United States
Department of
Agriculture

Soil
Conservation
Service

P.O. Box 2890
Washington, D.C.
20013

November 16, 1987

NATIONAL SOIL TAXONOMY HANDBOOK
430-VI
ISSUE NO. 11

Purpose. To distribute current amendments to Soil Taxonomy, Agriculture Handbook 436.

Effective Date. These amendments and revisions are effective when received.

Filing instructions. File this copy of the changes in the 3-ring binder with Issue No. 1 through 10. It is suggested that you keep this binder with the Soil Taxonomy volume for easy reference.

Replace 615 contents dated June 1987 with the enclosed contents dated November 1987. File page 615-j following page 615-2i. File pages 615.111-162 following pages 615-110.

Supplementation. States and NTC's may not supplement the handbook.

Edgar H. Hollis
Per

ROBERT R. SHAW
Deputy Chief for Technology

DIST: NSTH

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615.45 Oxisol amendment

Introduction

In 1977 the Soil Conservation Service established the International Committee on Oxisols (ICOMOX), to review the classification of Oxisols and make recommendations for changes. The work of ICOMOX was partly based on the outcome of another committee, the International Committee on Low Activity Clays (ICOMLAC). The concept of the 'Kandic horizon' was developed by ICOMLAC and with this in place, ICOMOX could then define the oxic horizon and the classes of the Order.

The placement of soils with low activity clays (LAC) was a problem for many people working in the tropics. This relatively homogeneous group of soils was divided among several taxa in Soil Taxonomy. The presence of an argillic horizon was considered to be important and the definition of Oxisols excluded soils with argillic horizons. The performance of the LAC soils and many of their engineering properties, however, indicated their response was more similar to Oxisols than to Ultisols or Alfisols. After considerable testing, the concept of Oxisols was enlarged to include the LAC soils with more than 40% clay in the surface layers. This major conceptual change required revisions of the entire order of Oxisols. These revisions and corresponding changes in other taxa are presented in this amendment.

ICOMOX also considered other points of concern which users of

of the Humox, the perudic soil moisture regime, the sombric horizon, plinthite, and the general structure of the taxa itself were tested. The data base of the National Soil Survey Laboratories proved very valuable for this purpose.

These amendments to Soil Taxonomy include the final proposal of ICOMOX. Those who have reviewed it, agree that the result

615.45

Page 36, second column, oxic horizon. Delete all discussion on oxic horizon through item 7 of the "summary of properties" on page 39 and replace with the following:

"OXIC HORIZON

The oxic horizon is intended to characterize a mineral subsurface horizon of sandy loam or finer particle-size with low cation exchange capacity and low weatherable mineral content. It is at least 30 cm (12 in.) thick. The clay sized fraction is usually dominated by kaolinite with or without iron and aluminum oxyhydrates and with few or no other lattice silicate minerals except hydroxy interlayered vermiculites. The silt and sand fraction of the oxic horizon is generally dominated by quartz with some other resistant minerals. Weatherable minerals which are potential sources of plant nutrients (K, Ca, Mg) may be present only if they do not exceed 10 percent of the 50-200 micron fraction. Rock fragments or lithorelicts may be present only if they are coated with sesquioxides or if the included weatherable minerals are completely altered.

A quantifiable cation exchange capacity limit is placed on the clay sized fraction. Where dispersion is a problem, 3 x the percent water retained at 15 bar tension is used to estimate clay content. The apparent CEC, by the 1N NH_4OAc pH_7 method is equal to or less than 16 meq per 100 grams of clay and the effective CEC (ECEC) as determined by the sum of NH_4OAc displaced bases plus 1N KCl extractable aluminum is equal to or less than 12 meq per 100 gram of clay. Since the determination of apparent clay CEC values involves dividing the soil CEC by the percent clay content insures that soil materials with low activity clay but with high organic matter content are excluded. The mineralogy and charge characteristics also exclude horizons containing significant quantities of short-range order minerals. The oxic horizon does not have

andic soil properties1/. Some oxic-like horizons may have high amounts of low charge illite, but they have more than 10 percent muscovite in the 50-200 micron fraction and are thus excluded from oxic horizons. This same criteria is expected to limit horizons containing much pyrophyllite, a mineral with practically no permanent charge, from oxic horizons.

The upper boundary of the oxic horizon is at 18 cm below the soil surface or the base of the Ap horizon, whichever is deeper, or at a deeper depth where the mineralogical and charge characteristics meet the requirements of the oxic horizon. Any increase in clay content at the upper boundary must be diffuse. The lower boundary is also defined by the mineralogical and charge requirements. In addition the presence of saprolite that has rock structure may define the lower boundary of an oxic horizon.

1/ Andic soil properties are tentatively defined as soil materials meeting one or more of the following three requirements:

1.a. Acid oxalate extractable aluminum plus 1/2 acid oxalate extractable iron is 2.0 percent or more in the <2 mm fraction;
   b. Bulk density of the <2 mm fraction, measured at 1/3 bar water retention, is ≤ 0.90 g/cm^3; and
   c. Phosphate retention is more than 85 percent; or
2.a. More than 60 percent by volume of the whole soil is volcaniclastic material coarser than 2 mm; and
   b. Acid oxalate extractable aluminum plus 1/2 acid oxalate extractable iron is 0.40 percent or more in the <2 mm fraction; or
3. The 0.02 to 2.0 mm fraction is at least 30 percent of the <2 mm fraction and meets one of the following:
   a. If the <2 mm fraction has acid oxalate extractable aluminum plus 1/2 acid oxalate extractable iron of 0.40 percent, there is at least 30 percent volcanic glass in the 0.02 to 2.0 mm fraction;
   b. If the <2 mm fraction has acid oxalate extractable aluminum plus 1/2 acid oxalate extractable iron of 2.0 percent or more, there is at least 5 percent volcanic glass in the 0.02 to 2.0 mm fraction; or
   c. If the <2 mm fraction has acid oxalate extractable aluminum plus 1/2 acid oxalate extractable iron of between 0.40 percent and 2.0 percent, there is a proportional content of volcanic glass in the 0.02 to 2.0 mm fraction between 5 and 30 percent.

Significance to soil classification and use

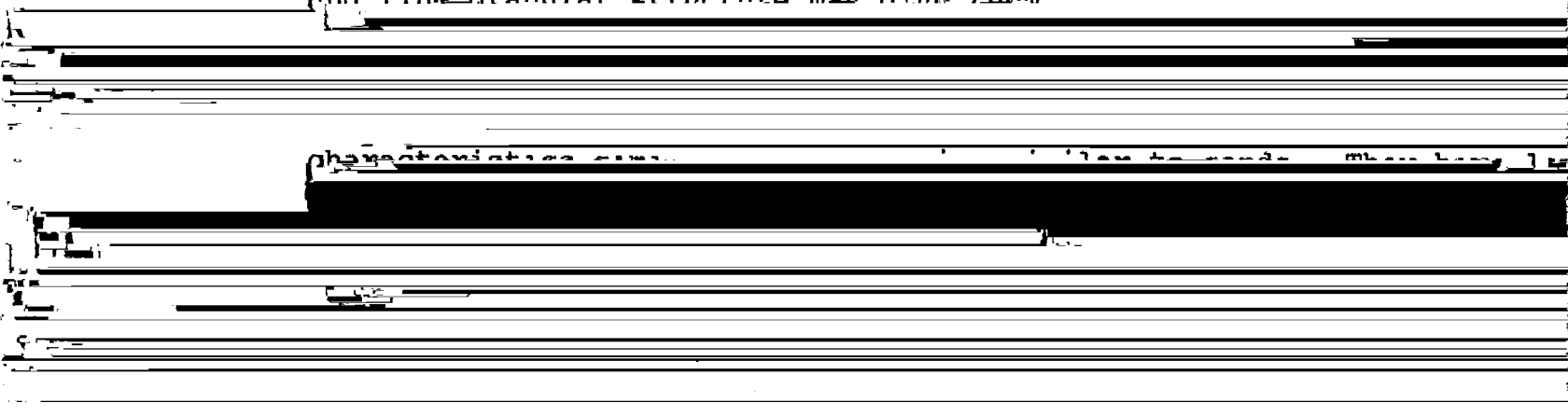
One important attribute of the oxic horizon is that it is almost devoid of primary weatherable minerals, thus further weathering will release few plant nutrients.2/

Another important attribute is that in many soils with oxic horizons the clay content is relatively constant with depth indicating little or no clay mobility. This suggests a high order of stability in the clay fraction which has been attributed to cementation by sesquioxides. Oxic horizons usually have only traces of water dispersible clay, if their net charge is near zero, but this characteristic is also shared by some other horizons.

