Annals of the University of Oradea, Fascicle: Environmental Protection, doi.org/10.5281/zenodo.4362296, **Vol. XXXIV, 2020**
Analele Universităţii din Oradea, Fascicula: Protecţia Mediului, doi.org/10.5281/zenodo.4362296, **Vol. XXXIV, 2020**

SOILS AND PEDOGENETIC CONDITIONS IN THE LOW PLAIN OF CRIŞURILOR

Berchez Octavian*

* University of Oradea, Faculty of Environmental Protection, Gen.Magheru st., no.26, 410048, Oradea, Romania, e-mail: berchez_octavian@yahoo.com

Abstract

The aim of the paper is to approach in a detailed interdisciplinary analysis of some aspects related to the natural framework of soil formation in the Low Plain of Crişurilor and the characterization in a unitary conception of the soil taxonomic units.

The paper presents a detailed interdisciplinary analysis, conceived and developed through a multitude of interdependence relations between the physico-chemical parameters of the soil, correlated with the elements of the natural environment. The analysis of the physical-geographical factors in the formation and evolution of the soils of the area, will allow a better understanding of the particularities of this area and the taking of the most efficient decisions regarding the judicious use of the land fund.

Surveys on soil identification and mapping were conducted between 2017 and 2020

Following the correlation of the field data with the laboratory analyzes and the previously existing scientific information, the soils from the Low Plain of the Crişuri were identified, on structural plain units.

Key words: soil profile, soil taxonomic unit, climatic parameters, physico-chemical parameters, synthesis.

INTRODUCTION

From a hydrographic point of view, the Crişuri Low Plain is a component part of the Crişuri Transboundary Basin. Geographically, it is a subunit of the Crişurilor Plain, being located in the northwestern part of Romania (fig. 1). It presents as western limit the western border of the country, and as eastern limit the Crisene Hills. To the north it continues with the High Plain of Criş, and to the south the Mureş Plain, having continuity in Hungary.

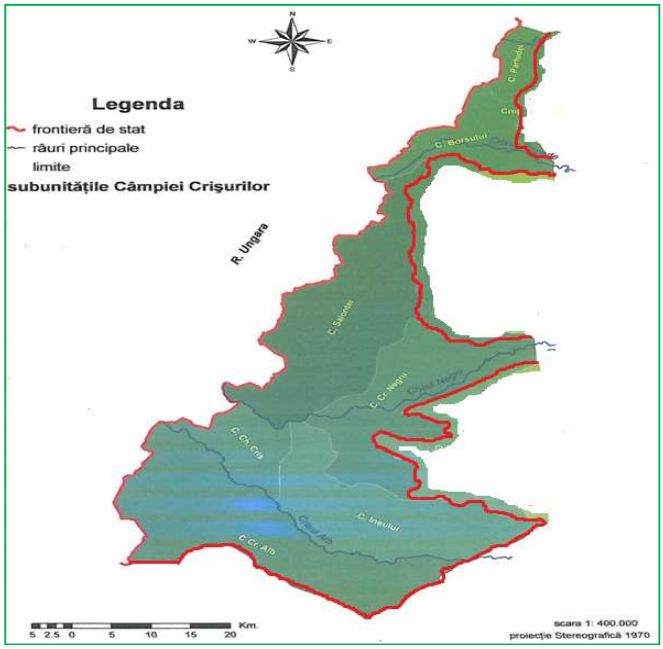

Fig. 1. The Low Plain of Crișuri

It presents as subdivisions: Parhidei Plain, Borşului Plain, Salontei Plain, Crişului Alb Plain (Măhăra - 1977), subdivides this plain into: Teuzului Plain north of Crişul Alb, Chişineu Criş Plain occupying the western part in continuation of Salontei Plain and Ineului Plain, Crişului Negru Plain.

MATERIAL AND METHOD

The identification of the soil surfaces was performed following the correlation of the field data with the laboratory analyzes and the scientific information provided by OSPA Bihor. Based on these correlations, the soil surfaces occupied by different soil taxonomic units were identified and established at the level of the entire plain and by subdivisions of the low Crişuri Plain.

RESULTS AND DISCUSSION

Geological structure and hydrogeology of the low plain of Crisurilor

The surface deposits in the Low Plain of Crişuri are of Quaternary age, the clay-sand alluvial deposits predominate (Măhăra 1977). The widest distribution is the Holocene alluvial deposits but also the alluvial-proluvial deposits that appear at the contact of the plain with the hills.

