Available online at
http://journals.usamvcluj.ro/index.php/promediu

ProEnvironment

ProEnvironment 8 (2015) 270 - 274

Original Article

Agrochemical Characterization of Soils and Hydrophysical Indices in Bistrita-Nasaud

BAKOS Stefan[1*], Marilena MARGHITAS[2], Lavinia MOLDOVAN[2]

[1]Soil and Agrochemical Studies Office Cluj, Fagului street No.1, Cluj-Napoca, Romania
[2]University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Manastur Street, 3-5, 400372, Cluj-Napoca, Romania

Received 20 April 2015; received and revised form 15 May 2015; accepted 20 May 2015
Available online 20 June 2015

Abstract

This paper refers to the mapped area of the Bistrita-Nasaud, respectively 24 administrative territorial units, totaling 123,521 ha of agricultural land. The authors present a brief description of climatic conditions with reference to relief, geology, climate, hydrological description that led to the formation of ground couverture. In the course of the activity at OSPA Cluj, was conducted numerous agrochemical soil studies, including soil analysis in this area. These studies have highlighted, among others, agrochemical parameters of soils and hydrophysical properties of soils in the area of mentioned. Soil reaction: strong acid on an area of 360 ha, moderate acid on 7850 ha, weak acid 76210 ha, neutral on 12780 ha, slightly alkaline on 22340 ha, moderately alkaline on 3941 ha and strongly alkaline on 40 ha, reserve of humus (0-50 cm) very small and small on 59831 ha, moderate on 43210 ha, high and very high on 20480 ha. In terms of physical and hydrophysical indices of soil, a sandy texture was identified on 11290 ha, clayey on 48203 ha, loamy on 75698 ha, very loose and loose soils and 23120 hectares, unsettled on 25620, compacted and strong compacted on 74781 ha, very superficial and shallow soils on 23080 ha, moderately deep on 4860 ha, powerful and extremely deep on 68210 ha, low and extremely low porosity on 28830 ha, moderately on 73289 ha, high and very high on 21402 ha, bulk density is high and very high on 11100 ha, medium on 36800 ha, low and very low on 76001 ha, extremely low on 3300 ha, easily accessible water capacity is very low and low on 35625 ha, medium on 62436 ha, high and very high on 25450 ha. Summarizing the above, one finds that the main agrochemical and hydrophysical indicators are in close contact with the blanket of soil and improvement of management practices can only be done through deep knowledge and inventory of the land agrochemical and hydrophysical characteristics.

Keywords: agrochemistry, resources, limitative, productive.

1. Introduction

Given the varied climatic conditions soils differ greatly as morphological, physical and chemical characteristics, and in terms of fertility and productive potential [1, 2]. The use of wrong or inadequate technologies for crops often affects not only a quantities and quality of agricultural production but also threatens the very soil reserves, which as we know is limited, the surfaces cultivated decrease each year due to massive removal of land from the agricultural circuit [3, 7, 8, 6].

Agriculture in Bistrita aligned with trends of recent decades applying modern production technology, along with massive use of chemicals to increase agricultural production, subsequently inevitably followed by reports of negative effects on the environment and soil.

While not considered an area with high agricultural potential, in Bistrita-Nasaud major interventions took place on the soil, with special

* Corresponding author.
Fax: +40-264-596384
Tel: +40-264-593792
e-mail: bakosstefan@yahoo.com

implications in the evolution of present and future land.

This fully justifies Soil and Agrochemical modern research, planning to substantiate not only technical and scientific aspects, but using the most appropriate measures in order to increase crop production and the soil conservation in conditions correlated with the demands of the environment.

2. Material and Method

The research was conducted within the county Bistrita-Nasaud, on an area of 123521 ha, concerns of agricultural land area of 24 administrative territorial units of a total of 288891 ha, which is the total county agricultural area. Surface structure by main categories of use is presented in Table 1.

Description of specific climatic conditions of the area studied, delimitation and definition of soil and ground units, and chemical soil analysis of the main traits was made after Soil Assessment Study Methodology (vol. II, III), developed by ICPA Bucharest 1987 [4], as well as Roman System Soil Taxonomy – SRTS, 2012 [5, 9, 10, 11], determination of soil analyzes were made using the following methods: pH –potentiometric, humus – Walklez - Black, texture - Kacinscki, the soil bulk density by dividing the mass of the cylinder volume, useful edaphic volume, degree of compaction and water capacity easily accessible by calculation.