A third attribute of most oxic horizons is the stable fine and very fine granular structure and thus the friable and porous nature of the horizon. Bulk densities are generally low, often near 1 gm/cm^3 in fine and very fine particle size classes. Macro-structure may be angular or subangular blocky, but the grade of blocky structure is generally weak.

These and other attributes directly or indirectly influence the performance of soils containing oxic horizons. The very low cation exchange capacity is an important consideration in soil management. In addition, some oxic horizons have a high capacity to adsorb anions and make some, especially phosphates, unavailable to plants. Large amounts of phosphate may need to be added as an initial amendment to overcome the fixation capacity. Cations may need to be added frequently and in small amounts to compensate for leaching loss. The low CEC, where dominated by exchangeable Al, is often an advantage in that it only takes small amounts of basic cations to increase the base saturation percentage. Further, the ease with which basic cations are leached makes the chemical deepening of the root zone feasible via continued lime or gypsum applications.

Although oxic horizons often contain high amounts of clay, their tendency to form a strong grade of very fine and fine granular structure may give them



available water holding capacities because most of the pores are either very large, between the granules, and

at too great a tension for plants to extract. Plants may show moisture stress after only a week without rain. Although the low available water holding capacity is most limiting to shallow rooted plants, yields of deep rooted trees such as rubber and oil-palm are also known to decline due to moisture stress.

It is considered desirable to identify soil horizons that are nearly mineralogically sterile due to being unable to supply basic cations from the continued weathering of primary minerals. As such, the oxic horizon can be considered a counterpart of the cambic horizon which has a greater content of weatherable minerals. As with the cambic horizon, the exclusion of certain coarse particle-size classes is admittedly arbitrary, but in the case of the oxic horizon it is considered necessary to preserve the uniformity of the horizon with materials that have enough clay to reflect the low CEC nature and structural tendencies.

When considered in the vertical sequence of a soil profile, an increase in clay content with depth may be associated with increased grades of blocky structure not common to the central concept of the oxic horizon. Where the clay content increase underlies coarser particle size surface horizons, a small increase in the amount of clay appears more significant to moisture relationships than when the surface horizon is clayey in texture. This is especially true in the interpretation of soils that have been subjected to accelerated erosion. Where coarser textured surfaces erode in cultivated areas and finer textured subsoil material becomes incorporated into the plow layer, spatial heterogeneity with respect to plow layer characteristics develops. Thus, it is considered that this pattern is more closely related to soils that have argillic horizons than those that do not have rather abrupt increases in clay content with depth. Therefore, some horizons, with many oxic horizon properties such as low CEC and absences of weatherable minerals, will classify as kandic horizons and may be part of Ultisols and Alfisols rather than Oxisols if there is less than 40 percent clay in the upper 18 cm.

The identification of an oxic horizon in most soils requires that the clay content increase with depth not exceed 1.2 times the clay content in the overlying horizons within a vertical distance of 15 cm (gradual boundary limit) if the surface horizon contains 20 percent to 40 percent clay. If the surface horizon contains more than 40 percent clay an oxic horizon must have less than an 8 percent absolute clay content increase within a 15 cm depth. If the surface horizon contains less than 20 percent clay the oxic horizon must

have an absolute clay content increase less than 4 percent in a vertical distance of 15 cm. This is admittedly an arbitrary limit, but one that lends itself to consistent identification in the field and rather easy verification by laboratory techniques.

Genesis

Oxic horizons are generally in soils on very old stable geomorphic surfaces. They may occur in soils on younger surfaces if the parent rock is easily weatherable, such as basalts or serpentinites, or if the material is pre-weathered. Oxic horizons are not common in soils on steep slopes where rejuvenation of the soil takes place through erosion, truncation, or lateral flow of base enriched subsurface water.

Soils on old geomorphic surfaces which may date to mid- or late-Tertiary have generally been reworked. Many of

rock or mineral fragments in the oxic horizon. These are generally rare and if present are frequently coated with sesquioxides. Pseudomorphs of olivine and augite may be present in some oxic horizons, but these are not considered as indicators of lack of weathering.

On stable surfaces, time has permitted the homogenization of the soil material by pedoturbation processes. It is also possible that the active pedoturbation has disrupted and assimilated any evidence of lessivage such as clay skins. Consequently, most oxic horizons are uniform in color, texture, and other mineralogic-chemical properties to great depths in the soil. The pedoturbation processes have also disrupted any rock structure. In some saprolites, weathering results in a pseudomorphic alteration of feldspar phenocrysts to gibbsite, the aggregates of which retain the original fabric. Mineralogically-chemically, the saprolite may meet the requirements of an oxic horizon, but is not considered an oxic horizon if it retains more than 5 percent rock fabric and if the secondary minerals are pseudomorphs after the primary minerals. In this respect, booklets of kaolinite formed through the pseudomorphic alteration of biotite are considered as weatherable minerals. In an oxic horizon, these are disrupted and assimilated in the soil material.

Soils with oxic horizons frequently occupy the upper part of the landscape. The silica potential is also very low in such soils, having a net leaching environment, so that there is no possibility for synthesis of 2:1 clay minerals. Even in the wet soils with oxic horizons, the recharging water may be so low in bases and silica, that despite the high water table, the soil is continuously flushed and leached. Isohyperthermic soil temperature regimes and udic or perudic soil moisture regimes are often considered optimal for oxic horizon formation. However, soils with oxic horizons are common in areas with ustic soil moisture regimes or with isothermic soil temperature regimes but are rare in areas with aridic soil moisture regimes and isomesic soil temperature regimes. Some oxic horizons are present in non-iso soil temperature regimes and, although paleoclimatic factors have been attributed to their formation, parent material is also probably a major contributor.

Summary of Oxic horizon properties

In summary, the oxic horizon is a subsurface horizon that:

1. Is at least 30 cm thick;
2. Has a particle-size of sandy loam or finer in the fine earth fraction;
3. Has a fine earth fraction (<2 mm) that has an

apparent ECEC (NH_4OAc bases plus 1N KCl extractable Al) equal to or less than 12 meq per 100 g clay and has an apparent CEC pH_7 (NH_4OAc CEC) equal to or less than 16 meq/100 g clay (measured clay or 3 x 15 bar water, whichever is greater but less than 100);

4. Does not have as much as 10 percent weatherable minerals in the 50-200 micron faction;
5. Has a diffuse upper particle-size boundary (i.e., <1.2 times clay content increase within a vertical distance of 15 cm if the surface horizon contains 20-40 percent clay; less than 4 percent absolute clay content increase if the surface contains ≤20 percent clay; <8 percent absolute if the surface contains ≥40 percent clay.);
6. Does not have andic soil properties3/;
7. Has less than 5 percent by volume that shows rock structure unless the lithorelicts containing weatherable minerals are coated with sesquioxides."