The presence at depths of 2-6 m of chalcosodium muds in some areas of the plain has guided the process of pedogenesis in the direction of the formation

of salsodisols or saline, sodium or salsodic subunits of different types of soils.

Following the drilling, in the surface lithology, an alternation of clays and powders with pseudo-psammitic banks was highlighted. In the localities of Batăr and Talpoş, the drillings highlighted the composition of the Crişului Negru deposits, made of sands, gravel sands and boulders, interspersed with clays, to the south, at Berechiu, with the presence of fine-grained deposits (Măhăra 1977).

The deposits in the south of the plain are made up of an alternation of clays, sandy clays and sands. In the Crisului Alb meadow the deposits are of alluvial nature, made up of sands, gravels and boulders.

The relief and morphometric characters of the Low Plain of Crișuri

In the Low Plain of Criş, the altitude of the relief presents oscillating values between 80 and 120 m. The arrangement of the relief forms is longitudinal, in steps from east to west. The lowest altitude is found in the southeast of the plain, on Crişul Alb, at the Romanian-Hungarian border, being 88 m. The maximum limit is about 200 - 230 m, in the south of Barcău and the Cigher basin of 140m). The average altitude of the plain is 110-120m. The rivers that make up the hydrographic network lack terraces, with many abandoned branches and a migratory character (Măhăra 1975).

The watercourses that drain the Low Plain of Crișuri have a permanent character to which are added those with a temporary character, presenting importance also the secondary valleys, with lengths of 3 -5 Km and widths of maximum 150 m and permanent flow, like Canaliş Valley, Valea Gepiu, Valea Vida, Valea Topei, Valea Holodului. There are also a series of canals, oriented in the NS direction: Collector Canal (61Km, Crişul Repede-Tărian locality → Crişul Negru-Tămaşda locality), Cermei Tăut Canal, Morilor Canal (Crişul Alb, Buteni locality → border with Hungary), Canal Culişer (Crişul Negru → Collector Canal → Salonta → Hungary), Cermei-Tăut Canal or Criş Canal, Matca Canal (Mureş → Crişul Alb). In many cases, due to alluvial deposits, the flow level increased. This is the main factor in groundwater rise, stagnation and wilting. In years with above average rainfall, torrential and lasting rains, or a long rainfall, there is a high frequency of floods.

Groundwater

The depth at which the groundwater is found increases from east to west of the plain. The average depth is between 1 and 5m. In February-March the hydrostatic level is at maximum levels, minimum levels are recorded in October-November, the average amplitude of variation being between 1 and 1.5 m, even 2.5 - 3 m, depending on the rainfall regime. It has a medium or high content in soluble salts which, associated with the

depth (critical or subcritical), determines the manifestation in the soil profile of the salinization, soda and salsodization processes. The critical depth favors the manifestation of stagnogleization in profile, with the formation of gyrosols or endogleic, gleic and batigleic subtypes of different types of soils (Chisinau-Criş Plain, Crişului Alb Plain, Salonte Plain).

Stagnant waters

They are represented by water accumulations from precipitation or surface runoff above a hard permeable horizon. They have a temporary or permanent character in the soil, being in close accordance with the pluviometric regime and the existence in the soil profile of the argic B horizon. Water stagnation in the soil causes the manifestation of stagnant processes and the formation of stagnant soils or stagnant subtypes of other soil types.

As a result of the stagnation of rainwater or groundwater in the Low Plain of Crisuri, over time have resulted large areas affected by swamps (about 1200 h). Large areas between the former swamped areas, have been transformed over time and arranged as ponds so they were introduced into the economic circuit: the lake complex of Cefa (670ha), Lake Inand (200ha), Madaras (30ha), Homorog (105ha), Tămaşda (206 ha), the lakes on Crişul Alb (Bocsig, Ineu, Seleuş - Crişului Alb Plain), Tăuţ , Cigher lake, Socodor lake (155ha), Pilu lake (260ha).

The natural vegetation of the Low Plain of Crișuri

The role and influence of the biological factor in the pedogenesis process is inseparable from the climatic factor, depending on it the distribution, the structure and the floristic composition of the vegetation, microflora and fauna of the soil, as well as the intensity of the pedogenetic processes.

