PROPERTIES OF TYPICAL DISTRICAMBOSOL SOIL UNDER THE INFLUENCE OF SURFACE EROSION

Mihaela BĂLAN

Institutions *University of Craiova, 19 Libertății Street, Craiova, Romania*

Abstract

This paper presents the evolution of the typical districambosol soil in the vicinity of the Experimental Camp for the Preajba Grassland Culture in Gorj County under the influence of surface erosion. In this respect, 2 soil profiles were comparatively executed as follows: one profile located on the plateau where the slope was 2 to 5%, characterised by the following sequence of horizons Ao-Bv1-Bv2-Bv3 with 30 cm Ao horizon, and the other profile was located halfway down the slope on a slope of 10 to 15%, characterised by the following sequence of Ao-Bv1-Bv2-Bv3 horizons, where slow geological (surface) erosion can be observed which has led over time to the removal of 13 cm of soil from the surface of the Ao horizon, reaching a 17 cm thickness.

By analysing the main physical and chemical properties of the soil samples collected from the two soil profiles, it was revealed that the loss of the topsoil layer, by washing away the fertile soil layer year after year, also leads to a gradual worsening of the soil chemical properties. In this respect, the soil quality reports were drawn up and, on the basis of the quality scores, the potential yields that could be achieved under normal conditions by applying appropriate technologies were determined.

Thus, it was found that on soil with no risk of erosion, with a slope of 2 to 5%, potential yields are 32.76% higher for wheat, 50.77% higher for maize and sunflower, 50.98% higher for potatoes and 32.76% higher for peas and beans than on soil with a high risk of erosion, with a slope of 10 to 15%, showing the negative influence that slope has on soils and implicitly on yields.

Key words**: **surface erosion, horizon, slope, typical districambosol soil, bonitation

INTRODUCTION

Soil is the foundation of agriculture, without which life on earth would not be possible. Of the processes affecting soil quality, erosion is of greatest interest, both in terms of the damage it causes and the affected areas.

Soil erosion risk assessment differs from region to region depending on specific conditions: vegetation type and cover, climatic conditions, soil, relief geometry. The need for a study on the impact of surface erosion on soils is topical because measures and ways to prevent and combat surface erosion can be developed.

In Gorj County, water erosion is the most widespread form of soil degradation and affects an area of 139,027.95 ha which represents about 57.03% of the total of the agricultural area, of which 134.940,26 ha surface erosion (55.36% of agricultural area), and 4,087.69 ha deep erosion.

Water from precipitation in its dynamic action gradually removes, in variable quantities, the upper layer of soil, so that, under the unchanging influence of time, the total removal of the layer of fertile soil and the removal of non-fertile horizons to the surface can be reached, reaching the bedrock. This form of erosion is the most dangerous because it is very difficult to detect and can lead to irreparable loss of the surface horizon which is rich in humus and nutrients. For this reason, this form of erosion is arguably the most serious because it is more difficult to notice and is not given the importance it deserves, and its effects are particularly felt following the small yields obtained, which are often blamed on other factors.

In this regard, in order to highlight how surface erosion acts on soils, as well as how they evolve under the influence of surface erosion, we studied a type of soil in the vicinity of the Experimental Field for Grassland Culture, from Prejba, Gorj County, namely, the typical districambosol soil.

MATERIALS AND METHODS

Soil profiles have been carried out on the typical district soil in the vicinity of the

Preajba Experimental Field, in Gorj County, to see how geological erosion acts on soil quality.

Main profiles and secondary profiles were executed according to the working method as follows:

- the main profiles were made to a depth of 1.5 m, a length of 1.5 m and a width of 0.6 m;
- the secondary or control profiles were made to a depth of 0.8 m, a length of 1 m and a width of 0.4 m.

. After setting the main profiles on the plan, the control profiles were executed according to the same methodology in order to establish the soil limits.

The work plan included planimetry and levelling data, ground boundaries were drawn according to the characteristics of the terrain expressed on the work plan.

Soil samples were collected following the same field methodology developed by ICPA Bucharest. Soil samples were collected from each soil profile on horizons.

Two types of samples were taken:

- pedological samples - samples in disturbed structure (were collected in bags);
- samples in undisturbed structure (were collected in cylinders);
- agrochemical samples – were collected according to the agrochemical sampling methodology.