Pages 36, 38, and 39. Delete footnotes 10, 11, 12, 13, 14, and 15.

Page 41, first column, line 14. Change ". . . 2.5 times 15-bar water . . ." to ". . . 3 times 15-bar water . . ."

Page 48, Lithic contact, second column. Change the last paragraph of this section to read:

"A lithic contact is diagnostic at the subgroup level if it is within 125 cm of the soil surface of Oxisols and within 50 cm of the soil surface of all other mineral soils."

Page 56, first column, second paragraph, last sentence. Change to the following: "The formative element *per* is used in selected taxa."

Page 87, Table 7, Oxisols, Aquox. Delete: "Gibbsiaquox, Ochraquox, and Umbraquox". Add: "Acraquox, Eutraquox, and Haplaquox."

Page 87, Table7, Oxisols. Delete: "Humox and Orthox and associated great groups."

Page 87, Table 7, Oxisols. Following Aquox, add: "Perox and Acroperox, Eutroperox, Haploperox, Kandiperox, and

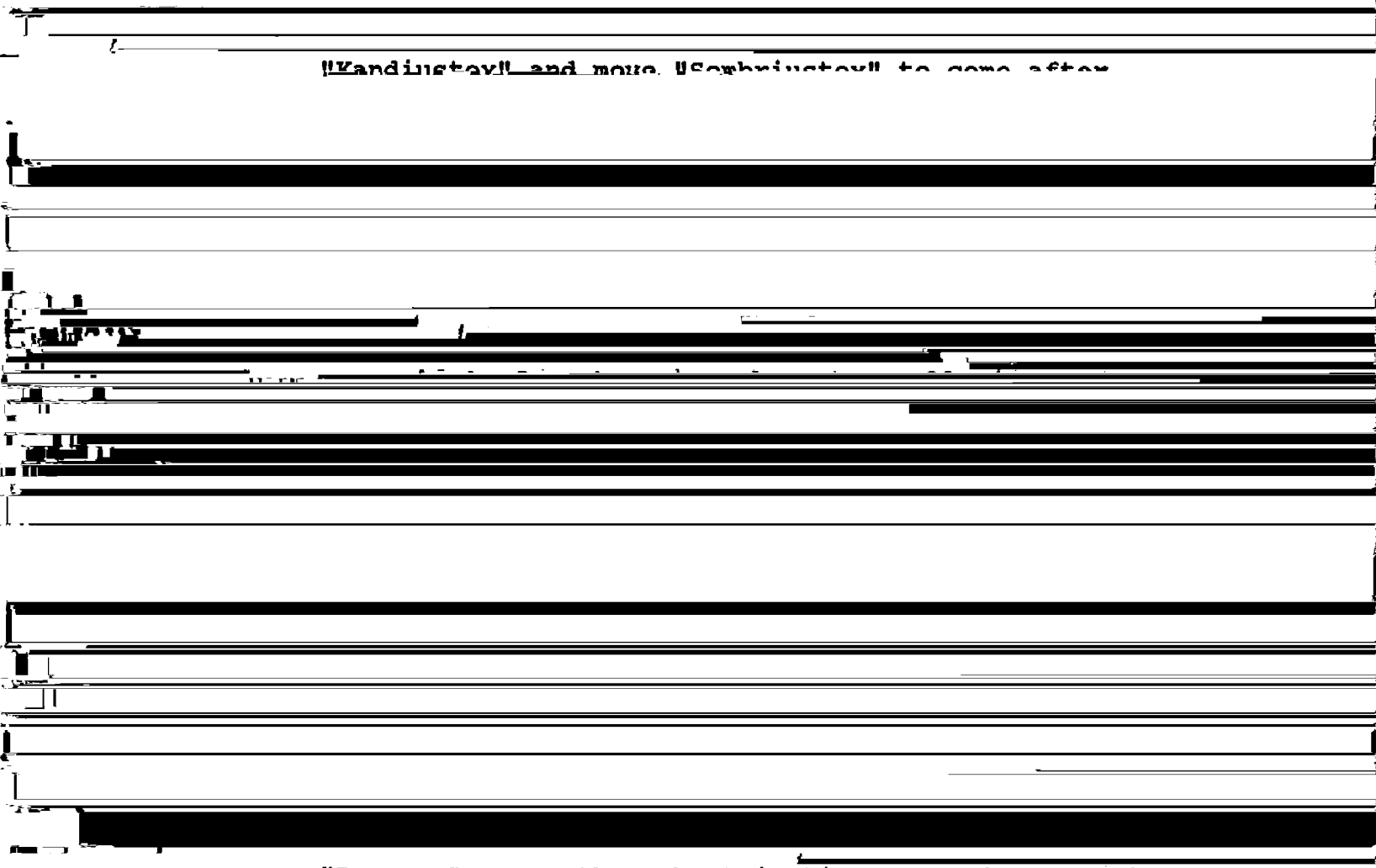
3/ See footnote 1.

Sombriperox" respectively under Suborder and Great Group columns.

Page 87, Table 7, Oxisols, Torrox. Under Great Group column, delete: "Torrox"; and add: "Acritorrox, Eutrotorrox, and Haplotorrox."

Page 87, Table 7, Oxisols. Following Torrox, add: "Udox and Acrudox, Eutrudox, Hapludox, Kandiudox, and Sombriudox" respectively under Suborder and Great Group columns.

Page 87, Table 7, Oxisols, Ustox. Following Haplustox, add: "Kandiustox" and move "Sombriustox" to come after



"Per----L. *per*, throughout in time----(omit mnemonicon)---Perudic moisture regime."

Page 90, Table 11, Following Aeric, add: "Anionic-----Gr. *anion*-----Anion-----Positively charged colloid.

Page 90, Table 11, Following Grossarenic, add: "Humic-----L. *humus*, earth------Humus------Presence of organic matter."

Page 90, Table 11, Following Plinthic, add: "Rhodic------Gr. base of *rhodon*, rose-------Rhododendron-------Dark red color."

2) 40 percent or more clay in the surface 18 cm, after mixing, and, with its upper boundary within 150 cm of the soil surface, either an oxic horizon, or a kandic horizon that meets the weatherable mineral requirements of an oxic horizon."

Oxisols, p. 323

Page 92, delete footnote 1.

National Soil Taxonomy Handbook issue No. 1. page 615-10

(Page 93, second column, item I.). Change item I.4. to read:

"4. A fragipan or an oxic horizon with its upper boundary between a depth of 150 and 200 cm."

Pag 96, first column, item 6. Change to read:

"Do not have an oxic horizon within 150 cm of the soil surface and do not have a kandic horizon within 150 cm of the soil surface if there is 40 percent or more clay in the surface 18 cm, after mixing, and the kandic horizon meets the weatherable mineral requirements of an oxic horizon."

Page 96, first column, Limits between Alfisols and soils of other orders, item 5. Change to read:

"5. To distinguish Alfisols from Oxisols. Alfisols must

surface or a kandic horizon within 150 cm of the soil surface if there is 40 percent or more clay in the surface 18 cm, after mixing, and the kandic horizon meets the weatherable mineral requirements of an oxic horizon."

Page 100, Plate 4D. Change Tropeptic Haplorthox to "Rhodic

surface if there is 40 percent or more clay in the surface 18 cm, after mixing, and the kandic horizon meets the weatherable mineral requirements of an oxic horizon."

Page 180, top of second column. Change item 6. to read:

"6. To distinguish Entisols from Oxisols, Entisols must not have an oxic or kandic horizon."

