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ASPECTS REGARDING THE CORRELATION OF THE ROMANIAN SOIL TAXONOMY SYSTEM (2003) WITH WRB (2006)

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The Romanian system of soil taxonomy evolved in time, borrowing a series of elements from international soil classification systems (FAO, WRB) or from those with applicability to large areas (Soil Taxonomy), without losing its own characteristics, facts that allow a better correlation with WRB (2006). The correlation between the two taxonomy systems is needed in bringing up-to-date the soil terminology.

Keywords: Romanian Soil Taxonomy System (2003), WRB-SR (2006), correlation.

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АСПЕКТИ КОРЕЛЯЦІЇ РУМУНСЬКОЇ СИСТЕМИ ТАКСОНОМІЇ ҐРУНТІВ (2003) З WRB (2006)

Румунська система таксономії ґрунтів розвивається в часі, запозичаючи ряд елементів з міжнародних систем класифікації ґрунтів (ФАО, WRB) або з тих, які застосовуються в багатьох регіонах (таксономія ґрунтів), не втрачаючи своїх особливостей, які дозволяють кращу кореляцію з WRB (2006). Кореляція між двома системами таксономії необхідна в забезпеченні сучасної термінології ґрунтів.

Ключові слова: румунська система таксономії ґрунтів (2003), WRB (2006), кореляція.

The first proposal for organizing the Romanian soils belongs to Gh. Munteanu–Murgoci (1911) (IUSS Working Group WRB, 2006); the first official classification has been elaborated by the National Institute for Soil and Agrochemical Research (ICPA) Bucharest (1973) (Conea, Rapaport, Popovaț, Asvadusrov, Teaci, 1976), followed by intermediary versions (1980) (Conea, Florea, Puiu coord., 1980). (2000) (Florea, Munteanu coord., 2000). Presently the Romanian Soil Taxonomy System (SRTS) 2003 is in use (Florea, Munteanu coord., 2003). At the initiative of the International Society of Soil Science, in 1961 a project for the creation of a world soil map scaled 1:5.000.000 begun, map presented with the occasion of the 9th ISSS Congress (1969). This project continued, being taken the decision to elaborate a world base for the classification of soil resources, being continuously improved (1998 and 2006) (FAO-ISRIC-ISSS, 1998; IUSS Working Group WRB, 2006).

SRTS evolved at the beginning under the influence of the Russian classification systems, and later the more recent editions borrowed elements from FAO, Soil Taxonomy (USDA, 1998) and WRB systems. Presently the Romanian Soil Taxonomy System integrates both the classic terminology and the recent elements that allow a better soil characterization and classification.

OBJECT AND METHODS

Departing from the recent editions of the two soil classification systems, we considered necessary the re-correlation of some taxa (references=types) or of some secondary elements (qualifiers), that would lead to an improvement in the correlation of SRTS with the WRB and the amendment of the nomenclature used in the Romanian system.

SRTS 2003 is a multi-category hierarchic system, with a two level structure (lower and upper), different from that elaborated by WRB-SR (2006). In SRTS, at the superior (upper) level are individualized the soil class, types and subtypes, and at the lower (inferior) the soil variety, species, family and variant, while in WRB to the first level belong the references, and to the second the qualifiers – combinations added to the references. In this situation the references may be assimilated to the soil types and the qualifiers to the subtypes.

Because WRB is a taxonomic system of global coverage, it will have higher horizon diversity in what regards soil formation. Thus in WRB there are more horizons (33) than in SRTS (31), the second system being characterized by a higher diversity of the bio-accumulative horizons (table 1).

Table 1

Comparative table of the SRTS (2003) and WRB (2006) structures

SRTS (2003)	WRB (2006)
Structure	
Classes 12,	no equivalent
Types 32	32 references
subtypes 64 (+28 subdivisions of subtypes)	179 qualifiers
Horizons (total number)	
33	31
Equivalent horizons	
17	
Properties (number)	
21	14
Equivalent properties	
10	
Diagnostic (parental) materials	
6 materials (to which are added 5 subdivisions for anthropic materials)	12 materials

The correlations between SRTS (2003) and WRB-SR (2006) have an approximate character, fact that recommends in the translation of the designations, if possible, references to the soil morphological description and chemical analyses. The 2003 edition of the SRTS includes correlation tables with the WRB (1998), and here is where we need a series of modifications imposed by the last edition of the WRB, some of which are detailed in what follows.

The reference soil group of the Stagnosols recently included in the 2006 WRB has been correlated in the previous edition (1998) with the SRTS reference groups of the Cambisols and Luvisols, preceded by the stagnic qualifier. Now we might say that there is a better correlation among the two taxonomic entities (Secu, Patriche).