Analyses, processing and interpretation of soil physical and chemical data were done in collaboration with Gorj OSPA, according to Bucharest ICPA methodology. Following laboratory analyses, the physical and chemical properties of the soil under study were determined.

RESULTS AND DISCUSSIONS

The soil type, typical disticambosol, soil was comparatively studied in a profile located on the plateau where the slope was 2 to 5%, characterised by the following sequence of Ao-Bv1-Bv2-Bv3 horizons, the Ao horizon having a development of 30 cm and in one, located on the uneven slope, halfway down the slope with a slope of 10 to 15% and which had the profile scheme Ao-Bv1-Bv2-Bv3 where the Ao horizon had a 17 cm thickness. It can thus be observed, by analysing the development of the surface horizon, the existence of slow geological (surface) erosion.

By comparing the profile on the plateau with the one on the slope, the following aspects were highlighted:

- in addition to the thickness of the horizon from the surface to the soil on the slope denoting the manifestation of slow geological erosion, another morphological property, modified by this process, evidenced in the soils studied, is the colour.
- in the soil unit on the plateau or in the upper third of the slope, the colour of the Ao horizon is dark (dark brown) due to the higher humus content, whereas in the soil on the slope with a slope of 10 to 15%, the colour of the same horizon is lighter (light brown) due to the gradual removal of the humified surface layer.

Typical dystricambosol soil

The profile is of the type: Ao-Bv_1-Bv_2-Bv_3.

Tg.-Jiu Territory
Gorj County
Working scale 1:5000

General development conditions

Relief: plateau with slope 2 to 5% (terrace)

Parent rock: sandy clays

Depth of groundwater: 5 – 10 m

Characteristic vegetation: acidophilus grassland vegetation

Morphological description

Representative profile no. 1

Ao Horizon (0 – 30 cm), light brown colour, poorly defined small polyhedral angular structure, sandy-loamy texture, contains rare ferromanganese nodules, very dense roots; it is a porous medium, a compact medium.

Bv_1 Horizon (30 – 45 cm) is brown, slightly yellowish, poorly defined small polyhedral angular structure, sandy-loamy texture, contains rare roots, it is a porous medium, a compact medium.

Bv_2 Horizon (45 – 75 cm) is yellowish brown with rare rusty spots, with poorly developed small polyhedral angular structure, sandy-loamy texture; it is a porous medium, a compact medium.

Bv_3 Horizon (75 – 100 cm) is light yellowish brown, poorly structured, sandy-loamy texture; it is a porous medium, a compact medium.

Typical dystricambosol soil

The profile is of the type: Ao-Bv_1-Bv_2-Bv_3.

Tg.-Jiu Territory
Gorj County
Working scale 1:5000

General development conditions

Relief: half of the slope **10 to 15%**

Parent rock: sandy clays

Depth of groundwater: 5 – 10 m

Characteristic vegetation: acidophilus grassland vegetation

Morphological description

Representative profile no. 2

Ao Horizon (0 – 17 cm), light brown colour, poorly defined small polyhedral angular structure, sandy-loamy texture, contains rare ferromanganese nodules, very dense roots; it is a porous medium, a compact medium.

Bv_1 Horizon (17 – 52 cm) is brown, slightly yellowish, small polyhedral angular structure, sandy-loamy texture, contains rare nodules, dense roots; it is a porous medium, a compact medium.

Bv_2 Horizon (52 – 75 cm) is yellowish brown, with small polyhedral angular structure, sandy-loamy texture; it is a porous medium, a compact medium.

Bv_3 Horizon (75 – 100 cm) is yellowish, with rare rusty spots, poorly structured, sandy-loamy texture; it is a porous medium, a compact medium.

Table 1

Main physical and chemical properties of typical districambosol soil (2 to 5% slope)

Horizon	Depth -cm-	pH	Humus %	P p.p.m.	K p.p.m..	N Total %	Particle Size Analysis				Texture
							Coarse Sand%	Fine Sand%	Dust %	Colloid Clay %	
Ao	0-30	6,1	2,44	26	60	0,262	12,9	38,5	33,3	15,3	LN
Bv1	30-45	5,9	1,44	6	46	0,200	14,3	36,2	31,7	17,8	LN
Bv_2	45-75	5,1	1,36	3	42		14,2	36,3	31,2	18,3	LN
Bv_3	75-	5,3		3	38		15,3	40,1	29,8	14,8	LN