Page 227, second column, Definition. Change item 1.a. to read:

"a. Do not have a spodic, argillic, kandic, or natric horizon, or an oxic horizon within 150 cm of the soil surface, unless . . ."

National Soil Taxonomy Handbook issue No. 1, page 615-13 (Page 272, first column, item renumbered as 5.). Change to read:

"5. Do not have an oxic horizon within 150 cm of the soil surface and do not have a kandic horizon within 150 cm of the soil surface if there is 40 percent or more clay in the surface 18 cm, after mixing, and the kandic horizon meets the weatherable mineral requirements of an oxic horizon."

Page 272, second column. Change item 6. to read:

"6. To distinguish Mollisols from Oxisols, Mollisols must not have an oxic horizon within 150 cm of the soil surface or a kandic horizon within 150 cm of the soil surface if there is 40 percent or more clay in the surface 18 cm, after mixing, and the kandic horizon meets the weatherable mineral requirements of an oxic horizon."

Pages 323 through 332. Delete and replace Chapter 14 with the following:

CHAPTER 14

OXISOLS

Oxisols (plate 4D) are reddish, yellowish, or grayish colored soils. They are most common on the gentle slopes of geologically old surfaces in tropical and subtropical regions. Their profiles are distinctive because of the lack of obvious horizons. Their surface horizons are usually somewhat darker in color than the subsoil, but the transition of subsoil features is gradual.

Oxisols consist mainly of quartz, kaolinite, oxides, and

organic matter. Both the structure and "feel" of Oxisols are deceptive. Upon first examination they appear structureless and feel like a loamy particle-size. While some are loamy or even coarser, many are extremely clayey, but that clay is aggregated in a strong grade of fine and very fine granular structure. To obtain a true "feel" of the fine texture, a

clay. There is little silt in most Oxisols, thus they have an extremely low available water holding capacity. Soil organic matter contents are usually much higher than indicated by the soil color. This may be due to red staining of the associated iron oxides. Frequently this organic matter is very stable, infertile humus, and is slow to decompose.

The most extensive areas of Oxisols are on the interior plateaus of South America, the lower portion of the Amazon basin, significant portions of the central African basin and important areas in Asia, Australia, and several tropical and subtropical islands.

Definition

Oxisols are mineral soils that
"1. Meet one of these two requirements:
a. Have an oxic horizon with its upper boundary within 150 cm of the soil surface and do not have a clay content increase necessary to define the upper boundary of a kandic horizon within a depth of 150 cm; or
b. Have 40 percent or more clay in the surface 18 cm, after mixing, and, within 150 cm of the soil surface, either an oxic horizon or a kandic horizon that meets the weatherable mineral requirements of an oxic horizon; and
2. Do not have a spodic horizon.

Key to suborders

CA. Oxisols that are either saturated with water within 30 cm of the mineral soil surface 30 days per year in most years or artificially drained, and have one or more of the following:
1) a histic epipedon;
2) if faintly mottled or not mottled within 50 cm of the soil surface, an epipedon that has a moist color value less than 3.5 and chroma of 2 or less immediately below the epipedon; or
3) if there are distinct or prominent mottles within 50 cm of the soil surface, a chroma of 3 or less or a hue of 2.5Y or yellower in 50 percent or more of the horizon immediately below the epipedon.

Aquox

CB. Other Oxisols that have an aridic soil moisture regime.

Torrox

CC. Other Oxisols that have an ustic soil moisture regime.

Ustox

CD. Other Oxisols that have a perudic soil moisture regime.

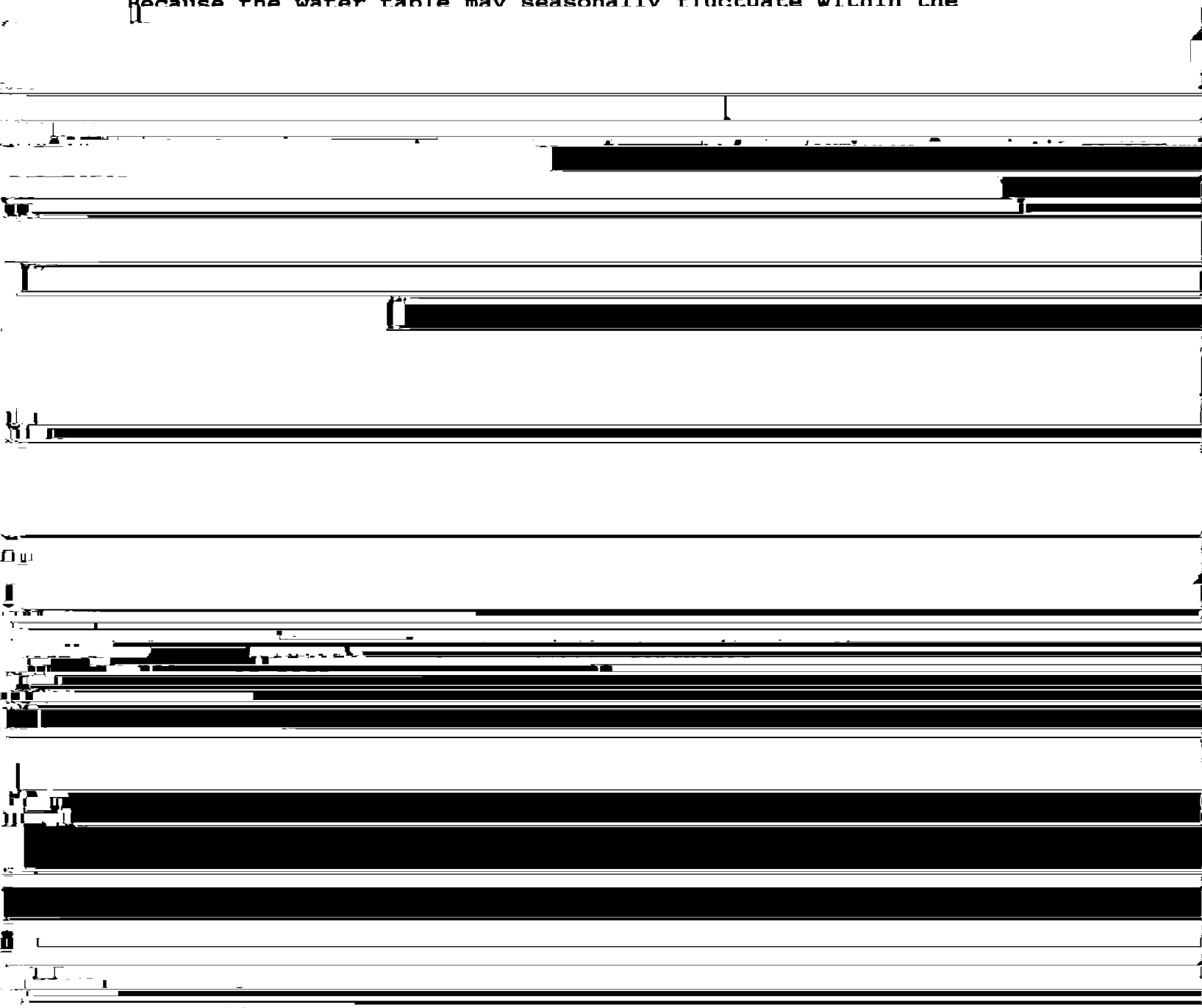
Perox

CE. Other Oxisols.

Ud x

Aquox

These are wet Oxisols. They are present in shallow depr ssions and as seepage areas at the base of slopes. Because the water table may seasonally fluctuate within the



ar small.