Differently from the previous edition where was included the Antrosols reference group, WRB-SR 2006 maintains the old designation only for soils modified through agricultural activities, and introduces the *Technosols reference group*, soils whose formation is determined by human influence, mainly through industrial activities, but also by certain parental materials associated to the mentioned activities. In SRTS the anthropically-modified soils are assigned to two classes – the Entiantrosol to the Protisols class, and the Erodosol and Antrosol to the Antrosols class; the taxonomic concept is in the first case the profile morphology through thickness and in the second the soil forming factor – human activities.

At the lower level, the correlation of the qualifiers with the subtypes, of the diagnostic properties and of the parental materials between the two taxonomic systems implies numerous problems, that will be approached according to their importance in soil designation.

The approach of the correlation problems was realized on the basis of the existent literature, analyses of soil profiles and discussions with soil scientists at national conferences.

RESULTS AND THEIR DISCUSSION

The introduction of the Stagnosols reference group in WRB-SR assures the correspondence with the SRTS Stagnosol type and a correlation at the subtype – qualifier level, with the exception of the planic Stagnosol (table 2).

In WRB-SR the *planic* qualifier does not exist, so it may be partly assimilated to the *abruptic* qualifier, with the mention that the later does not enter the qualifiers associated to the Stagnosols reference group. From another viewpoint, the planic character refers strictly to the sudden textural transition between the E (eluvial) and Bt (argic) horizons, while the

abruptic character mentions the sudden textural change in the first 100 cm of the soil profile, thus being applicable to a larger number of soil reference groups (Solonetz, Plintosols, Phaeozems and others).

Table 2

Correlation of Stagnosols (SRTS 2003 – WRB 2006)

SRTS (2003)	WRB-SR (2006)
Stagnosol luvic (STlv)	Luvic Stagnosol (lvST)
Stagnosol albic (STal)	Stagnosol (Albic) (STab)
Stagnosol vertic (STvs)	Vertic Stagnosol (vtST)
Stagnosol gleic (STgc)	Stagnosol (Gleic) (STgl)
Stagnosol planic (STpl)	?
Stagnosol histic (STtb)	Histic Stagnosol (hiST)

The correlation of the soils formed under the influence of the anthropic activities or of the materials resulted from these raises numerous problems of correlating the subtypes with qualifiers. In SRTS the soil types formed under the influence of the anthropic factor are separated into two classes (the Entiantrosol belongs to the Protisols class; the Erodosol and Antrosol to the Antrosols class). The separation criteria have had in view the weak profile development and the presence of the anthropic parent materials (in the case of the Entiantrosols), the diminishment of the profile's thickness through human intervention (Erodosols) or the modification of the upper horizons through deep tillage or through input of materials (Antrosols).

Having in view the fact that WRB covers a much larger area that our national taxonomy system, we may appreciate that there is a good correlation of the soils formed under anthropic influence. Still, in some cases this correlation is impossible, and from this motive he preferred to use the question sign ? for the lack of a correspondence or the bracketed sign (?) when we consider the correlation is not so good (table 3 and 4).

Table 3

Correlation of Antrosols (SRTS 2003, WRB-SR 2006)

SRTS (2003)	WRB-SR (2006)
Antrosol hortic (ATho)	Hortic Anthrosol
Antrosol antracvic	?
Antrosol psamic	Anthrosol arenic
Antrosol pelic	Anthrosol clayic
Antrosol calcaric	Anthrosol ?
Antrosol eutric	Anthrosol eutric
Antrosol distric	Anthrosol distric

The proposed correlation Entiantrosol rudic (SRTS) – Skeletic Regosol (WRB) is not quite congruent, because the Entiantrosol implies anthropic parent materials while the Regosol comes from the transformation of mineral materials. The skeletic anthropic parent material that defines the rudic character faces some deficiencies, because the skeleton only refers to rocks. Thus it would be more proper to use the *pseudo-skeletic* denomination, that would indicate the presence of un-compacted, anthropically transported (natural) rocks. This separation would also need a specification of the percentage of the skeleton from the soil (horizon) volume. In this way, the possible new qualifier *pseudo-skeletic* would be different from the litoplacic one, because the rocks included in the soil material wouldn't be compacted.

Respecting the soil thickness morphological criterion, the Entiantrosol is more closely related to the Regosol, situation presented by SRTS, but differs through its pedogenesis; while the rudic character is defined in terms related rather to the technic qualifier.