Table 1. Structure of agricultural areas by the main categories of use (ha)

Arable	Pastures	Meadows	Vineyards	Orchards	Total Agricultural
70478	29646	21219	458	1721	123521
57%	24%	17%	0.3%	1.7%	100%

3. Results and Discussions

Bistrita-Nasaud is situated in the central west of the country, between parallel 47^0 37' and $46^0$48', respectively between meridians 23^0 27 'and 25^0 36'.The total area of the county is 5355 square kilometers, encompassing several major relief units: Somes Mare Lane, Transylvania Plain, Somes Plateau, Tiblesului, Rodnei and Calimani Mountains. Therefore the relief is predominantly hilly, mountainous area occupying approx. 1/3 of the area of the county. The minimum altitude is located at the exit of the county Somes Mare (245m) and the maximum is situated on top Rodnei (2279 m).

The mountain area located in the north east of the county is represented by the massifs: Tiblesului Mountains, Rodnei Mountains, Borgo and Calimani Mountains, the latter being the highest volcanic massive in the country. The hilly includes the central and south-west of the county, being structurally complex: monoclinal hills, domes and diapirs.They include Bistrita Hills, Calimanilor Piedmont Hills Sieului and part of Transylvania Plain and Plateau Soemsan. Low plains themselves (with altitudes below 200 m) are lacking, their place being filled by broad meadows of Somes Mare and Sieu.

Geologically, the situation is similarly highly variable: pecto-graphics diversity of mountain areas (granite intrusions, eruptive, crystalline schists, limestones of Mesozoic and Paleozoic) but hilly areas (deposits of marl, marl and clay, sandstone, Dej Tuff) contributed to the formation of important subsoil resources.

Hydrographicly, the County is well represented with a rich network and tributary main rivers: Somes Mare, Şieului, Ilva, Bistrita Valley and Dipsa. The largest lake is at Colibita and lakes appear in the Transylvanian Plain heavily salted and mineralized: Beclean, Figa, Saratel.

The climate of Bistrita-Nasaud is closely related to geographical position and relief items: whereas in the mountain range does not exceed the average annual temperature 2-3^0C, thermal values multiannual goes up to 8.5^0C in the west of the county. The value of thermal hilly area is between 6-7^0C. The absolute maximum was recorded in summer 1962 in Bistrita (37.6^0C) and dropped to the absolute minimum in the year 1954 of -37.6^0C in Teaca. Rainfall is distributed unevenly both on relief and throughout the year: over 1000 mm in mountainous area, 600-650 mm in Somes Plateau, Calimanilor Piedmont, Bistrita and Sieului Hills and 550-600 mm in the south east in Transylvania Plain. The number of days with frost is 160 days in the mountains, 130 days in piedmont and 120 days in the rest of the county.

In these pedoclimatic conditions, pedological blanket is highly variable, its formation is closely linked to the conditions of relief, climate, parental rock, groundwater influence of periodic overflows of water and not least the influence of anthropogenic (Table 2).

Table 2. The main soil types and associations in Bistrita-Nasaud

No.	WRB-SR-1998	Agricultural (ha)	%
1	Dystric leptosols (dy, eu, eu-li)	360	0.30
2	Regosols (dy, eu, mo)	2570	2.00
3	Alenosols (pr, dy,eu, ca)	1223	1.00
4	Fluvisols (dy, eu, ca, gl)	12360	10.00
5	Chernozems (ca, ha, lv, gc)	1650	1.30
6	Phaeozems (ha, ca, lv, st)	16420	13.30
7	Rendzinic leptosols	1377	1.11
8	Eutric cambisols (eu, mo, ca, st)	7620	6.16
9	Distric cambisols (ha, st, gz)	579	0.46
10	Luvisols (ha, st, ab, mo, vr)	58918	47.70
11	Planosols (ha, ab)	76	0.06
12	Entic podzols	123	0.10
13	Podzols (um, fe, li)	310	0.25
14	Stagnosols (ha, lv, ab, vr)	675	0.54
15	Gleysols (ha, ca, mo)	6860	5.55
16	Solonchaks	23	0.02
17	Solonetz	17	0.01
18	Anthrosols (ho, er, dc)	12360	10.14
	TOTAL	123521	100.00

The table above shows that soils in class luvisols are dominant, followed by the class protisols, followed by class chernozems.