Definition

Aquox are the Oxisols that are saturated with water within 30 cm of the mineral surface 30 days or more per year in most years or are artificially drained and have one or more of the following:

1. A histic epipedon;
2. If not mottled, a moist color value, low than 3.5 and

Definition

Acraquox are the Aquox that have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic horizon within a depth of 150 cm of the soil surface.

Key to subgroups

[redacted]

some horizon within a depth of 125 cm of the soil surface.

Plinthic Acraquox

CAAB. Other Acraquox that have mottles with chroma of more than 2 in 50 percent or more of the horizon immediately below the epipedon.

Aeric Acraquox

CAAC. Other Acraquox.

Typic Acraquox

Eutraquox

These Aquox have base saturation of more than 35 percent at pH_7 in all horizons to a depth of 125 cm.

Definition

Eutraquox are the Aquox that
1. Have more than 35 percent base saturation (NH_4OAc) in all parts within a depth of 125 cm of the soil surface;
2. Do not have plinthite that forms a continuous phase within a depth of 125 cm of the soil surface; and
3. Do not have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CACA. Eutraquox that have a histic epipedon.

Histic Eutraquox

CACB. Other Eutraquox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface.

Plinthic Eutraquox

CACC. Other Eutraquox that have mottles with chroma of more than 2 in 50 percent or more of the horizon immediately

below the epipedon.

Aeric Eutraquox

CACD. Other Eutraquox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter.

Humic Eutraquox

CACE. Other Eutraquox.

Typic Eutraquox

Haplaquox

These are low base status Aquox.

Definition

Haplaquox are the Aquox that
1. Have 35 percent or less base saturation (NH_4OAc) in some or all parts within a depth of 125 cm of the soil surface;
2. Do not have plinthite that forms a continuous phase within a depth of 125 cm of the soil surface; and
3. Do not have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CADA. Haplaquox that have a histic epipedon.

Histic Haplaquox

CADB. Other Haplaquox that have more than 5 percent plinthite

small areas of Plinthaquox have been observed and no data has been made available for study.

Definition

Plinthaquox are the Aquox that
1. Have plinthite that forms a continuous phase within a depth of 125 cm of the soil surface; and
2. Do not have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CABA. Plinthaquox that have mottles with chroma of more than 2 in 50 percent or more of the horizon immediately below the epipedon.

Aeric Plinthaquox

CABB. Other Plinthaquox.

Typic Plinthaquox

Perox

This is a new suborder. Although the perudic soil moisture regime was defined as one in which precipitation equals or exceeds potential evapotranspiration every month of the year, the criteria was not used in Soil Taxonomy (1975). Perox are well drained Oxisols with a perudic soil moisture regime. Clearing and burning is difficult because of atmospheric wetness. Also, it is difficult to cure many seed crops and storage of produce is difficult. There are not large areas of perudic soil moisture regime, but they appear distinctive enough to show and identify on some small scale soil maps. If found useful, perhaps the concept should be considered in other orders.

Definition

Perox are the Oxisols that have a perudic soil moisture regime.

Key To Great Groups

CDA: Perox that have a sombric horizon within 150 cm of the soil surface.

Sombriperox

CDB: Other Perox that have both an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic or kandic horizon within a

depth of 150 cm of the soil surface.

Acroperox

CDC: Other Perox that have more than 35 percent base saturation (NH_4OAc) in all parts within a depth of 125 cm of the soil surface.

Eutroperox

CDD: Other Perox that have more than 40 percent clay in the surface 18 cm, after mixing, and the upper boundary of a kandic horizon occurring within a depth of 150 cm of the soil surface.

Kandiperox

CDE: Other Perox.

Haploperox

Acroperox

These are well drained Oxisols in the perudic soil moisture

Acroperox are the Perox that
1. Have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic or kandic horizon within a depth of 150 cm of the soil surface; and
2. Do not have a sombric horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CDBA. Acroperox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface and a petroferric contact within 125 cm of the soil surface.

Aquic Petroferric Acroperox

CDBE. Other Acroperox that have a delta pH (KCl pH - 1:1 water pH) with a 0 or net positive charge in some layer 18 cm or more thick within a depth of 125 cm of the soil surface.

Anionic Acroperox

CDBF. Other Acroperox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface.

Plinthic Acroperox

CDBG. Other Acroperox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Aquic Acroperox

CDBH. Other Acroperox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Humic Rhodic Acroperox

CDBI. Other Acroperox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Humic Xanthic Acroperox

CDBJ. Other Acroperox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter.

Humic Acroperox

CDBK. Other Acroperox that have a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Rhodic Acroperox

CDBL. Other Acroperox that have a color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Xanthic Acroperox

CDBM. Other Acroperox.

615.45

Definition

Eutroperox are the Perox that

1. Have more than 35 percent base saturation (NH_4OAc) in all parts within a depth of 125 cm of the soil surface;
2. Do not have a cambric horizon within a depth of 150 cm of the soil surface; and
3. Do not have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic or kandic horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CDCA. Eutroperox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface and a petroferric contact within 125 cm of the soil surface.

Aquic Petroferric Eutroperox

CDCB. Other Eutroperox that have a petroferric contact within 125 cm of the soil surface.

Petroferric Eutroperox

CDCC. Other Eutroperox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface and a lithic contact within 125 cm of the soil surface.

Aquic Lithic Eutroperox

CDCD. Other Eutroperox that have a lithic contact within a depth of 125 cm of the soil surface.

Lithic Eutroperox

CDCE. Other Eutroperox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface and mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Plinthaquic Eutroperox

CDCF. Other Eutroperox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface.

Plinthic Eutroperox

CDCG. Other Eutroperox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Aquic Eutroperox

CDCH. Other Eutroperox that have more than 40 percent clay in

surface.

Kandiudalfic Eutroperox

CDCI. Other Eutroperox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and have the lower boundary of the oxic horizon within a depth of 125 cm of the soil surface.

Umbreptic Eutroperox

CDCJ. Other Eutroperox that have the lower boundary of the oxic horizon within a depth of 125 cm of the soil surface.

Inceptic Eutroperox

CDCK. Other Eutroperox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Humic Rhodic Eutroperox

CDCL. Other Eutroperox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Humic Xanthic Eutroperox

CDCM. Other Eutroperox that have 16 Kg or more organic carbon

CDCN. Other Eutroperox that have a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Rhodic Eutroperox

Haploperox are the Perox that
1. Have 35 percent or less base saturation (NH_4OAc) in some or all parts within a depth of 125 cm of the soil surface;
2. Do not have a sombric horizon within a depth of 150 cm of the soil surface;
3. Do not have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic horizon within a depth of 150 cm of the soil surface; and
4. Do not have more than 40 percent clay in the surface 18 cm, after mixing, and an upper boundary of a kandic horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CDEA. Haploperox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface and a petroferric contact within 125 cm of the soil surface.

Aquic Petroferric Haploperox

CDEB. Other Haploperox that have a petroferric contact within 125 cm of the soil surface.

Petroferric Haploperox

CDEC. Other Haploperox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface and a lithic contact within 125 cm of the soil surface.

Aquic Lithic Haploperox

CDED. Other Haploperox that have a lithic contact within a depth of 125 cm of the soil surface.

Lithic Haploperox

CDEE. Other Haploperox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface and mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Plinthaquic Haploperox

CDEF. Other Haploperox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface.

Plinthic Haploperox

CDEG. Other Haploperox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Aquic Haploperox

CDEH. Other Haploperox that have an 18 cm or thicker layer in the upper 75 cm with a bulk density less than 1 g/cc and in which all the Al plus one-half the Fe that is extractable with acid oxalate totals more than 1.0 percent.

Andic Haploperox

CDEI. Other Haploperox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Humic Rhodic Haploperox

CDEJ. Other Haploperox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Humic Xanthic Haploperox

CDEK. Other Haploperox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter.