The mixic qualifier doesn't have an equivalent in WRB-SR (2006), but still resembles the terric horizon, respectively the homonymous qualifier, that has a totally different significance and applicability in comparison to the teric qualifier from the SRTS. On the basis of the mentioned features we have correlated the type Entiantrosol mixic with the Terric Antrosol (mixic≈teric (WRB)≠teric (SRTS)).

Table 4

Correlation on Entiantrosols (SRTS, 2003) with Technosols (WRB-SR, 2006)

SRTS (2003)	WRB-SR (2006)
Entiantrosol urbic (Etur)	Urbic Tehnosol (ub
Entiantrosol rudic (Etru)	? Tehnic Regosol
Entiantrosol garbic (Etga)	Garbic Tehnosol
Entiantrosol spolic (Etsl)	Spolic Tehnosol
Entiantrosol mixic (Etmi)	? Terric Antrosol
Entiantrosol reductic (ETre)	Tehnosol reductic
Entiantrosol psamic (ETps)	Tehnosol arenic
Entiantrosol pelic (Etpe)	Tehnosol clayic
Entiantrosol copertic (ETco)	(?) mollic (umbric) Tehnosol
Entiantrosol litic (ETli)	Leptic Tehnosol
Entiantrosol litoplacic (ETlp)	Ecranic Tehnosol

The type Entiantrosol copertic may have two equivalents at the qualifier level (molic and umbric). The umbric horizon is associated for the Romanian territory with the high mountainous area, usually with reduced anthropic activities, yet we cannot exclude the possibility of its combination with the Technosol (Entiantrosol), on very small surfaces.

For a better use of the SRTS we appreciate that it would be advisable that the future edition of the taxonomy system to include a sole class for the anthropically modified soils (e.g. Anthrosols).

In this sole, we consider appropriate to use in the separation of the subtypes the criterion of the *strength of the soil forming factor*. In a first stage would be identified the activity (activities) that generate a soil type or more through correspondence to the main soil forming process that imprints specific features to the soils from a class (e.g. the eluviation-iluviation leads to the formation of the soils belonging to Luvisols, and so on). To some anthropic activities are associated diagnostic horizons (e.g. the hortic and antracvic horizons), and to others anthropic materials (e.g. garbic, urbic).

In this way the soils resulted from agricultural activities might be designated as *Antroagrosols*, while those formed in industrial areas would be *Antrotehnosols*.

In a second stage, will be applied the *morphologic criterion*, as an expression of the pedogenetic process, that will allow the individualization of the soil subtypes on the basis of some properties of the horizons or of the materials, that at the taxonomic level is translated through the sequence of qualifiers.

Another aspect that should be taken into account in the nomenclature ascribing is its relevance in relation to the soil forming process, the parent material that significantly contributes to the formation of the taxonomic unit and the class it is part of.

In SRTS 2003 there are soil types whose names have a common origin with the class, through the soil forming process (e.g. the Luvisols class with the Preluvosol, Luvosol, Planosol and Alosol soil types), classes in which the designations are totally different, generated mainly by the different soil forming factors (e.g. the Protisols class), and classes that have different names, although the pedogenesis mainly takes place under the influence of the same factor (human), even if through different activities. In what regards the name of the soils resulted from erosion (Erodosols), it may be corrected, due to the fact that erosion is not always human-induced, being also a natural, geologic process, manifested in time as a consequence of the rainfall aggressiveness. We consider that for the soil resulted from accelerated erosion induced by human activities, the designation of Antroerodosol would be more proper, being at the same time closer to the name of the soil class.

Another problem occurred in the correlation of the WRB *Luvisols* with the Preluvosols, the later being in an intermediary evolution stage, reflected by the lack of the eluvial horizon. These soils do not have a correspondent at the level of the units from the reference group of the Luvisols (WRB-SR, 2006). As a consequence we appealed again to a qualifier undefined in WRB-SR, respectively *protoalbic*, that denotes an incipient stage in the formation of the albic horizon, that includes all the eluvial horizons defined in SRTS 2003 (luvic, albic). The correlation *Protoalbic* Luvisols (WRB-SR, 2006) with the Preluvosols

(SRTS, 2003) is somehow forced, because not always the pedogenetic evolution is progressive, evolving in the direction of an eluvial (E) horizon formation.