Table 2

Main physical and chemical properties of typical districambosol soil (10 to 15% slope)

Horizon	Depth -cm-	pH	Humus %	P p.p.m.	K p.p.m..	N Total %	Particle Size Analysis				Texture
							Coarse Sand %	Fine Sand %	Dust %	Colloid Clay %	
Ao	0-17	5.5	1.12	6	46	0.240	18.1	27.3	34.4	20.2	LL
Bv1	17-52	5.8	0.8	10	38	0.213	18.5	34.2	28.2	19.1	LN
Bv_2	52-75	5.9	0.61	9	38		17.1	36.1	31.3	15.5	LN
Bv_3	75-100	5.8		9	30		18.5	35.6	30.1	15.8	LN

In most cases, through the erosion process, as a result of the decrease in humus content, there is also a decrease in soil acidity, following the bringing up to date of better or totally saturated horizons in bases compared to the surface horizon of non-eroded soils.

Water erosion affects not only the morphological and chemical properties of the soil, but also its physical properties.

Thus, the partial loss of the A horizon of soils on slopes contributes to an increase in bulk density per profile, pH, wilting coefficient, as well as a decrease in total soil water capacity, field capacity, useful water reserves, soil porosity, etc..

Year after year, the loss of soil from the horizons at the surface of the land causes the appearance of new physical and hydrophysical conditions that are not suitable for plant life.

The action over time of surface erosion first affects the texture of the upper horizons which from sandy loam (LN) in the Ao horizon at the typical 2 to 5% slope plateau districambosol soil has evolved to a loamy texture (LL) in the Ao horizon at the eroded soil.

Analysing the two soil profiles, it is clear that in the typical eroded districambosol soil on a 10-15% slope, because of erosion, the Ao surface horizon is 13 cm lower. In this case we can say that the slope played a key role in triggering erosion. Also, by washing away the fertile topsoil year after year which lead to the loss of 13 cm of horizon thickness Ao, has also led to the worsening of chemical traits of the soil. This can be seen in Tables 1 and 2. Thus, in the surface Ao horizon, in the soil on the plateau, the humus content was 2.44% and decreased by 1.31%, (i.e. more than half) to 1.12%, in the soil at mid-slope. Total nitrogen content also decreased from 0.262% to 0.240% by 0.022%, mobile phosphorus content decreased from 26 ppm to 6 ppm by 20 ppm and mobile potassium content decreased from 60 ppm to 46 ppm by 14 ppm.

The structure of the soil has also been modified by the action of falling raindrops, which hit the structured soil aggregates on the surface of the ground, throwing dislodged material at variable distances from the impact site, thus favouring erosion and reducing the hydric stability of the soil aggregates, and therefore of the soil structure.

The worsening of the relationship of eroded soils with water as the main means of transporting nutrients (which are already unpalatable on slopes) in the vital soil-plant circuit is one of the most important factors in the yields that can be obtained from all crops on slopes. For this purpose, in order to see the evolution of yields on soils affected by erosion and to compare them with the yields obtained on soils not affected by this phenomenon, bonitation sheets on the previously described soil types were drawn up.

Table 3
Sheet for the calculation of the bonitation grade on the typical districambosol soil on the slope of 2 to 5%

Ecoped. Indicator	WHEAT	MAIZE	SUN FLOWER	POTATO	PEA/BEAN
Tm	1	1	1	0,9	1
Pm	1	1	1	1	1
Gz	1	1	1	1	1
Pz	1	1	1	1	1
Sa	1	1	1	1	1
Tex	0,9	1	1	1	0,9
Pol	1	1	1	1	1
I%	1	1	1	1	1
Hazel	1	1	1	1	1
Groundwater	0,9	0,9	0,9	0,9	0,9
Flood	1	1	1	1	1
Porosity	0,9	0,9	0,9	0,9	0,9
$CaCO_3$	1	1	1	1	1
pH	1	1	1	1	1
Ed Vol.	1	1	1	1	1
Rez.	0,8	0,8	0,8	0,7	0,8
Exc.	1	1	1	1	1
Bonitation grade	58	65	65	51	58
Favourability class	V	IV	IV	V	V
Average bonitation grade = 59 points					
FAVOURABILITY CLASS – Vth					

Thus, yields are expressed on the basis of bonitation scores and kilograms per bonitation point for the following crops: wheat, maize, sunflower, potato, pea and bean.

