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MODIFICATION OF THE MAIN PHYSICAL PROPERTIES UNDER THE INFLUENCE OF THE CROP SYSTEM OF THE EROSIONED SOIL IN THE NORTH WESTERN ROMANIA CONDITIONS

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Abstract. *The influence of the crop system on the main physical properties of the erosioned soil was studied in the year 2000 in the plots for the erosion measurement placed on the hill with 10% slope in Agricultural Research and Development Station Oradea. The metal panels at the base and soil dams there were between the plots. The variants studied: clean fallow, pasture, wheat, maize on the level curves, and maize from hill to valley. The biggest soil losses were determined in the variant with clean fallow and in variants with maize seeded from hill to valley. The erosion determined the important differences between the physical parameters (hydrostability of the macrostructure – aggregates bigger than 0.25 mm, bulk density, total porosity, hydraulic conductivity, penetration resistance) of the soil in the top of the hill in comparison with the base of the hill. In the top of the hill, the values of the physical parameters were less favorable for plants in comparison with the hill base. The most unfavorable values of the physical properties of the soil were registered in the variant with clean fallow fallowing the variants cropped with maize from hill to valley, the variants cropped with maize on the level curves, wheat and pasture.*

Keywords: soil erosion, structure, bulk density, total porosity, penetration rezistance, hydraulic conductivity

1.Introduction

In Romania and in the North Western part of the country, too, soil erosion affects large area. [1, 2]. The negative influence of the soil erosion on chemical, physical and biological properties of the soil was emphasized by numerous researches from Romania and from the other country [12, 9, 4, 5, 6, 7, 11, 3, 12, 8, 10].

In the Bihor County, an area of 200,000 hectares (38% from the agricultural land) has lands with slopes bigger than 5%, were erosion is possible. The researches

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regarding the erosion from Bihor County started in 1983 by I. Colibas and I. Mihut, in Hidiselu de Sus, and Pocola and researches regarding the soil management against erosion were made. These researches was continuated by Domuţa C. after 1996 in Pocola. The researches regarding the determination of the soil erosion using the plots for check runn of was made in Beiuş during 1990-1994 and in Oradea after that. Other, researches regarding the soil management on the land with slope was made both in Beiuş and in Oradea [4,5, 6, 7, 14],

2. Materials and methods

The researches were carried out during 2009-2011 in Agricultural Research and Development Station Oradea on a hill with 10% slope. The plots for the soil erosion measurement were placed in the 2000 year, in the following variants: clean fallow, maize from top to valley, maize on the level curve direction, wheat, pasture. The plots' sizes were 45x3.5 m and metal panels were placed at the base of the plots as well as soil dams between the plots on the hill.

The physical and chemical properties of the soil after 9 years of research were determined in a laboratory from the Agricultural Research and Development Station Oradea. The macroaggregates' hydrostability was determined by wet sifting using the Cseratzki method. The bulk density (BD) was determined in 5 repetitions using cylinders with a diameter of 100 cm^3; the same cylinders were used in order to determine the penetration resistance and the hydraulic conductivity of the soil. The total porosity (TP) was calculated using the following formula: TP=(1-BD/D)x100, in which D=density=2.65 g/cm^3. The rainfall data was registered in the Meteorological Station Oradea at $45^o03'$ latitude and $21^o56'$ longitude.

3. Results and Discussions

On the top of the hill, the lowest values of the macro aggregates' hydrostability were registered in the variant with clean fallow. In the other variants studied, the values of the macro aggregates' hydrostability increased; the differences compared with the values in the variant with clean fallow were of 10.0% in the variant with maize cropped from top to valley, 22.2% in the variant with maize cropped on the level curves direction, 31.0% in wheat and 45.1% in pasture. The rows' position from top to valley and the soil erosion between the rows give an explanation for the higher values of the macro aggregates' hydrostability compared to the values registered in the variant with clean fallow from the base of the hill, 56.04% vs. 53.68%; the biggest value of the macro aggregates' hidrostability at the base of the hill was registered in pasture 58.82% (table 1).