The primary steppe plant associations have over time been replaced by agricultural crops or secondary herbaceous vegetation, often degraded or ruderalized. In the remains of primary steppe meadows, the associations of Carex praecox, Poa pratensis with Festuca vallesiaca and Festuca pseudovina with Stipa pennata, Poa bulbosa, Koeleria gracilis, Koeleria javorkae, and Botriochloa ischaemum with Adonis vernalis, Chrypsensogon ech italicum, Nepta nuda, Orobanche elatior, Orobanche reticulata, Ranunculus ilyricus, Stipa capilatta, Vicia narbonensis, Vicia serratifolia Arthemisia sp., Lathyrus silvestris, Peucedanum alsaticum, Senecio doria, Seseli varium, Trinia ramosissima. Weed associations predominate in agricultural crops: Arthemisia austriaca, Cynodon dactylon, Poa bulbosa, Bromus squarrosus, Agropyron sp.

The areas that have a good water supply, but face drought during the summer period have in the floristic composition the species: Alopecurus pratensis, Becmannia eruciformis, Roripa kerneri. Specific to the area are

also plant species: Plantago schwartyenbergiana, Plantago tenuiflora, Pholiurus pannonicus, Limonium gmelini, Peucedanum officinale, Aster sedifolius, Filipendula vulgaris, Agropyron pectiforme.

The woody vegetation is sparse, having an accidental character (clumps of scattered forests left behind by massive deforestation). Robinia pseudocacia and Quercus pedunculiflora appear predominantly, with Quercus pubescens, less frequently Quercus frainetto and Quercus cerris. On the soils under the oak forests appears Dornicum hungaricum, Gladiolus imbricatus, Iris graminea, Oenanthe fistulosa, Corydalis solida. The shrub substrate is dominated by Crataegus monogyna and Rhamnus cathartica. The lands located in the low and wet meadows are mostly affected by siltation (areas with groundwater at critical or subcritical depth), presenting a natural vegetation composed of mesohydrophilic and hydrophilic associations, with Dechampsia caespitosa, Agrostis canina, Agrostis stolonifera, Agrostis , Tripholium hibridum, Festuca pratensis, Euphorbia palustris, Cirsium brachicephalum, Stipa pennata, Echium maculatum, Dictamnus albus, Phragmites cmmunis, Typha latifolia, Carex riparia, Carex hordeistichos, Carex apporopinquata, Carex elata Hot, aloides, Hypericum tetrapterum Menyanthes trifoliata, Ranunculus ligua, Geranium pratense, Berula erecta, Aster linosiris, Iris spuria and Juncus sp .. Uncommon are Menianthes trifoliata, Cicuta virosa, Salix aurita, Urtica kioviensis. On the surface of the lake water gloss, we can find Nymphaea alba, Nuphar lutea, Trapa natans, Sagittaria sagittifolia Caltha palustris, Berula erecta. The presence of a groundwater close to the surface with a high content of chloride salts, in addition to changing soil properties and properties (evolution and degree of salinization), has also led to changes in vegetation. The meadows that occupy these soils are composed of: Static gmelini, Bassia hirsuta, Puccinelia distans, Agropyron elongatum, Crypsis aculeata, Spergularia marginata, Petrosimonia triandra, Aster tripolium, Atriplex sp., Camphorosma annua, Camphorosma lonsumia, Planthorosma monspelia, santonicum, Hordeum histrix, Trifolium fragiferum, Aster tripolium, Aster sedifolius, Peucedanum latifolium, Scorzonera parviflora, Scorzonera laciniata, Mentha polegium, Spergularia media, Sueda maritima, Arthemisia maritima ssp. Achillea collina, Scorzonera canum, Juncus gerarde, Sueda pannonica, Cripsis aculeata. In springs with a high rainfall regime, due to the washing of the salts from horizon A, a rich nehalophilic flora can appear, with Orhis elegans and Silene multiflora. Out of the total of over 600 species of grassy and woody plants, there are 20-40 rare or endangered species, which are protected, among which we mention: Acer negundo, Ailanthus altissima, Amorpha fructicosa, Fraxinus pennsylvanica, Xanthium sp.

In the composition of the woody vegetation, Quercus pedunculiflora and Quercus pubescens predominate, in pure stands or in fields, together with Quercus cerris, Quercus frainetto, Quercus robur, Tilia tomentosa, Acer campestre, Fraxinus excelsior. On soils with a shallower aquifer, the forest vegetation is characteristic, consisting of forests of Qercus robur with Carpinus betulus and Corylus avellana.