Humic Haploperox

CDEL. Other Haploperox that have a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Rhodic Haploperox

CDEM. Other Haploperox that have a color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Xanthic Haploperox

CDEN. Other Haploperox.

Typic Haploperox

Kandiperox

These Oxisols with a perudic soil moisture regime have clay textured surface horizons and a kandic subsurface horizon. Prior to this amendment, they would have been Paleudults. Subsoils often have weak to moderate grades of blocky structure. No pedons have been studied.

Definition

Kandiperox are the Perox that

1. Have more than 40 percent clay in the surface 18 cm, after mixing, and an upper boundary of a kandic horizon within

615.45

or all parts within a depth of 125 cm of the soil surface;

3. Do not have a sombric horizon within a depth of 150 cm of the soil surface; and
4. Do not have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CDDA. Kandiperox that have mottles of 4 or more value moist

percent.

Andic Kandiperox

CDDI. Other Kandiperox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm

depth of 125 cm of the soil surface.

Lithic Sombriperox

CDAC. Other Sombriperox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter.

Humic Sombriperox

CDAD. Other Sombriperox.

Typic Sombriperox

Torrox

These are Oxisols of the arid regions. They frequently have a higher base saturation than other Oxisols and when irrigated and fertilized are excellent soils for a variety of crops. Their known occurrence is limited to Hawaii and perhaps some areas in Australia. Pedon 107 illustrates the Torrox in Hawaii.

Definition

Torrox are the Oxisols that have a torric moisture regime.

Key To Great Groups

CBA: Torrox that have both an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic horizon within a depth of 150 cm of the soil surface.

Acritorrox

CBB: Other Torrox that have more than 35 percent base saturation (NH_4OAc) in all parts within a depth of 125

Eutrotorrox

CBC: Other Torrox.

Haplotorrox

Acritorrox

This great group is provided for Torrox with very low cation exchange values. No examples have been available for study.

Definition

Acritorrox are the Torrox that have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CRAA. Aquiterrox that have a petroferric contact within a

of the oxic horizon within 150 cm of the soil surface.

Key to subgroups

CBCA. Haplotorrox that have a petroferric contact within a depth of 125 cm of the soil surface.

Petroferric Haplotorrox

CBCB. Other Haplotorrox that have a lithic contact within a depth of 125 cm of the soil surface.

Lithic Haplotorrox

CBCC. Other Haplotorrox.

Typic Haplotorrox

Udox

Previously these Oxisols with udic soil moisture regimes were known as Orthox. The connotation of orth is the "true" Oxisols, and this certainly was the concept of Oxisols as Soil Taxonomy was prepared. It now appears that there is as much extent, or perhaps more, of Ustox than Udox. Many of th soils in the udic soil moisture regime of the upper Amazon basin classify as Ultisols rather than Oxisols as originally thought. Therefore it appears inappropriate to refer to well drained Oxisols with udic soil moisture regimes as "the true" Oxisols, and the name Udox is selected in keeping with usage in other orders. There are less than 90 days during which crops are not planted; however, there are one to three months in most years that are considered "dry" in local terms.

Definition

Udox are the Oxisols that have an udic moisture regime.

Key To Great Groups

CEA: Udox that have a sombric horizon within a depth of 150 cm of the soil surface.

Sombriudox

CEB: Other Udox that have both an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more

kandic horizon occurring within a depth of 150 cm of the surface.

Kandiudox

CEE: Other Udox.

Hapludox

Acrudox

These are Udox with very low CEC values in the subsoil. Frequent but small applications of fertilizer and lime are required. Because the CEC is low, the amount of exchangeable Al in the subsoil is low and can be corrected by leaching basic cations from lime and fertilizer.

Definition

Acrudox are the Udox that

1. Have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic or kandic horizon within a depth of 150 cm of the soil surface; and
2. Do not have a sombric horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CEBA. Acrudox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface and a petroferric contact within 125 cm of the soil surface.

Aquic Petroferric Acrudox

CEBB. Other Acrudox that have a petroferric contact within 125 cm of the soil surface.

Petroferric Acrudox

CEBC. Other Acrudox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface and a lithic contact within 125 cm of the soil surface.

Aquic Lithic Acrudox

CEBD. Other Acrudox that have a lithic contact within a depth of 125 cm of the soil surface.

Lithic Acrudox

CEBE. Other Acrudox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of

surface.

Aquic Anionic Acrudox

CEBF. Other Acrudox that have a delta pH (KCl pH - 1:1 water pH) with a 0 or net positive charge in some layer 18 cm or more thick within a depth of 125 cm of the soil surface.

Anionic Acrudox

CEBG. Other Acrudox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface.

Plinthic Acrudox

CEBH. Other Acrudox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Aquic Acrudox

CEBI. Other Acrudox that have more than 35 percent base saturation (NH_4OAc) in all parts within a depth of 125 cm of the soil surface.

Eutric Acrudox

CEBJ. Other Acrudox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Humic Rhodic Acrudox

CEBK. Other Acrudox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Humic Xanthic Acrudox

CEBL. Other Acrudox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter.

Humic Acrudox

CEBM. Other Acrudox that have a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to

CEBO. Other Acrudox.

Typic Acrudox

Eutrudox

These are Udox with high base saturation throughout the profile. These are highly valued by shifting cultivators and are most common in areas near basic geologic rock.

Definition

Eutrudox are the Udox that

1. Have more than 35 percent base saturation (NH_4OAc) in all parts within a depth of 125 cm of the soil surface;
2. Do not have a sombric horizon within a depth of 150 cm of the soil surface; and
3. Do not have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic or kandic horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CECG. Other Eutrudox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Aquic Eutrudox

CECH. Other Eutrudox that have more than 40 percent clay in the surface 18 cm after mixing and the upper boundary of a kandic horizon within a depth or 150 cm of the soil surface.

Kandiudalfic Eutrudox

CECI. Other Eutrudox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of

CECJ. Other Eutrudox that have the lower boundary of the oxic horizon within a depth of 125 cm of the soil surface.

Hapludox

These Udox are acid and range in color from dark red to pale yellow. They are common in the uplands of Africa, the central part of Indonesia, and many other areas.

Definition

Hapludox are the Udox that

1. Have 35 percent or less base saturation (NH_4OAc) in some or all parts within a depth of 125 cm of the soil surface;
2. Do not have a sombric horizon within a depth of 150 cm of the soil surface;
3. Do not have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic horizon within a depth of 150 cm of the soil surface; and
4. Do not have more than 40 percent clay in the surface 18 cm, after mixing, and an upper boundary of a kandic horizon within a depth of 150 cm of the soil surface.

Key to subgroups

surface.

Plinthic Hapludox

CEEG. Other Hapludox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Aquic Hapludox

CEEH. Other Hapludox that have the lower boundary of the oxic horizon within a depth or 125 cm of the soil surface.

Inceptic Hapludox

CEEI. Other Hapludox that have an 18 cm or thicker layer in the upper 75 cm with a bulk density less than 1 g/cc and in which all the Al plus one-half the Fe that is extractable with acid oxalate totals more than 1.0

Kandiudox

These Udox have more than 40 percent clay in the surface and an increase in clay content with depth. They have previously been classified as Paleudults and Tropudalfs. The subsoil frequently has a moderate grade of blocky structure.

Definition

Kandiudox are the Udox that

1. Have more than 40 percent clay in the surface 18 cm or after

surface.

Plinthic Kandiudox

CEDG. Other Kandiudox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Aquic Kandiudox

CEDH. Other Kandiudox that have an 18 cm or thicker layer in the upper 75 cm with a bulk density less than 1 g/cc and in which all the Al plus one-half the Fe that is extractable with acid oxalate totals more than 1.0 percent.