The bonitation grades for each crop are multiplied by the kilograms/point of bonitation which is different for each crop, i.e.: wheat – 60 kg/point, maize – 80 kg/ point, sunflower – 30 kg/point, potato – 450 kg/ point, pea – 28 kg/ point and bean – 15 kg/ point.

Calculating in this way, the following potential bonitation have been highlighted which can be achieved under normal conditions by applying appropriate technologies.

At the typical districambosol soil on a 2 to 5% slope, according to the bonitation scores (table 3) and kilograms per bonitation point, the following possible yields can be obtained:

- Wheat – 58 points x 60 kg/point = 3.480 kg/ha
- Maize – 65 points x 80 kg/ point = 5.200 kg/ha
- Sunflower – 65 points x 30 kg/ point = 1.950 kg/ha
- Potato – 51 points x 450 kg/ point = 22.950 kg/ha
- Pea – 58 points x 28 kg/ point = 1.624 kg/ha
- Bean – 58 points x 15 kg/ point = 870 kg/ha.

Table 4

Sheet for the calculation of the bonitation grade on the typical districambosol soil on the slope of 10 to 15%

Ecoped. Indicator	WHEAT	MAIZE	SUNFLOWER	POTATO	PEA/BEAN
Tm	1	1	1	0,9	1
Pm	1	1	1	1	1
Gz	1	1	1	1	1
Pz	1	1	1	1	1
Sa	1	1	1	1	1
Tex	0,9	1	1	1	0,9
Pol	1	1	1	1	1
I%	0,9	0,8	0,8	0,7	0,9
Hazel	1	1	1	1	1
Groundwater	0,9	0,9	0,9	0,9	0,9
Flood	1	1	1	1	1
Porosity	0,9	0,9	0,9	0,9	0,9
$CaCO_3$	1	1	1	1	1
pH	1	1	1	1	1
Ed Vol.	1	1	1	1	1
Rez.	0,6	0,5	0,5	0,5	0,6
Exc.	1	1	1	1	1
Bonitation grade	39	32	32	25	39
Favourability class	VII	VII	VII	VIII	VII
Average bonitation grade = 33 points					
FAVOURABILITY CLASS – VIIth					

In the case of the typical districambosol soil on the 10 to 15% slope, according to the bonitation grades in Table 3, the following potential yields can be obtained:

- Wheat – 39 points x 60 kg/point = 2.340 kg/ha
- Maize – 32 points x 80 kg/ point = 2.560 kg/ha
- Sunflower – 32 points x 30 kg/ point = 960 kg/ha
- Potato – 25 points x 450 kg/ point = 11.250 kg/ha
- Pea – 39 points x 28 kg/ point = 1.092 kg/ha
- Bean – 39 points x 15 kg/ point = 585 kg/ha

Thus, one can see the negative influence that slope has on soils and implicitly on yields. From Tables 3, 4 and 5 and Figure 1, it can be seen that on soil with no risk of erosion, with a slope of 2 to 5%, yields are 32.76% higher for wheat, 50.77% higher for maize and sunflower, 50.98% higher for potatoes and 32.76% higher for peas and beans, compared to soil with a high risk of erosion, with a slope of 10 to 15%.

Table 5

Potential yields of different crops on typical uneroded and eroded districambosol soils (kg/ha and %)

Slope	Wheat		Maize		Sunflower		Potato		Pea		Bean	
	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%
2 - 5%	3.480	100	5.200	100	1.950	100	22.950	100	1.624	100	870	100
10-15%	2.340	67,24	2.560	49,23	960	49,23	11.250	49,02	1.092	67,24	585	67,24

