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General Considerations on the Soil Cover of Banat (Romania)

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Abstract *This quantitative and qualitative evaluation of the soil layer in Romanian Banat represents only a sequence in the long process of evolution, a "picture" of the moment with an explanation of the processes developed in the past and with some forecasts for the future.*

The brutal anhtropical interferences in the agricultural landscape, especially on soils, as well as the episodic modification in the taxonomy and classification of the soils during the last 50 years, explain the necessity of the permanent actions of re-evaluation of the quality of the soil layer and of correlation of the new soil units with similar situations in the past.

The study of the genesis, evolution and properties of the soils in Romanian Banat done a surface of 1,198,246 ha of agricultural land, relied on a vast documentation in the archives of the specialised institutions in South-Western Romania and on the previous making, by the author, of some sequence assemblies on administrative or physical-geographical units.

Key words *soils, quality, quantity, Banat, Romania*

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The genesis of Banat relief is closely related to the dynamics of the plates and micro plates in the base, fragmented and plunged at different depths on lines of major faults and reoriented by local fracture (Oncescu, 1965; Saulea, 1967; Măhăra, 1970. According to Erhart (1966) theory the soils made in different geological intervals were destroyed by natural catastrophic factors (endogenous or exogenous), theory that forecasts a scenario of cyclic evolution.

The general aspect of the relief is that of a cuvete with a wide westward opened plain bordered by hills and mountains in the east.

The macroclimatic particularities are determined by the geographical position of Banat in Europe and by the air masses circulation conditioned by centres of dynamic or thermic origin. Due to the very large diversity of the subjacent surface in Banat climate there were identified a series of topoclimates with direct influences on the diversity of soils or of the geobotanical characteristics (Văleanu et Ianoş, 1985).

The hydrogeological particularities are criteria's (separation) of the geomorphological and pedological units. Within every unit the level of the first layer of underground water is influenced by the density of the hydrographical network and by the lythological characteristics of the horizons that carry it (Roşescu, 1972; Țenu, 1975).

Due to the glacis character of Banat Plain with fluvio-torential formations in the subbasement, a large amount of underground waters being pushed from the mountain and piedmountain zone by permeable strata heads towards the low plain.

Therefore, the enriched mineralisation of the phreatic waters in the high plain will decisively influence the characteristics of the phreatic waters in the low plain.

The large variety of the geomorphological, climatic and pedological conditions of Banat are reflected by a corresponding variety of the vegetal layer accentuated along the years by an intense anthropical preasure.

General Regard on the Soil Cover of Banat

Function of the natural and anthropical solification conditions the Banat soil layers present the following general characteristics:

The mountain solification layer is very thin and discontinuous. The soils were made in a mountain climate under the influence of an arborescent or alpine hay vegetation and there presents a reduced profoundness with a more or less scheletic character. The succesion of the soils in this zone is determined by the general bioclimatical conditions and influenced by rock and relief. In Tarcu, Godeanu, Semenic, Poiana Rusca and Almaj Mountains the soils have evolved on alluvial and deluvial materials resulted after the weathering "in situ" of the crystalline shits. The predomination of the acid rocks and of the cold and humid climate have favourised the development on large surfaces of the districambisols. On the tops of mountains with hays and pastures in Tarcu and Godeanu Mountains or in the high depressions there were identified humic and lithic dystricambisols, prepodzols, podzols, regosols, lithosols (Ianoş et Goian, 1995).

The band of Jurassic limestone Resita-Moldova Noua in Anina and Almaj Mountains, in Cerna and Mehedinti Mountains, has constituted the solification rock the rendzic eutricambisols, of the rendzic lithosols and of rodic eutricambisols generally with a shallow profile and a high content of coarse fragments.

The soils of Banat low mountains are influenced by the petrographical structure and their high energy of relief shape on eruptive rocks (Arinis Mountains), crystalline (Locvei Mountains), crystalline with granite intrusions (Dognecea Mountaine), the identified soils are of the districambisols, rarely of the eutricambosols; there are fragmentally appearing regosols and lithosols.

The soils in the western piedmountaine hills and in the intramountain depressions are relatively little diversified and they are characterised by the predominance of the stagnic luvisols and of the albic-stagnic luvisols in association with regosols.