Andic Kandiudox

CEDI. Other Kandiudox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Humic Rhodic Kandiudox

CEDJ. Other Kandiudox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Humic Xanthic Kandiudox

CEDK. Other Kandiudox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter.

Humic Kandiudox

CEDL. Other Kandiudox that have a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Rhodic Kandiudox

CEDM. Other Kandiudox that have a color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Xanthic Kandiudox

CEDN. Other Kandiudox.

Typic Kandiudox

S mbriudox

These are poorly understood Udox that have an increase in organic carbon content in the subsoil. The only known pedons are near the Rift Valley in Africa.

Definition

Sombriudox are the Udox that have a sombric horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CEAA. Sombriudox that have a petroferric contact within a depth of 125 cm of the soil surface.

Petroferric Sombriudox

CEAB. Other Sombriudox that have a lithic contact within a depth of 125 cm of the soil surface.

CCC: Other Ustox that have more than 35 percent base saturation (NH_4OAc) in all parts within a depth of 125 cm of the soil surface.

Eutrustox

CCD: Other Ustox that have more than 40 percent clay in the surface 18 cm after mixing, and the upper boundary of a kandic horizon occurring within a depth of 150 cm of the soil surface.

Kandiustox

CCE: Other Ustox.

Haplustox

Acrustox

These are Ustox with extremely low cation exchange values. They can easily have their chemical environment altered by fertilizer and lime applications. Because of their low buffering capacity, it is desirable to use small but frequent applications of fertilizer and lime. Low content of exchangeable Al in the subsoil can be corrected by leaching basic cations from lime and fertilizer.

Definition

Acrustox are the Ustox that
1. Have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic or kandic horizon within a depth of 150 cm of the soil surface; and
2. Do not have a sombric horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CCBA. Acrustox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface and a petroferric contact within 125 cm of the soil surface.

Aquic Petroferric Acrustox

CCBB. Other Acrustox that have a petroferric contact within 125 cm of the soil surface.

Petroferric Acrustox

CCBC. Other Acrustox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of

depth of 125 cm of the soil surface.

Lithic Acrustox

CCBE. Other Acrustox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface and have a delta pH (KCl pH - 1:1 water pH) with a 0 or net positive charge in some layer 18 cm or more thick within a depth of 125 cm of the soil surface.

Aquic Anionic Acrustox

CCBF. Other Acrustox that have a delta pH (KCl pH - 1:1 water pH) with a 0 or net positive charge in some layer 18 cm or more thick within a depth of 125 cm of the soil surface.

Anionic Acrustox

CCBG. Other Acrustox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface.

Plinthic Acrustox

CCBH. Other Acrustox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of

Aquic Acrustox

CCBI. Other Acrustox that have more than 35 percent base saturation (NH_4OAc) in all parts within a depth of 125 cm of the soil surface.

Eutric Acrustox

CCBJ. Other Acrustox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Humic Rhodic Acrustox

CCBK. Other Acrustox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Humic Xanthic Acrustox

CCBL. Other Acrustox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter.

Humic Acrustox

CCBM. Other Acrustox that have a color hue of 2.5 YR or redder with moist values of less than 4 in most of the

25 to 125 cm depth from the soil surface.

Rhodic Acrustox

CCBN. Other Acrustox that have a color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Xanthic Acrustox

CCBO. Other Acrustox.

Typic Acrustox

Eutrustox

These high base status Ustox are well known by local farmers because of their relatively high native fertility. Often they supported natural forests while surrounding areas of like rainfall but low base status supported savannas. It is rare to see forest vegetation today because the forests have been completely cut by native farmers. Why these Ustox have high saturation throughout their profile is not known, but they tend to occur over or near basic rocks such as limestone or basalt.

Definition

Eutrustox are the Ustox that

1. Have more than 35 percent base saturation (NH_4OAc) in all parts within a depth of 125 cm of the soil surface;
2. Do not have a sombric horizon within a depth of 150 cm of the soil surface; and
3. Do not have an apparent ECEC of less than 1.50 meq/100 g clay and a pH value (1N KCl) of 5 or more in some part of the oxic or kandic horizon within a depth of 150 cm of the soil surface.

Key to subgroups

CCCD. Other Eutrustox that have a lithic contact within a depth of 125 cm of the soil surface.

Lithic Eutrustox

CCCE. Other Eutrustox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface and mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Plinthaquic Eutrustox

CCCF. Other Eutrustox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface.

Plinthic Eutrustox

CCCG. Other Eutrustox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Aquic Eutrustox

CCCH. Other Eutrustox that have more than 40 percent clay in the surface 18 cm after mixing and the upper boundary of a kandic horizon within a depth or 150 cm of the soil surface.

Kandiustalfic Eutrustox

CCCI. Other Eutrustox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and have the lower boundary of the oxic horizon within a depth of 125 cm of the soil surface.

Umbreptic Eutrustox

CCCJ. Other Eutrustox that have the lower boundary of the oxic horizon within a depth of 125 cm of the soil surface.

Inceptic Eutrustox

CCCK. Other Eutrustox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and a color hue of 2.5 YR or redder with

surface litter.

Humic Eutrustox

CCCN. Other Eutrustox that have a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Rhodic Eutrustox

CCCO. Other Eutrustox that have a color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

the soil surface.

Aquic Lithic Haplustox

CCED. Other Haplustox that have a lithic contact within a depth of 125 cm of the soil surface.

Lithic Haplustox

CCEE. Other Haplustox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface and mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Plinthaquic Haplustox

CCEF. Other Haplustox that have more than 5 percent plinthite in some horizon within a depth of 125 cm of the soil surface.

Plinthic Haplustox

CCEG. Other Haplustox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface and have the lower boundary of the oxic horizon within a depth or 125 cm of the soil surface.

Aqueptic Haplustox

CCEH. Other Haplustox that have mottles of 4 or more value moist and 2 or less chroma within a depth of 125 cm of the soil surface.

Aquic Haplustox

CCEI. Other Haplustox that have the lower boundary of the oxic horizon within a depth or 125 cm of the soil surface.

Inceptic Haplustox

CCEJ. Other Haplustox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and a color hue of 2.5 YR or redder with moist values of less than 4 in most of the 25 to 125 cm depth from the soil surface.

Humic Rhodic Haplustox

CCEK. Other Haplustox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter and color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Humic Xanthic Haplustox

CCEL. Other Haplustox that have 16 Kg or more organic carbon per square meter to a depth of one meter, exclusive of surface litter.

Humic Haplustox

CCEM. Other Haplustox that have a color hue of 2.5 YR or

[redacted]

Rhodic Haplustox

CCEN. Other Haplustox that have a color hue of 7.5 YR or yellower with moist values of 6 or more in most of the 25 to 125 cm depth from the soil surface.

Xanthic Haplustox

CCEO. Other Haplustox.

Typic Haplustox

Kandiustox

These Ustox have more than 40 percent clay in the surface 18 cm and an increase in clay content sufficient to meet the

[redacted]

25 to 125 cm depth from the soil surface.

Xanthic Kandiustox

CCDM. Other Kandiustox.

Typic Kandiustox

Sombriustox

These are poorly understood Ustox. Often this layer has andic properties and spodic properties. The only known

Page 386, first column, Choices of 7 or 11 particle-size classes, second paragraph. Delete the words "and Oxisols."

Page 386, second column, Key to mineralogy classes, first paragraph. Change to read:

"All mineral soils, except Oxisols, are placed in the first mineralogy class of the key in Table 12 that accommodates them although they may appear also to meet the requirements of other mineralogy classes. The correct mineralogy class for Oxisols is determined by using the key in Table 12a. These are keys, not complete definitions. . . which, by definition, are siliceous."