The forests are a mixture of woody species: Tilia tomentosa, Carpinus betulus, Ulmus foliacea, Fraxinus excelsior, Qercus robur, Quercus robur with Carpinus betullus and Corylus avellana, along with which Quercus petraea can appear. Quercus frainetto, Acer campestre, Ulmus foliacea and Carpenus betulus have a more limited distribution. The subshrub is dominated by Ligustrum vulgare, Crataegus monogyna, Rosa canina, Cornus mas, Cornus sanguinea, etc. Brachypodium silvaticum, Hypericum hirsutum, Geum urbanum, Carex sp., Juncus sp., Convalaria majalis, Fragaria vesca, Festuca gigantea, Hieracium racemosum, Hieracium murorum, etc. dominate the structure of the grassy vegetation under the forests. On soils with groundwater at depths greater than 2 meters, plant associations of Festuca sulcata with Festuca pseudovina, Poa bulbosa, Alopecurus pratensis, Koeleria gracilis, Lolium perene, Euphorbia cyparisias, Antoxantum odoratum, Lolium perene, Plantara lanceolata appear . The associations of Alopecurus pratensis, Poa pratensis, Agrostis stolonifera and Agrostis alba, occur in wet pastures and hayfields. cannina, Trifolium hibridum, Festuca pratensis, Phragmites communis, Typha latifolia, Carex sp., Juncus effusus, Juncus inflexus., Scirpus palustris, Schoenoplectus palustris.

Taxonomic units of higher level soils in the Low Plain of Crișuri

Following field research and subsequent correlation with laboratory results, 13 soil types belonging to 7 soil classes were identified, researched and mapped and 60 soil subtypes (Table 1 and Table 2)

Table 1.

Soil cover of the Low Plain of Crișuri (by territorial administrative units), by classes and types of soils (according to SRTS)

Crt. No.	Soil type (World Reference Base for Soil Resource)	Area of spread
1	Regosols	The old terraces of the rivers
	Fluvisols	Sântandrei, Oradea, Batăr, Apateu, Ciumeghiu, Boiu, Avram Iancu, Tămașda, Chiorac, Craiva, Coroi.
2.	Cernozems	Vărșad, Pilu, Grăniceri, Siclău, , Nădaș, Olari, Cintei, Siontea Mică, Zărand.
	Phaeozems	Berechiu, Bicaci, Homorog, Santău Mic, Santău Mare, Girișu de Criș, Tărian, Sântandrei, Vânători, Boiu, Roit, Sânicolau Român, Cefa, Mădăras, Salonta, Roșiori,

3.	Cambisols	Sântandrei, Salonta, Oradea, Parhida, Niuved, Arpăşel, Tulca, Batăr, Tăut, Mădăras, Ineu, Chereluş, Vaida, Homorog,
4.	Luvisols	Sepreuş, Mişca, Zerindu Mic, Tămaşda, Ghiorac, Tinca, Chişineu Criş, Seleuş, Ineu, Nădab, Chereluş, Şicula, Sintea Mică, Oradea, Miersig, Bicaci, Gurbediu.
		Mioşca, Sepruş, Zerindu Mic, Ghiorac, Tămaşda, Oradea, Ucuriş, Căuşad, Usag, Craiva, Crişu Negru, Avram Iancu.
	Planosols	Sunt răspândite în complex cu luvosolurile
5.	Vertisols	Zerindu Mic, Sepreuş, Văşad, Moroda, Pilu, Cintei, Sintea Mică, Zărand, Nădab, Zerind.
6.	Gleysols	Borş, Parhida, Tulca, Ghiorac, Cefa, Homorog, Salonta, Ciumeghiu.
	Stagnic Luvisols	Girişu de Criş, Ghiorac, Tămaşda, Zerindu Mic, Vânători, Sepreuş, Oradea, Cihei, Bicaci, Vasile Goldiş, Avram Iancu, Coroi, Tălmaci, Soşag, Berechiu.
7.	Solonetz	Tărian, Cheresig, Sântion, Mihai Bravu, Tămaşda, Cintei, Sintea Mică, Zărand, Grăniceri, Socodor, Ineu, Adea, Mişca, Zerind,
	Solonchaks	sectorul Zărand-Cintei-Sintea Mică, judeţul Arad.