Table 1. Macroaggregates' hydrostability modifications under the erosion and crop system influence, Oradea 2011

Crop system	Macroaggregates	Difference		
	%	%	%	%
Top of the hill				
1. Clean fallow	38.30	100	-	-
2. Maize, from top to valley	42.13	110.0	3.83	10.0
3. Maize, on the level curves direction	46.78	122.2	8.48	22.2
4. Wheat	50.14	131.0	11.84	31.0
5. Pasture	55.56	145.1	17.26	45.1
Base of the hill				
1. Clean fallow	53.68	100	-	-
2. Maize, from top to valley	56.04	104.4	2.36	4.4
3. Maize, on the level curves direction	52.40	97.7	-1.28	-2.3
4. Wheat	54.25	101.1	0.57	1.1
5. Pasture	58.82	109.6	5.14	9.6

The influence of the crop system on bulk density

On the soil profile located at the top of the hill, the highest value of the bulk density was determined in the variant with clean fallow, 1.54 g/cm^3. In all of the variants, the values of the bulk density show an improvement of the soil settling with 2.6%, in the variant with maize cropped from top to valley, with 7.8%, distinctively significant, in the variant with maize cropped on the level curves direction, with 10.3% and 14.2%, in the variants with wheat and with pasture (table 2).

The values of the bulk density on the soil profile from the base of the hill are lower than the values in all the studied variants. The highest value was registered in the variant with clean fallow, 1.47 g/cm^3, a very high one. In the variants with maize cropped from top to valley and maize cropped on the level curves direction, the values are high and in the variant with wheat and with pasture the values of the bulk density are median ones. (table 2).

Table 2. Bulk density modifications under the erosion and crop system influence, Oradea 2011

Crop system	Bulk density		Difference	
	g/cm^3	%	g/cm^3	%
Top of the hill				
1. Clean fallow	1.54	100	-	-
2. Maize, from top to valley	1.50	97.4	-0.04	-2.6
3. Maize, on the level curves direction	1.42	92.2	-0.12	-7.8
4. Wheat	1.38	89.7	-0.16	-10.3
5. Pasture	1.32	85.8	-0.22	-14.2
Base of the hill				
1. Clean fallow	1.47	100	-	-
2. Maize, from top to valley	1.43	97.3	-0.04	-2.7
3. Maize, on the level curves direction	1.37	93.2	-0.10	-6.8
4. Wheat	1.30	88.5	-0.17	-11.5
5. Pasture	1.25	85.1	-0.22	-14.9

The influence of the crop system on total porosity

As a consequence, the lowest values of the total porosity were registered in the variant with clean fallow both in the top of the hill (41.8%) and in the base of the hill (44.5%). In the top of the plot, in the variant with maize cropped from top to valley, the value of the total porosity (43.4%) is higher than the value registered in the variant with clean fallow (table 3).

The values of the total porosity at the base of the experimental plots are higher than the values determined in the top of the plots in all of the variants. A better value of the total porosity in comparison with the one determined in the top of the plot in the variant with clean fallow (44.5%) was registered in the variant with maize cropped from top to valley (46%); in the variant with maize cropped on the level curves direction a difference of 48.3% was determined. In the variants with wheat and with pasture, the values determined (50.9% and 52.8%) are higher than the values determined in the variant with clean fallow (table 3).

Table 3. Total porosity modifications under the erosion and crop system influence, Oradea 2011

Crop system	Total porosity		Difference	
	%	%	%	%
Top of the hill				
1. Clean fallow	41.8	100.0	-	-
2. Maize, from top to valley	43.4	103.9	1.6	3.9
3. Maize, on the level curves direction	46.4	106.4	4.6	6.4
4. Wheat	47.9	114.6	6.1	14.6
5. Pasture	50.1	119.9	8.3	19.9
Base of the hill				
1. Clean fallow	44.5	100.0	-	-
2. Maize, from top to valley	46.0	103.4	2.0	3.4
3. Maize, on the level curves direction	48.3	108.6	3.8	8.6
4. Wheat	50.9	114.4	6.4	14.4
5. Pasture	52.8	118.7	8.3	18.7

The influence of the crop system on penetration rezistance

In the top of the hill, the values of the penetration resistance are high in the variant with clean fallow (55.8 kg/cm^2) and in the variant with maize cropped from top to valley (50.1%). In the other variants, the values of the penetration resistance are median ones, 32.7 kg/cm^2 in the variant with wheat and 25.8 kg/cm^2 in the variant with pasture. A difference of 15.2% was registered when comparing the penetration resistance in the variant with maize cropped on the level curves direction with the penetration resistance in the variant with maize cropped from top to valley (table 4).