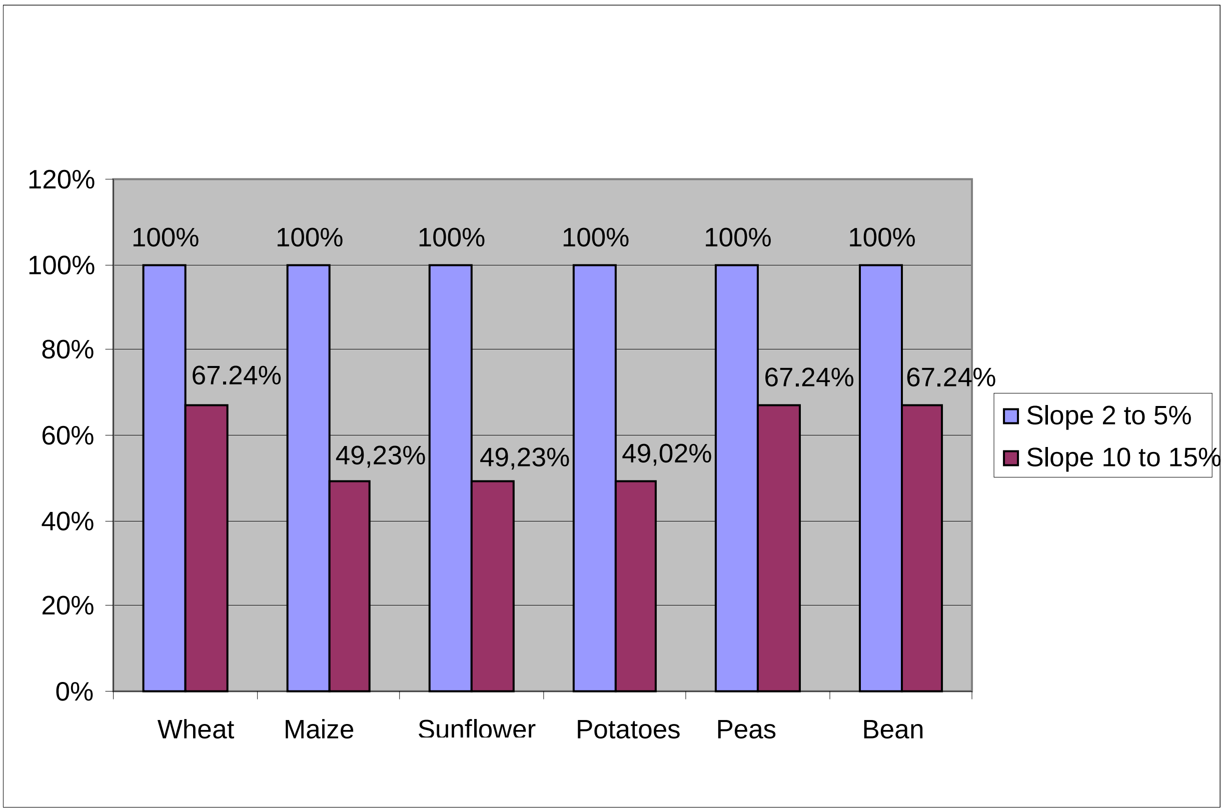

Fig. 1 Potential yields of different crops on typical uneroded and eroded districambosol soils

CONCLUSIONS

Surface erosion is manifested by the gradual and almost uniform removal of fertile layers over the entire slope surface, which is why it is considered the most dangerous form of erosion, as it is invisible to the naked eye.

Through the analysis of the main physical and chemical properties of the soil samples collected from the two soil profiles, it was revealed that the loss of the surface soil layer, by washing away the fertile soil layer year after year, gradually leads to a worsening of the soil chemical properties.

Surface erosion affects not only the chemical properties of the soil but also the morphological and physical properties of the soil.

By drawing up the bonitation sheets, based on the bonitation scores, it was revealed that on soil without risk of erosion, with a slope of 2 to 5%, the potential yields that can be obtained under normal conditions, by applying appropriate technologies, are 32% higher, 76% for wheat, 50.77% for maize and sunflowers, 50.98% for potatoes and 32.76% for peas and beans, compared to soil with a high risk of erosion, on a 10 to 15% slope, showing the negative influence of slope on soil and, therefore, on yields.

Knowing the consequences of surface erosion, human activity is very important for soil protection, in terms of systematization of crops on arable land, choice of land use category, use of technological system of plant cultivation, exploitation of forest resources, rational grazing and sustainable development management in Gorj County.

It is recommended to identify as accurately as possible the areas at risk of erosion, in order to intervene with consolidation, stabilisation, levelling, land shaping and other hydric improvement works.

It is recommended to choose the Halbac-Cotoara-Zamfir Rares (2015) Land degradation – an overview, 14th International Conference on Environmental Science and Technology (CEST2015) Rhodes, Greece, 3 - 5 September 2015best use category, to improve the land, to use the appropriate agrotechnical system in order to prevent the negative effects of erosion, to preserve the main means of production, which is the soil.

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