Due to the variety of shapes relief they do not undertake clearly delimited zones. Their geographical disposition is determined by the local natural drainage and by the texture of the solification deposits. Therefore the typical luvisols come at the contact with the piedmont depression in the Almaj Mountains in the southern part of Poganis Hills, in Oravita Hills and in the southern and western part of Lipova Hills. The albic luvosols generally pseudogleyed are largely spread on the plateaus and on the slopes of Faget Hills, in the eastern part of Lipova Hills on the large terraces of Timis and Bega Rivers.

Generally, from west to east together with the growth of altitude and as we get to the mountain range, the frequency of typical luvisols dwindles and in the soil layer there become predominant the stagnic-albic luvisols.

Due to the high energy of relief and of the intense fragmentation, the areal and linear erosion has removed the soil layer, in some places up to the parental rock. In these conditions the zonal soils present the soil profile eroded in different stages up to their transformation in regosols or erodisols. The lenticular presence of marls and of marl-clays in the lithological constitution of the Lipova, Doclin, Oravita Hills, in the hills in the Almaj Depression or in those in Timis-Cerna Passage are favourising the beginning of the most different types of landslides. On the slopes affected by landslides under the influence of the coast springs there appear clinogleyisols together with eutric cambisols, typical luvisols, regisols etc.

On the numerous erosion valleys there appear gleyic or gleyed cambisols and alluviosols associated with gleyisols.

The next pedomorphological stage in time evolution is the one of the **high piedmountain plain**. The soils have evolved on similar materials with those in the immediate neighbourhood where they have started from. Due to a mature relief with a phreatic level under 5 m the soil layer presents an advanced enough stage of development. On the eroded plateaus on whose slopes the relief has partially been diminished, there have been evolving mollic preluvisols (like in Vinga Plain - Ianoş, 2000). In Gataia and Oravita Plains, on expandable rocks together with mollic preluvisols there are vertisols (Ianoş, 1996) or vertic varieties of the zonal types of soils. The negative hydrophisical characteristics of the soils with Bt horizon or of those with vertic characters, have determined the beginning of the pseudogleyzation processes.

A typical characteristic is a tight portion between the confluence of Nera River with Danube at the western lap of Locvei Mountains. Here on Romanian part, there are extended the eastern terminations of a high loess field when there have been evolving haplic and calcaric and cambic chernozems, with a shallow soil profile (Ionaşec, 1978).

Although the **low plain relief** of Banat is very little varied, the soil layer presents a great diversity accused by the different lithology, by the shapes of micro relief (plane surfaces, levees, erosion, sagging, deflation depressions, abandoned channel) and by the different position of the phreatic level. The western extremity of Banat plain is influenced by the vast areas of influence still active, from Csongrad-Szeged and Alibunar (Tufescu, 1957; Posea, 1997) that have printed to the soils an accentuated hydromorphism. In these areals made on a basement mode of fluvio-lacustrine deposits there have been evolving mollic gleysols, typical gleyosols, gleyed vertisols together with solonetz (Aranca, Cenei-Ionel-Livezile, Moravita Plains).

The higher and better drained zones (Jimbolia Plain) were covered with loess mixed materials. There have been evolving the most fertile soils of Banat - calcaric and cambic chernozems, gleyed or not.

The intense movement of rivers and especially of the armes of "Paleomures" have determined the accumulation of important amounts of sand deposits of Galatca River course where there have been evolving arenosols and typical chernozems. The soil layers in the dejection cones of Banat Rivers are characterised by a great variety owing both to the solification rocks as well as to micro relief. The higher parts are occupied by typical and calcaric chernozems and the lowest by mollic and typical gleysols. At the contact of the cone with the divagation plain, in the zones of inflection there is a band of solonetz and solonetzic soils.

In the river meadow zones due to the periodic floods and of the repeated alluvionations the soils are in reduced stages of evolution: eutric cambisols and alluviosols in different stages of gleyzation or bogging up. Due to the alluvial plains works of Timis, Bega, Barzava, Caras Rivers regularization they do not longer flood and the soils tend to evolve towards the bioclimatical type.

The Diversity of the Agricultural Soils in Banat

There was studied according to the quality a surface of 1,198,264 ha representing the agricultural terrains of the Romanian Banat (63,69% of the entire land resources in south-western Romania).