Page 387, Table 12. Change title of this table to read:

"Table 12.--Key to mineralogy classes of mineral soils, except Oxisols"

Page 388. Add the following Table 12a:

Does the mineralogy control section have:

1. More than 40 percent iron oxide (>28 percent Fe) by citrate-dithionite in the <2 mm fractions?
2. More than 40 percent gibbsite in the <2 mm fractions?
3. 18-40 percent iron oxide (12.6- 28 percent Fe) by citrate-dithionite in the <2 mm fractions?
4. 18-40 percent gibbsite in the <2 mm fractions?
5. More than 50 percent by weight kaolinite in the <0.002 mm fraction?
6. More than 50 percent by weight halloysite in the <0.002 mm fraction?

none of the above---*Mixed*
1 with or without *2, 4, 5, 6---Ferritic*
2 with or without *3, 5, 6---Gibbsitic*
3 with or without *5, 6---Ferruginous*
4 with or without *5, 6---Allitic*
3 and 4 with or without *5, 6---Sesquic*
5---Kaolinitic
6---Halloysitic"

Page 388, first column, Calcareous and reaction classes

selected taxa. The definitions follow:

Acid.--The pH . . .

Nonacid.--The pH . . .

Allic.--There is more than 2 meq of KCl extractable Al per 100 gm soil (<2 mm fraction) in some 30 cm layer in the control section.

Acid and nonacid classes are used only in names of families of Entisols and Aquepts; they are not used in sandy . . . that have carbonatic or gypsic mineralogy. The allic class is used only in names of families of Oxisols."

Page 388, second column, Depth of soil, Shallow. Change to read:

"Less than 50 cm to the upper boundary of a duripan or petrocalcic horizon or to a lithic, paralithic or petroferric contact. Used in lithic and petroferric subgroups of Oxisols and all great groups of Alfisols, Aridisols, Entisols, Inceptisols, Mollisols, Spodosols, and Ultisols, except pergelic subgroups of the cryic great groups and lithic subgroups. It is emphasized that the adjective "shallow" is not used in the family name of lithic subgroups of orders, other than Oxisols, because it would be redundant."

Page 389, Slope or shape of soil - second column, sentence starting in third line. Change to read:

"In aquic great groups, particularly in Aquolls, Aquox, and Aquults, use the shape of the soil as a family differentia. For Aquolls and Aquults use classes of level and sloping as these classes are defined in the Soil Survey Manual. For Aquox use sloping in the names of families if slope is >8 percent. It may be necessary . . . "

Page 687, Classification. Change classification to: "Anionic Acrudox, fine, ferruginous, isohyperthermic."

Page 689, Classification. Change classification to: "Xanthic Hapludox, very-fine, kaolinitic, isohyperthermic."

Page 691, Classification. Change classification to: "Inceptic Eutrudox, very-fine, kaolinitic, isohyperthermic."

Page 693, Classification. Change classification to: "Anionic Acrudox, very-fine, ferritic, isohyperthermic."

Page 695, Classification. Change classification to: "Humic Hapludox, very-fine, ferruginous, isohyperthermic."

Pag 697, Classification. Change classification to: "Typic Haplotorrox, very-fine, kaolinitic, isohyperthermic."

615.46 Eutroboralfs

This amendment establishes two subgroups, Aquic Arenic Eutroboralfs and Glossaquic Eutroboralfs.

Page 121, second column, distinctions between Typic Eutroboralfs and other subgroups. Change item a. to read:

"a. Have an argillic horizon that
(1) If its upper boundary is <50 cm below the soil surface, does not have mottles that have chroma of 2 or less in the upper 25 cm if it is saturated with water within that depth at some time when the soil temperature is 5° C or higher; or

(2) If the upper boundary of the argillic horizon is 50 cm or more, does not have mottles that have chroma of 2 or less within a depth of 75 cm below the soil surface;"

Aquic Eutroboralfs. Change to read:

"*Aquic Eutroboralfs* are like Typic Eutroboralfs except for *a* with or without *e* or *f* or both."

Add, following Aquic Eutroboralfs the following:

"*Aquic Arenic Eutroboralfs* are like Typic Eutroboralfs except for *a* and *b* with or without *c* or *e* or both.

Add, following Arenic Eutroboralfs the following:

"*Glossaquic Eutroboralfs* are like Typic Eutroboralfs except for *a* and *c* with or without *e*.

Page 121, second column, description of subgroups, Typic Eutroboralfs. Change last 2 lines on this page as follows:
"Soils that have mottles or low chroma in the upper 25 cm of the argillic horizon or within 75 cm of the soil surface if the upper boundary of the argillic horizon is deeper than 50 cm and ground . . ."

Page 122, first column, Aquic Eutroboralfs. Change to read:

soil is artificially drained. They may also have an Ap horizon that has a color value, moist, of 3 or less or upper horizons that have a color value, moist, of 3 or less after the soil to a depth of 18 cm has been mixed. In addition, they may have an argillic horizon that has a texture of loamy fine sand or coarser or that is made up of lamellae. Most of these soils are in the northern lake states in the United States.

Page 122, first column. After Aquic Eutroboralfs, add:

"Aquic Arenic Eutroboralfs.--These soils have mottles that have chroma of 2 or less within 75 cm of the soil surface and the mottled horizon is saturated with water

at a time when the soil temperature is 5° C or higher or the soil is artificially drained. In addition, the epipedon is between 50 cm and 1 m thick and has texture of loamy fine sand or coarser. They may also have an Ap horizon that has a color value, moist, of 3 or less or

1. Have tongues of albic materials in the argillic horizon;
2. Have a fragipan;
3. Do not have an agric horizon or a natric horizon; and
4. Do not have an argillic horizon that in it's upper part, consists of discrete nodules that range in diameter from 2.5 to 5 cm to about 30 cm and that have exteriors enriched and weakly cemented or indurated with iron.

Distinctions between Typic Fraglossudalfs and other subgroups

Typic Fraglossudalfs are the Fraglossudalfs that
a. Do not have mottles that have chroma of 2 or less in

[redacted]

season when the soil temperature is 5° C.

Aquic Fraglossudalfs are like Typic Fraglossudalfs except for *a*.

Description of subgroups

Typic Fraglossudalfs.--The central concept or typic subgroup of Fraglossudalfs is fixed on moderately well drained soils that have a fragipan at a depth of 1 to 1.25 m of the soil surface. These are the most freely drained soils of this great group. The argillic horizon has evidence of destruction in the form of deep wide tongues of albic materials that at least extend through the upper 15 cm and may extend through the horizon. Tongues constitute 15 percent or more of the matrix in that part. These soils are rare in the United States and only the typic subgroup has been mapped."

615.48 Additions and corrections

615.48

Page 302, first column, Vertic Calciustolls (Ref.: National Soil Taxonomy Handbook issue No. 10 - was inadvertently omitted from this issue). Change to read: "*Vertic Calciustolls* are like Typic Calciustolls except for *g*, with or without any or all of *a*, *b*, and *d*, and the cracks are open between 135 and 180 days in most years.

National Soil Taxonomy Handbook issue No. 10, page 615-105, *Udertic Argiustolls* (correction). Near end of second line, change "wor" to "or".

National Soil Taxonomy Handbook issue No. 10, page 615-105, *Vertic Argiustolls* (corrections). Change to read: ". . . are like Typic Argiustolls except for *g*, with or without *a* or *e* or both, and the cracks are open between 135 and 180 days in most years."

#U.S. Government Printing Office : 1987 - 201-056/60712