The other soil classes are spread unevenly, with a weight and a smaller significance in agricultural production. In line with the classification system (SRTS-2012, WRB-SR-1998), the main soil types of the specific characteristics of agrochemical: the class luvisols are characterized by moderately to slightly acid pH acidic medium or content low humus, chernozems they are characterized by rich humus content, pH neutral to slightly alkaline. Regosols located in sunny exhibitions and limestone formed on limestone and marl have a ph of weak to moderately alkaline, having also low in humus and organic matter. Aluvosols have a pH varied depending on the nature of fluvial deposits that have evolved.

There are soils that shows extreme variations pH: soils belonging to classes umbrisols and cambisols, pH podzols are characterized by moderate to strong acid, while at the other extreme are located soils belonging to the class solonchaks, solonetz with strong and very strong pH alkaline. Among the many attributes that characterize soils agrochemical, are presented those considered important in practical business agrotechnics: reaction soil and humus content.

After centralizing the data in the archive OSPA Cluj [12], the situation is as follows:

Table 3. Structure of agricultural areas considering soil's reaction (ha)

Strongly acidic	Moderate acidic	Low acidic	Neutral	Low alkaline	Moderate alkaline	Strongly alkaline
pH = 3.6-5.0	pH = 5.1-5.8	pH = 5.9-6.8	pH = 6.9-7.2	pH = 7.3-8.4	pH = 8.4-9.0	pH = 9.1-10
360	7850	76210	12780	22340	3941	40
0.3%	6%	62%	10%	18%	3%	0.7%

Table 4. Structure of agricultural areas considering the humus reserve (ha)

Very small	Small	Medium	Big	Very big	Total
1-60 t/ha	61-120 t/ha	121-160 t/ha	161-200 t/ha	>201 t/ha	
18600	41231	43210	16800	3680	123521
16.36%	18.33%	27.9%	30.75%	6.65%	100%

Among hydrophysical and physical indicators were synthesized data: density apparently useful edaphic volume, the degree of soil compaction, porosity, and total water capacity easily accessible.

Table 5. The structure of agricultural areas after the apparent density value (g/cm^3) (ha)

Very big	Big	Medium	Small	Very small	Extremely small	Total
>1.67	1.54-1.66	1.40-1.53	1.26-1.39	1.13-1.25	<1.13	
2800	8300	36800	25600	46721	3300	123521
2%	7%	30%	21%	37%	3%	100%

Table 6. The structure of agricultural areas by soil texture (ha)

Sandy	Loam- sandy	Sandy-silty	Clay	Loam-silty	Clay-loam	Silty	Total
2670	8620	11670	24863	42620	29750	3328	123521
2%	7%	9%	20%	35%	24%	3%	100%

Table 7. The structure of agricultural areas after total porosity values (% v/v) (ha)

Extremely small	Very small	Small	Medium	Big	Very big	Extremely big	Total
<22	22-38	39-43	44-48	49-53	54-58	>58	
3200	25630	40455	32834	10632	8250	2520	123521
3%	21%	32%	26%	9%	7%	2%	100%

Table 8. Structure by volume edaphic useful agricultural areas (the soil thickness cm) (ha)

Very shallow	Moderate shallow	Weak deep	Moderate deep	Powerful deep	Highly deep	Total
0-20	21-50	51-75	76-100	101-125	125-200	
13400	9680	27371	4860	62340	5870	123521
10%	8%	22%	4%	51%	5%	100%

Table 9. The structure of agricultural areas after compaction degree (% v/v) (ha)

Very loose	Loose	Not compacted	Weak compacted	Moderate compacted	Powerful compacted	Total
<-18	-18…11	-10…0	1…10	11…18	>18	
2820	16620	25620	70261	4520	3680	123521
2%	13%	21%	58%	4%	2%	100%

Table 10. The structure of agricultural areas easily accessible by water capacity (mm) (ha)

Very small	Small	Medium	Big	Very big	Extremely big	Total
<30	30-50	51-70	71-90	91-120	>120	
11800	23825	36665	25781	16850	8600	123521
10%	19%	29%	21%	14%	7%	100%

From artificial situation presented above shows that primarily in Bistrita-Nasaud acidic and moderately acidic soils dominate over 50% of the mapped area.