According to the notions presented above, in Banat there were identified, on the agricultural lands the following classes, types and subtypes of soil (are presents soil associations or inclusions) (fig.1):

- **protisols – PRO** (158 518 ha – 13,14%):
  lithosols – LS (29 089 ha – 2,43%);
  regosols – RS (27 508 ha – 2,30%);
  psamosols – PS (1 535 ha – 0,13%);
  alluviosols – AS (99 124 ha – 8,27%);
  entianthroposols – ET (1 262 ha – 0,10%)
- **pelisols - PEL:**
  vertisols - VS (90 127 ha - 7.52%);
- **cernisols – CER** (211 080 ha - 18.45%):
  calcaric chernozems – CZti (119 381 ha - 9.96%);
  cambic chernozems - CZca (79 927 ha - 6.67%);
  phaeozems - FZ (16 596 ha - 1.39%);
  rendzina – RZ (5 176 ha - 0,43%);
- **umbrisols - UMB** (4 174 ha - 0.36%):
  nigrosols - NS (2 174 ha - 0.18%);
  humosiosols - HS (2 000 ha - 0.17%);
- **cambisols - CAM** (225 834 ha - 18.85%):
  eutricambisols - EC (140 767 ha - 11.75%);
  rodic eutricambosols ECro (1 035 ha - 0.09%);
  districambisols - DC (84 032 ha - 7.01%);
- **luvisols- LUV** (344 968 ha - 28.79%):
  rodic preluvosols - ELro (10 486 ha - 0.88%);
  tipic preluvisols - ELti (157 366 ha - 13.13%);
  rodic luvisols – LV-ro (2 850 ha - 0.24%);
  tipic luvisols - LVti (121 467 ha - 10.41%);

albic luvisols – LVal (46 288 ha - 3.86%);
planosols - PL (6 511 ha - 0.55%);

- **spodisols - SPO** (3 877 ha - 0.32%):
  prepodzols - EP (1 352 ha - 0.11%);
  podzols- PD (2 525 ha - 0.21%);
- **hydrisols - HID** (97 008 ha - 8.09%):
  mollic gleysols - GLmo (41 212 ha - 3.44%);
  tipic gleysols - Glti (42 585 ha - 3.55%);
  clinogleysols - GLcl (2 203 ha - 0.18%);
  stagnosols (11 008 ha - 0.92%);
- **salsodisols - SAL:**
  solonetzs - SN (16 682 ha - 1.39%);
- **histisols - HIS:**
  turbosols - TB (317 ha - 0.02%).
- **antrisols – ANT** (35 679 ha – 2,97%):
  erodosol – ER (32 136 ha – 2,68%);
  hortic anthroposols – ATho (3 543 ha – 0,29%).

The Main Characteristics in the Agricultural Soils in Banat

On the basis of the properties and feature of the agricultural soils in Banat (Ianoş et al. 1997) have made a synthesis regarding some essential characteristics usually typical for the separation of the soil units at the level of variety, species or family. This synthesis relies in the grouping together of all resemblances on surfaces and procentual levels as it follows:

- **gleyzation levels:**
  weak, in the depth (43 110 ha - 3.6%),
  weak (132 076 ha - 11.02%),
  moderated (190 656 ha - 15.91%),
  strong (90 334 ha - 7.54%),
  very strong (82 475 ha - 6.88%),
  excesive (9 563 ha - 0,8%);
- **pseudogleyzation levels:**
  weak, in the depth (2 042 ha - 0.17%),
  weak (142 223 ha - 11.87%),
  moderated (143 501 ha -11.98%),
  strong (30 813 ha - 2.57%),
  very strong (11 008 ha - 0.92%),
  excesive (317 ha - 0.02%);
- **salinization levels:**
  weak (64 835 ha - 5.41%),
  moderated (9 852 ha - 0.82%),
  strong (2 495 ha - 0.21%);
- **alkalinization levels:**
  in the depth (17 781 ha - 1.48%),
  weak (66 962 ha - 5.59%),
  moderated (18 415 ha - 1.54 %),
  strong (13 684 ha - 1,14%),
  very strong (11 947 ha - 1.0%);
- **carbonatation levels:**
  calcareous (137 066 ha - 11.44%),
  semicalcareous (66 968 ha - 5.59%),
  weak decarbonatated (191 783 ha - 16.0%),
  moderated decarbonatated (116 616 ha - 9.73%),
  strong decarbonatated (122 190 ha - 10.2%),
  excessive decarbonatated (563 641 ha - 47.04%);
- **levels of lithic contact:**
  very superficial (29 089 ha - 2.43%),
  superficial moderated (77 118 ha - 6.43%),
  superficial (5 176 ha - 0.43%),
  profound moderated (2 495 ha - 0.21%),
  very profound (73 740 ha - 6.15%),
  strong profound (8 920 ha - 0.74%),
  extremely profound (1 001 726 ha - 83.6%);
- **class of surface erosion:**
  no erosion (1 039 253 ha - 86.73%),
  weakly eroded (17 870 ha - 1.49%),
  moderated erodated (90 952 ha - 7.59%),
  strong eroded (18 053 ha - 1.51%),
  very strong eroded (4 675 ha - 0.39%),
  excessive eroded (27 461 ha - 2.29%);
- **types of parental materials and subjacent rocks:**
  eruptive intrusive rocks and acid metamorphic rocks as well as materials resulted by their weathering (136 170 ha - 11.36%),
  eruptive intrusive rocks and intermediary metamorphic rocks as well materials resulted by their weathering (29 089 ha - 2.43%),
  limestone, dolomites, limestone brecia, ultrabasic metamorphic rocks as well as materials resulted by their weathering (16 645 ha - 1.39%),
  sands (1 535 ha - 0.13%),
  loams (303 482 ha - 25.33%),
  clays (46 512 ha - 3.88%),
  expansive clays (159 136 ha - 13.28%),
  loess and loess-like deposits