The *Criptopodzols* raise in their turn a series of problems. They have been «promoted» in SRTS (2003) at the genetic soil type, belonging to the Spodisols class. The authors of the SRTS (2003) correlate both Criptopodzols and Prepodzols with the 1998 WRB-SR Entic Podzols, characterized by the lack of the eluvial horizon and the presence of a diffuse spodic B one. Yet the Criptopodzols are firstly characterized by the high quantity of organic matter from the level of the spodic horizon (>10 %), which masks the reddish color specific to the spodic horizon. This basic element is not found at the level of the Entic Podzols. Thus we consider as more adequate the correlation of the Criptopodzols with units of the organic matter rich Podzols, respectively *Umbric Podzols* (WRB-SR, 2006), or if we wish to specify the lack of the albic horizon we may accept the formula of *Umbri-entic* Podzol, which is closer to reality.

Other correlations that deserve being discussed are presented beneath. The correlation of the soil type Vertisol brunic (SRTS) with the chromic one of the WRB is not quite correct, because the brunic character refers to a light colored horizon, and the chromic one to a reddish one. The correlation between Vertisol nodulocalcaric (that presents $CaCO_3$ nodules disseminated in the soil mass in the first 100 cm) (SRTS) and the pelic ones from the WRB-SR doesn't make sense, the pelic qualifier referring in the later system to Vertisols that have a dark colored surface horizon. Erodosols (SRTS) cannot be correlated from our viewpoint with the eroded phases of the Cambisols, Luvisols etc., because by definition the initial soil cannot be retraced. For example the Cambic Erodosol may be derived from a Cambisol, but also from a Cambic Chernozem. The correspondences, in our opinion, are the eroded phases of the Regosols and Leptosols, which by definition may form and by accelerated erosion. At the secondary level, the cambic qualifier is more exactly defined by the WRB-SR in comparison to the SRTS, being specified and the horizon's occurrence depth in the first 50 cm.

Because in WRB-SR we do not have the *typical* qualifier that would correspond to the *typical* subtype from the SRTS, we propose the elimination of the correspondent for the typical taxonomic level, or its consideration as equivalent to the soil reference group from the WRB-SR.

In the case of the SRTS (2003) – WRB-SR (2006) correlation, it may be remarked on the one side the fact that the *definition of the diagnostic criteria* is more or less different at the level of the two classification systems, so that they are not completely over-imposed, even if they're quite similar. On the other side, WRB adopted a flexible variant to use combinations of qualifiers in the soil designation, through suffixes and prefixes. In SRTS the qualifiers have a fixed position in the soil label, after the symbol of the soil type. In WRB may be used combinations of two qualifiers, suffixes and prefixes, while in SRTS is recommended the use of 2–3 qualifiers.

For example, the dystric properties from the SRTS (2003) are characterized by a base saturation degree of less than 53 %, while in WRB-SR (2006) the same diagnostic feature is defined by the upper limit of 50 %.

Another problem-posing qualifier from the SRTS (2003) is the *pelic* one, and generally the genetic type of the *Pelosols*. Pelic refers to soils of a very fine texture in the first 50 cm. The qualifier exists under the same name in WRB-SR (2006), yet here it refers to a color Munsell value, moist, of 3.5 or less and a chroma, moist, of 1.5 or less in the first 30 cm of the soil profile, and is applicable only to Vertisols.

In this case, we have considered as possible the use of a qualifier not defined by the WRB-SR (1998, 2006), respectively *paravertic*, resulted from the combination of the *para-* prefix (meaning similar to other characteristics) with the *vertic* qualifier (with vertic horizon in the first 100 cm). As a consequence, the hybrid paravertic qualifier refers to soils that contain a horizon similar to the vertic one, but that do not qualify for the diagnostic requirements specified in the definition.

Thus, the following correlations from between SRTS-WRB-SR cannot be correspondent (Preluvosol pelic ≠ vertic Luvisol, Phaeozem pelic ≠ vertic Phaeozem, Chernozem vertic ≠ vertic Chernozem, Entiantrosol pelic ≠ vertic Regosol, Aluviosol pelic ≠ vertic

Fluvisol, Regosol pelic ≠ vertic Regosol) on the basis of the mineralogical characteristics that imprint specific morphologic features at the lower taxonomic level (subtype, respectively prefix qualifiers) [For the reader to easily perceive the taxonomic levels, the reference groups are written with title case, and the prefix and suffix qualifiers with lowercase].

Regarding the correlation of the Pelosols, it is quite clear that they cannot be assimilated to the Vertisols. Neither their correlation with the paravertic subunits isn't better, and thus the problem remains open.

The skeletic character in SRTS (2003) indicates a soil with a content of over 75 % in coarse fragments, the sub-skeletic one having a 26–75 % content of coarse rock fragments, while in WRB-SR (2006) the formative element at the secondary level refers to soils with 40 % skeleton.