Lower values of the penetration resistance were registered at the base of the hill than the ones registered at the top of the hill in all of the studied variants. All of the values registered are median, except for the one registered in the variant with pasture, 20.7 kg/cm^2, situated in the median characterization class. In comparison with clean fallow, the differences are lower negative ones (table 4).

Table 4. Penetration resistance modifications under the erosion and crop system influence, Oradea 2011

Crop system	Penetration resistance		Difference	
	kg/cm^2	%	kg/cm^2	%
Top of the hill				
1. Clean fallow	55.8	100.0	-	-
2. Maize, from top to valley	50.1	89.8	-5.7	-10.2
3. Maize, on the level curves direction	38.6	69.2	-17.2	-30.8
4. Wheat	32.7	58.6	-23.1	-41.4
5. Pasture	25.8	46.3	-30.0	-53.7
Base of the hill				
1. Clean fallow	47.0	100.0	-	-
2. Maize, from top to valley	40.1	85.4	6.9	-14.6
3. Maize, on the level curves direction	35.6	75.8	-11.4	-24.2
4. Wheat	25.4	54.1	-21.6	-45.9
5. Pasture	20.7	44.1	-26.3	-55.9

The influence of the crop system on hydraulic conductivity

The hydraulic conductivity had the lowest values in the variant with clean fallow both at the top (1.31 mm/h) and base of the hill (2.37 mm/h); the hydraulic conductivity had a low value in the top of the hill and a median one at the base of the hill. In the variant with maize cropped from top to valley, in the top of the hill, the hydraulic conductivity had a low value, as well, but higher (46.6%), than the value determined in the variant with clean fallow. In the other variants, the differences in comparison with clean fallow are bigger with 155% in the variant with maize cropped on the level curves direction, 206.9% in the variant with wheat and 360.0% in the variant with pasture. There is a difference of 74.0% between the value of the hydraulic conductivity in the variant with maize cropped on the level curves direction and the one in the variant with maize cropped from top to valley (table 5).

Table 5. Hydraulic conductivity modifications under the erosion and crop system influence,Oradea 2011

Crop system	Hydraulic conductivity		Difference	
	mm/h	%	mm/h	%
Top of the hill				
1. Clean fallow	1.31	100.0	-	-
2. Maize, from top to valley	1.92	146.6	0.61	46.6
3. Maize, on the level curves direction	3.34	255.0	2.03	155.0
4. Wheat	4.02	306.9	2.71	206.9
5. Pasture	6.02	460.0	4.71	360.0
Base of the hill				
1. Clean fallow	2.37	100.0	-	-
2. Maize, from top to valley	3.12	131.7	0.37	31.7
3. Maize, on the level curves direction	4.34	183.2	1.97	83.2
4. Wheat	5.06	214.4	2.69	114.4
5. Pasture	7.32	308.9	4.95	208.9

The values of the hydraulic conductivity at the base of the hill in comparison with the values determined at the top of the hill are situated in the same characterization class, median. In comparison with the hydraulic conductivity from the variant with clean fallow, an increase was registered in the variant with maize cropped from top to valley; the differences registered in all other variants were of: -83.7% in the variant with maize cropped on the level curves direction, 114.4% in the variant with wheat and 208.9% in the variant with pasture. There is a difference of 39.1% between the values of the hydraulic conductivity from the variant with maize cropped on the level curves and the variant with maize cropped from top to valley.

Conclusions

(1)The paper based on the researches were carried out in Oradea on a hill with an 10% slope in the plots for soil erosion check and the following variants were studied: clean fallow, maize seeded from top to valley, maize seeded on the level curves direction, wheat and pasture.

(2)The lowest values of the aggregates' hydrostability were registered in the variant with clean fallow both at the top and base of the hill (41.8% and 44.5%); the highest values were registered in the variant with pasture, 50.1% and 52.8%. In the variant with maize cropped on the level curves direction, the macrostructure' hydrostability values are higher than the values from the variant with maize cropped from top to valley.The values of the bulk density, total porosity, penetration resistance and hydraulic conductivity at the top of the hill are worse than the values registered at its base; the biggest difference between the base and top of the hill were registered in the variant with clean fallow and in the variant with maize cropped from top to valley.

(3)The researches results show that the negative effects of the erosion on the land with median slope can be reduced using a good crop structure (pasture, wheat) and working on the level curve.

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