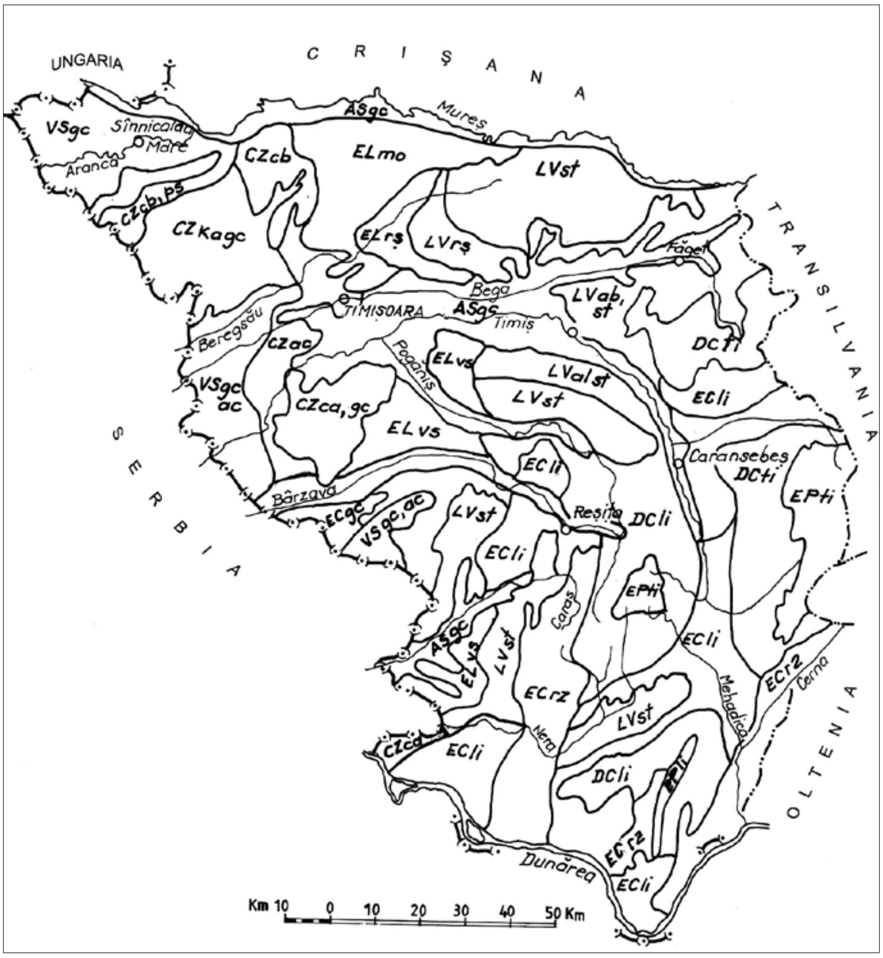

Figure 1 *The Map of Soil Associations in Banat (Conform Romanian System of Soil Taxonomy – Florea and Munteanu-2000)*
ASgc Gleyic Alluviosols in association with gleyic Cambisols and Gleysols, **VS**gc, ac Gleyic or natric Vertisols in association with Gleysols, Solonetz, Chernozems, **CZ**ka, gc, cb, ps, ac Calcaric, gleyic, cambic, psamic and natric Chernozems in association with Phaeozems, mollic Eutricambosols, Gleysols, Solonetz, **EC**gc, rz, li Gleyic, rendzic, lithic Eutricambisols în association with Rendzina, Phaeozems, **DC**ti, li Typic, lithic Districambisols in association with Lithosols, Regosols, Prepodzols, **El**mo, ca, rş Mollic, calcic, reddisch brown Preluvisols in association with argic Chernozems, Phaeozems, Regosols, Luvisols, **LV**st, rş, al Stagnic, reddisch brown, albic Luvisols in association with Planosols, Stagnosols, Regosols, **EP**ti, li Typic and lithic Prepodzols in association with Podzols, Lithosols,Districambisols.

(170 536 ha - 14.23%),
fluvial and fluvio-lacustrine deposits (334 324 ha - 27.9%),
polistratified parental materials (518 ha - 0.02%),
organic and peaty deposits (317 ha - 0.02%);

- **simplified granulometrical classes:** coarse texture (20 275 ha - 1.69%), medium texture (254 601 ha - 21.2%), fine-medium texture (554 115 ha - 46.3%), fine texture (204 986 ha - 17.11%), medium with skeleton (92 083 ha - 7.68%), fine with skeleton (5 176 ha - 0.43%), compact fissurated rocks (73 176 ha - 6.11%), organic deposits (317 ha - 0.02%);
- **textural classes in A horizons or 0-20 cm:** medium loamy-sand (20 275 ha - 1.69%), silty sandy-loamy (825 ha - 0.07%), medium sandy-loamy (67 396 ha - 5.62%), fine sandy loam (1 702 ha - 0.14%), silty-loamy (116 268 ha - 9.70%), medium loam (497 560 ha 41.52%), medium clay loam (357 089 ha - 29.80%), silty clay loam (28 190 ha - 2.35 %), loamy-clay (108 632 ha - 9.06%), organic deposits (317 ha - 0.02%);
- **textural classes in B or A/C horizons:** medium loamy sand (18 154 ha - 1.52%), medium sandy loam (29 280 ha - 2.44%), silty-loamy (8 758 ha - 0.73%), medium loam (284 320 ha - 23.73%), medium clay loam (416 071 ha - 34.72 %), loamy-clay (335 767 ha - 28.02%), organic deposits (317 ha - 0.02%), lithic contact (105 597 ha - 8.81%);
- **vertic characters:** 236 448 ha (19.73%) of which vertisols 90 127 ha - 7.52%).

Conclusion

1. The particularities of the process of making and evolution of the soils in South-Western Romania is due to the climate characteristics, of the typical lithology of the high mineralised ground waters, as well as of some intense and prolonged anthropical activities.
2. If in the mountain and piedmountain area the soils have evolved in equilibrium with the natural factors, in the plain area and especially in the low plains, the soil layer has evolved in different rhythms and directions according to the intensity and type of anthropical activities.
3. The presentation of the soil in the agricultural domain of Banat was done according to last national taxonomy, on classes, types and partially subtypes. For each of these there were presented the areas of extention and the percentage of occupation.
4. Parallel there were made studies referring to the characteristics and properties that define the subdivisions of the identified soils; gleisation, alkalinization, salinization, content and depth of carbonates, erosion, types of parental materials and their texture, the texture of the soils at two levels (0-20 and 60-80 cm). For each of the specified characteristics there were presented the domains of expansion and the process of participation in the total agricultural surface of Banat (1,198,264 ha).

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