This situation is due in large part to natural conditions in which these soils were formed, but a good part were acidified in a relatively short time due to anthropogenic influences and here we are referring primarily to the application of fertilizers with acid physiological reaction without mapping was based on an agrochemical, and ceasing subsidies granted after 2007 amending programs acidic soil.

In the period 1992-2007 were included in the program acidic soil amendment over 30000 ha, intervening in emergencies I and II of the amendment calcium. Surfaces amended fell below 1000 ha / year after that period.

At this rate we appreciate as a percentage of the next 20 years acidic soils will increase by at least 5-6%.

Humus content is closely correlated with soil type area, but there are few situations in which the content of humus lost through soil erosion, both by applying the wrong agrotechnical and by massive deforestation occurring in some areas of the county. Therefore only 36% of the mapped area shows a high and very high content of humus.

Physical and hydrophysical indices of soils in the area studied are linked in particular soil texture and structure so sandy soils have a low bulk density, high total porosity, loose and have a water capacity accesbila slightly reduced.

At the opposite end, heavy textured soils (clay), highly compacted, with high bulk density, porosity little in return has a large reserve of usable water almost all year.

4. Conclusions

Conditions varied relief, parent rock, climate generated a comforter extremely varied pedological, which together determine the environment in which spontaneous vegetation grow and develop as well as the cultivated ones.

In the administrative territory of Bistrita-Nasaud, are dominant luvisols, chernozems, cambisols, followed by undeveloped soils (regosols, fluvisols) scattered around the perimeter of the county.

In the program of monitoring of soils and soils were identified that offer low edaphic conditions in terms of crop agrochemical plants: highly acidic soils or very alkaline (solonetz, soloncheaks), but reduced their weight in the perimeter mapped.

In terms of reaction soils dominate weakly and moderately acidic soils (over 50%), both due to the climatic conditions of applying fertilizers and agrochemical without a base.

Regarding the soil texture there are 18% sandy texture, texture clayey 20% and 62% clay texture. Volume edaphic useful, in close correlation with soil type, soil horizons present in skeletal but also reflect processes of soil superficial slope of over 18%, slightly deeper 22%, 4% moderate and very deep and extremely deep 56%.

The degree of compaction is correlated with high clay content and high on 6% of the mapped area, sparsely compacted on 58%, 21% non-woven, loose and very loose on an area of 15%.

Easily accessible water capacity low and very low in sandy soils 29%, middle and high in clay soils 50% and high and extremely high 21%, the latter being typical clay soils but also those affected by phenomena of hydromorphism.

References

[1] Bakos St., 1994, Pedology of Transylvanian Plain, Review Soil Science, (4) 42-46.

[2] Bakos St., V. Miclaus, 2001, Contributions to the sunny slopes of the Transylvanian Plain, USAMV Cluj-Napoca, Symposium Homage, (2) 298-303.

[3] Bakos St., 2001, The soils on the sunny slopes of the Transylvanian Plain, Thesis, USAMV Cluj-Napoca.

[4] Florea N., V. Balaceanu, C. Rauta, A. Canarache, 1987, Methodology elaboration soil studies, vol. I, II and III and the agricultural propaganda, Bucharest.

[5] Florea N., I. Munteanu, 2012, Roman system of soil classification, ed. Sitech, Craiova.

[6] Marghitas M., M. Mihai, C. Toader, L. Moldovan, G. Roman, 2011, Manual of best practices in agricultural plants fertilization technology, Ed. Academic Press, Cluj-Napoca.

[7] Rusu M., M. Marghitas, T. Mihailescu, I. Oroian, A. Dumitras, 2005, Treaty agrochemical, Ed. Ceres, Cluj-Napoca.

[8] Rusu T., D. Weindorf, P. Moraru, H. Cacovean, V. Turcu, 2009, Research methods of soil and plant, Ed. Risoprint Cluj-Napoca, p. 157.

[9] ***(1988), FAO/UNESCO, Soil Map of the World, Revised Legend, World Soil Res., Rep. 60, Rome.

[10] ***(1997), Geography Romania, Ed. Academica, Bucharest.

[11] ***(1999), Soil Survey Staff, Soil Taxonomy Agric., Handbook, 436, USDA, 869 pp.

[12] ***(1968-2014), OSPA Archives Cluj-Napoca.