Table 2

Soil units from Low Plain of Crișuri, by territorial administrative units, and areas (according to SRTS)

Subunity of the plain	Total area -ha	soil type	Surface - ha Location- ha	Location- ha
Borşului Plain	15516	Fluvisols	7229	Borş, Biharia, Cetariu, Oradea, Sântandrei, Girişu de Criş, Toboliu.
		Phaeozems	4463,9	
		Gleysols	2776,6	
		Cambisols	605,2	
		Luvisols	345,5	
		Solonetz	1,3	
		Valleys, canals, waters	223,3	
Parhidei Plain	5509,6	Phaeozems	2514,8	Roşiori, Tămăşeu, Biharia, Sălard şi Cetariu.
		Gleysols	1665,0	
		Cambisols	826,8	
		Solonetz	276,6	
		Luvisols	31,9	
		Fluvisols	18,0	
		Valleys, canals, waters	176	
Salontei Plain	14269,3	Phaeozems	10495,1	Toboliu, Nojorid, Sânicolau
		Solonetz	7572,4	
		Cambisols	3848,5	

		Gleysols	2284,8	Român, Cefa, Mădăras, Salonta, Ciumeghiu, Avram Iancu.
		Vertisols	701,2	
		Luvisols	59,3	
		Fluvisols	14269,3	
Crişului Alb Plain	51041,4	Cernozems	12425,6	Pilu, Socodor, Grăniceri, Marca, Şimian, Chişineu Criş, Zărand, Olari, Pâncota, Seleuş, Ineu.
		Phaeozems	10495,1	
		Solonetz	7572,4	
		Cambisols	3848,5	
		Gleysols	2284,8	
		Vertisols	701,2	
		Luvisols	59,3	
Crişului Alb Plain	51041,4	Cernozems	12425,6	Pilu, Socodor, Grăniceri, Marca, Şimian, Chişineu Criş, Zărand, Olari, Pâncota, Seleuş, Ineu.
		Solonetz	12086,7	
		Cambisols	1202,8	
		Luvisols	1353,7	
		Arenosols	55,6	
		Rendzic leptosols	2,1	
		Valleys, canals, waters	64,0	
Crişului Negru Plain	34823,3	Fluvisols	18957,6	Tulca, Tinca, Batăr, Ciumeghiu, Apateu, Mişca, Sintea Mare, Sepreuş
		Cambisols	5766,7	
		Gleysols	2652,5	
		Phaeozems	2296,3	
		Solonetz	2128,8	
		Luvisols	2309,1	
		Vertisols	521,4	
		Stagnic Luvisols	217,8	
Ineului Plain	35666,4	Fluvisols	18781,6	Mişca, Avram Iancu, Zerind, Socodor, Chişineu Criş, Sintea Mare, Zărand,Şicula, Ineu, Beliu, Cermei.
		Vertisols	5417,8	
		Cambisols	3014,2	
		Phaeozems	2701,5	
		Gleysols	2358,2	
		Solonetz	2249,9	
		Luvisols	1014,4	
		Cernozems	38,7	
		Valleys, canals, waters	38,7	
Chisinau Cris Plain	12221,1	Vertisols	4466,8	Chişineu Criş, Zerind, Socodor, Pilu
		Fluvisols	4004,7	
		Solonetz	2488,4	
		Phaeozems	1116,3	
		Gleysols	144,9	

CONCLUSIONS

The identification of soil taxonomic units was performed at the level of soil class, type and subtype. In the Low Plain of Crișuri, the largest

surface is occupied by the soil type Fluvisols 7.0916.0 ha, present in all plain subunits. Luvisols occupies an area of 5,259.5 ha, in the Crişului Alb Plain, Crişului Negru Plain, Ineului Plain, in a smaller property Borşului Plain, and of planosols, present in Crişului Alb Plain and Borşului Plain.

Cernozems occupy an area of 46,258.7 ha, the class is represented by calcium cernozems in the Crişului Alb Plain and the Ineului Plain, phaeozems are present in all areas, and rendzic leptosols that occupy very small areas in the Crişului Alb Plain. Gleisols end stagnic luvisols occupies an area of 22,714.1 ha, represented by the types of stagnant soil luvisols, present in the Crişului Negru Plain and gleisols, present in all areas of the Low Plain.

Solonetz occupies an area of 26,804 ha and is spread in all areas of the Low Plain. Cambisols occupy 15,264.2 ha, eutric cambisols being spread in all areas of the plain. The soils from the vertisols class occupy larger areas in the Low Plain compared to the High Plain, the total area occupied by vertisols being 12,996.9 ha, present in the Salonte Plain, the Crişului Alb Plain, the Crişului Negru Plain, the Ineului Plain and the Chişineu-Criş Plain.