There are some qualifiers defined in SRTS (2003) that *do not have a correspondent* in WRB-SR (2006), or that have a correspondence but cannot be used but for certain soil types.

This is the case of the *brunic qualifier* (SRTS, 2003) that refers to Pelisols and Vertosols having in the upper horizon relatively light colors, with chroma over 2. The formative element at the secondary level (*brunic*) refers to the cambic horizon in the WRB-SR (2006), criteria 2 and 4. Although the two elements of the taxonomy systems have the same name, in reality they have different significance.

The maronic qualifier, used for the separation of Kastanozems and Chernozems with an forestalic Am horizon (variety of molic horizon formed under xerophylle forests, with quartz accumulations as weak powdery accumulations), formed under xerophyle forests, does not have a correspondent in WRB-SR, and we haven't found any possibility of at least partially correlating it with another qualifier. The authors of the SRTS correlate the soil type Kastanozem maronic with the WRB calcic one, although the maronic and calcic qualifiers don't share anything in common. The type Chernozem maronic (SRTS) is correlated by the respective authors with the calci-greyic Chernozem (WRB-SR), yet the greyic qualifier is specified to be attached only to Phaeozems. More, the forestalic Am horizon does not correspond to the Ame (molic greyic – with residual quartz accumulations, weakly luvic horizon) one.

We also remarked the problems raised by the correlation of the *Nigrosols* and *Humosiosols*, the two types from the Umbrisols class. The main diagnostic difference between the two soil types stands in the intimate mixture of the humificated matter with the mineral one in the case of the Nigrosols, in comparison to its segregation from the mineral part at the Humosiosols. In the case of Nigrosols, the higher altitude span in which they may occur and the diversity of the landforms have consequences in the profile morphology, through the presence of the Bv (cambic) horizon, aspect reflected at the subtype level (*aluvic* in the floodplain areas or on recent terraces, *litic* on the abrupt slopes formed on hard rocks etc.). Unlike Nigrosols, Humosiosols are entities linked to high mountainous areas.

Thus, we appealed to another criterion – that of the humus content, considering it to be lower for the Nigrosols. These then may be correlated, with certain reserves, with the *humic Umbrisols* of the WRB, the humic qualifier referring here to organic carbon contents, while in SRTS it has in view the organic matter content.

For Humosiosols we will use the haplic prefix qualifier, resulting *haplic Umbrisols*. This is not the only criterion that may be used. If we consider the occurrence of the Humosiosols at the highest altitudes from Romania, under the alpine grasslands from over 1800 m, with soil forming conditions determined by low temperatures and hard parental rocks, then we may refer to these soils, according to the WRB-SR (2006) designations, as *umbric Leptosols*, if the hard rock is situated at a depth of 25 cm.

The albeluvic tonguing *diagnostic property* from the WRB is found at the subtype level in the SRTS, being named glosic. The meaning of the first refers to the insertions of clay on the faces of structural aggregates. As a consequence, the glosic subtype is correlated with the glossalbic qualifier, with the mention that WRB extends the penetration of the albic horizon and in the natric one.

The continuous rock may occur in WRB as cemented pedogenetic horizon (petrocalcic) that has as correspondent in SRTS the association horizon petrocalxic.

The lithologic discontinuity has in WRB the level of diagnostic characteristic, different from the SRTS where it is a secondary morphologic characteristic of the main horizons,

being annotated as numbers situated before the mark of the horizon (e.g. 2C).

The vitric properties are not present in SRTS, but may be partially assimilated to the andic horizon or andic properties.

The diagnostic parent materials are most of them adopted from the FAO designations. In this case some names are equivalent (fluvic materials) in both systems, some aren't found in the Romanian taxonomy (ornithogenic material), while the organic material is defined both as horizon (peaty) and as strata.

CONCLUSIONS

The comparative analysis of the WRB (2006) – SRTS (2003) systems shows a good correlation at the reference – type level. Through the method of combining qualifiers, but also through their number, the WRB system gives a better possibility of naming a soil in comparison with SRTS.

The introduction of the two new reference groups of the Stagnosols and Technosols in WRB 2006 allows a better correlation with the Stagnosol and Entiantrosol types from SRTS. For certain soil types of the Romanian system that indicate stages of pedogenetic evolution (Preluvosol) may be used a formulation such as specification plus qualifier (e.g. protoalbic) plus reference (Luvisol). Some qualifiers have the same name, but imply different properties (e.g. brunic); others have the same name but indicate different limits (e.g. skeletic), while a series of qualifiers don't have a correspondence in the WRB (e.g. maronic).

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