Janeiro. Boletim Técnico no. 11:1-349, 1958.
-------, --------. Levantamento de Reconhecimento dos Solos do Estado do Rio Grande do Sul. Recife. Boletim Técnico no. 30:1-431, 1973.
Brasil, Ministério da Agricultura, EMBRAPA-SNLCS. Estudo expedito dos solos no Estado do Paraná para fins de classificação e correlação. Recife. Boletim Técnico no. 37:1-58, 1973.
-------, --------. Levantamento de reconhecimeto dos solos do Distrito Federal. Rio de Janeiro. Boletim Técnico no. :1-455, 1978.
-------, --------. Soc. Bras. Ciência do Solo. Anais da I reunião de classificação, correlação e interpretação de aptidão agricola de solos, pag. 276, 1979.
-------, --------. Estudo expedito de solos no Estado do Piaui para fins de classificação, correlação e legenda preliminar. Rio de Janeiro. Boletim Técnico no. 63:1-234, 1980.
-------, --------. Bases para leitura de mapas de solos. Rio de Janeiro. Serie Miscelanea no. 4:1-91, 1981.
-------, --------. Soc. Bras. Ciência do Solo. Anais da II reunião de classificação, correlação de solos e interpretação de aptidão agricola. Rio de Janeiro. Documentos SNLCS no. 5:1-138, 1983.
FAO-UNESCO. Soil Map of the World. Scale 1:5.000.000. Unesco, Paris, pag. 59, 1974.
Oliveira, J.B., Menk, J.R.F., Barbieri, J.L., Rottan, C.L. and W. Tremocoldi. Levantamento pedológico semi-detalhado do Estado de São Paulo: Quadricula de Araras. Bol. Tecn. Inst. Agron. Campinas, SP, no. 71:1-180, 1982.
RADAMBRASIL, Ministério das Minas e Energia. Levantamento de Recursos Naturais. Rio de Janeiro. Vol. 12(1976), 13(1977), 15(1977), 17(1978) and 18(1978).
Ramalho Filho, A., Pereira, E.G. and K.J. Beek. Sistema de avaliação de aptidão agricola das terras. Ministério da Agricultura, EMBRAPA/SNLCS-SUPLAN, 2ª edição. Rio de Janeiro, pag. 57, 1983.
Soil Survey Staff. Soil Survey Manual. Handbook no. 18. Soil Conservation Service, U.S. Dept. Agric., Washington, D.C. 1951.
--------. Soil classification, A comprehensive system, 7th Approximation. Soil Conservation Service, U.S. Dept. of Agric., Washington, D.C., 1960.
--------. Soil Taxonomy: A basic system of soil classification for making and interpreting soil surveys. Handbook no. 436. Soil Conservation Service, U.S. Dept. of Agric., Washington, D.C., 1975.
Thorp, J. and G.D. Smith. Higher categories of Classification: Order, Sub-Order and Great Soil Groups. Soil Science, 67:117-126, 1949.