In a systematic presentation, the studies and researches with pedogeographic character carried out in the Low Plain of Crisuri, constitute a real basis in solving some aspects little studied or neglected so far, regarding:

- making maps and sketches on the main pedogenetic factors: climate, relief, rock, groundwater.
- making soil maps, in a unitary conception
- obtaining and carrying out maps regarding: soil properties, soil technological indicators and maps regarding production capacity
- conservation and rational use of the entire land fund
- knowledge of soil surfaces affected by erosion and establishment of anti-erosion measures in order to capitalize on these lands
- improvement of soils affected by salting; depending on the degree of alkalization or salinization
- the improvement of acid soils followed the knowledge of the physico-chemical properties, the hydric regime, the nutritional regime and the surfaces occupied by these soils
- land leveling, by knowing the thickness of the humiferous horizon and the degree of development of the profile
- organization of the territory
- designing land improvement works
- the correct application in the units with agricultural profile of a differentiated agrotechnics
- credit rating and technological characterization of land areas

REFERENCES

1. Berchez O., 2015, Cheie pentru determinarea unităţilor taxonomice de sol la nivel superior: Sistemul Român de Taxonomie a Solurilor, corelarea cu Baza de Referinţă Mondială pentru Resursele de Sol (World Reference Base for Soil Resource) şi Sistemul American (USDA – Soil Taxonomy), . Editura Universităţii din Oradea.
2. Blaga Gh., Rusu I., Udrescu S., Vasile D., 1996, Pedologie, Ed. Didactică şi Pedagogică, Bucureşti.
3. Canarache A., 1980, Fizica solurilor agricole, Ed. Ceres Bucureşti.
4. Canarache A., Merculiev O., Dumitru Rozalia, Trandafirescu T., Chiochiu V., Miciov I., 1971, Caracterizarea hidrofizică a principalelor soluri din Cîmpia şi Piemonturile Vestice. Analele ICPA, vol. XXXVIII, 1970, Bucureşti.
5. Ciobanu Gh., Domuţa C., 2003, Eroziunea solurilor din Bihor în contextul sistemului de agricultură durabilă, Editura universităţii din Oradea, Oradea.
6. Ciobanu Gh., Domuţa C., 2003, Eroziunea solurilor din judeţul Bihor, în cotextul sistemului de agricultură durabilă, Editura Universităţii din Oradea, Oradea.
7. Canarache A., 1980, Fizica solurilor agricole, Ed. Ceres Bucureşti.
8. Florea N., Munteanu I., Rapaport C., Chiţu C., Opriş M., 1968, Geografia solurilor României, Editura Ştiinţifică, Bucureşti.
9. Florea N., Munteanu I., 2012, Sistemul Român de Taxonomie a Solurilor, Editura Sitech, Craiova.
10. Ianoş Gh., 1999, Pedogeografie, Editura Mirton, Timişoara.
11. Ispas St., Murătoreanu G., Leotescu R., Ciulei S., (2006), Pedologie, cercetarea solului pe teren, Editura Valahia University Press, Târgovişte.
12. Miclăuş V., 1991, Pedologie ameliorativă, Ed. Dacia Cluj Napoca.
13. Măhăra Gh., 1972, Evoluţia Câmpiei de Vest a României, Realizări în Geografia României, Ed. Ştiinţifică Bucureşti.
14. Măhăra Gh., 1977, Câmpia Crişurilor, în volumul Crişul Repede, Ţara Beiuşului, Ed. Ştiinţifică şi Enciclopedică Bucureşti.
15. Pop I., 1968, Flora şi vegetaţia Câmpiei Crişurilor, Ed. Academiei RSR, Bucureşti.
16. Petrea Rodica, (2001), Pedogeografie, Editura Universităţii din Oradea, Oradea.
17. Pop P Gr., 2005, Dealurile de Vest şi Câmpia de Vest, Editura universităţii din Oradea, Oradea.
18. Posea Gr. 1997, Câmpia de Vest a României, Ed. Fundaţiei România de Mâine, Bucureşti .
19. Rogobete GH., 1993, Ştiinţa solului, Ed. Mirton, Timişoara
20. Rogobete Gh., Ţărău D., 1997, Solurile şi ameliorarea lor, Editura Marineasa, Timişoara
21. Sabău N.C., Domuţa C., Berchez O., 1999, Geneza, degradarea şi poluarea solului, vol. I, Editura Universităţii din Oradea, Oradea.
22. Sabău N.C., Domuţa C., Berchez O., 2002, Geneza, degradarea şi poluarea solului, Vol. II, Editura Universităţii din Oradea, Oradea.
23. Şandor Maria, 2007, Ameliorarea solurilor cu exces de umiditate din Cîmpia Crişurilor, Editura Universităţii din Oradea.