SOIL AND NUTRIENT LOSSES FROM SLOPE SOILS AT PREAJBA – GORJ

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Abstract

The paper presents researches carried out at Preajba – Gorj Experimental Field on pasture crops on a stagnic luvosoil with 6% slope in order to determine soil and nutrient losses in function of fertilizer type and crop in 2009. The soil losses determined by surface losses have been reduced with natural and sown pastures, of 0.45-0.68 t/ha and rather high, of 4.72-5.26 t/ha when cropping corn. The fertilizer doses, especially $N_{138}P_{81}K_{100}$ have determined an increasing of plant development and the root system as well as the mitigation of losses. Along with the surface erosion there have been taken away nutrients, both macro and micronutrients. The most affectd by surface runoff was the nitrogen that is los, annually, between 0.82-4.16 t/ha, more with wide row crops like corn and less with natural and sown pastures; the phosphorus and potassium are less lost.The microelements losses have reduced values that macroelements yet the presence of phosphorus within the applied fertilizers generates the reduction of iron, manganese and zinc losses as a result of insolubilisation.

Key words: soil, slope, water, runoff, nutrients

The soil is the core of terrestrial ecosystems. This is why the understanding of the soil as a system is the key in creating and preserving a heatlhy environment by human activity (Brady and Weil, 2008).

The concerning of European Community on soil evolution related with environment degradation, of the way the life quality itself is affected has determined legislative actions on soil protection for future, by elaborating: Soil Protection Directive for soil sustainable usage.

Among distructive factors of soil, the erosion is one of the most important that affect, worldwide, 1.7 billion hectares of which 1.1 billion by water and 0.6 billion by wind.

Soil erosion has harmfull consequences from ecological point of view because it contributes to the diminishing of the soil thickness and the reduction of the soil chemical, physical and biological features. This way, there is reduced the soil water and nutrient capacity that are vital for plant development.

The moving of the soil particles and their accumulation downwards unstable the ecosystems in a way that along with the sediments there are accumulated important quantities of nutrients as well as chemical products used for plant protection that reach streams determining eutrophication and pollution (Merot, 2008; Behrendt, 2003).

Last time, the soil erosion has increased in our country as a result of bad applying of Law 18/1991 and because of uncontrolled and distructive activity of population (Popa, 2005).

MATERIAL AND METHOD

In order to evaluate the soil and nutrient losses on eroded soils from Oltenia there was set up an experiment within 2008-2009 period at Preajba-Gorj Research Centre that belongs to the University of Craiova. Within the researching resort there were three crops: natural pasture, sown pasture and corn. All three crops have received the following fertilizer variants: not fertilized, N_{138}, $N_{138}P_{81}K_{100}$.

The soil where the trial was located is an albic stagnic luvosoil formed on clays that has the following soil profile: At 0-1 cm; Ao 1-20 cm; El(A) 20-37 cm; Ebw 37-46 cm; Btw 46-65 cm; Btw2 65-90 cm; BC 90-106 cm; CR 106-150 cm. The soil is at 355 m altitude on a 5-6% slope within subcarpathian depression of Oltenia, the fifth terrace of Jiu having as bedrock clays and herbaceous xerophytical and acidophylic vegetation with the following agrochemical features within the surface horizon: moderate acid soil reaction (pH 5.29-5.46), low supplied by nitrogen (H%=1.25%, total nitrogen 0.14%, very low supplied with phosphorus, 1.4 ppm, low supplied by potassium, 35-51 ppm, reduced content of Cu ans Zinc, of 0.86 and, respectivelly, 0.69 ppm yet well supplied by iron and manganese (38 and 41 ppm).

RESULTS AND DISCUSSIONS

The nutrients were lost by following ways:

- by eroded soil that contributes to the moving of nutrients on slope and deposition of them at the bottom of the versant in function of the erosion agents;

- along with water flow downard, these losses being direct proportional with the solubility of the nutrient;

The erosion modifies the physical and chemical features of the soil. They are more powerfull than the ones produced on physical features. The most important changes are on the nutrients content for plants: humus, nitrogen, phosphorus and potassium (Ulen, 2005).

The most important humus losses are in the shallow soil layer (0-30 cm) and this fact has as a result the diminishing of the soil structure, water permebility and, in final, the intensification of soil erosion. As a result of changing of physical and chemical soil features by erosion, there is recorded a decreasing of soil microbial activity, conducting to the decreasing of soil fertility and diminishing the yields.

Researching these losses, in 2009, there results data from tables 1 and 2. The analysis of soil and nutrient losses the leaches and erosion per hectare show the following:

- the annual rainfall in 2007 have been of 729.6 mm;
- the liquid runoff, respectivelly, the water losses on the luvosoil from Preajba – Gorj have been of 518.4-821.5 m^3/ha, representing 9.6%-13.2% of rainfall.

The lowest runoff have been recorde with the natural pasture fertilized by $N_{138}P_{81}K_{100}$, of 518.4 m^3/ha and the highest, respectivelly, of 821.5 m^3/ha were recorded with not fertilized corn. So, with the not fertilized wide row crops the water runoff is highest.

In a direct correlation with the water runoff the soil losses per hectare have been the same. This has recorded the lowest value with the natural pasture fertilized by $N_{138}P_{81}K_{100}$ as a proof that plants grew better and the roots have retained the soil better. The highest soil quantity was recorded with the not fertilized corn, of 5.26 t/ha.

The humus losses have been higher with the not fertilized corn and the lowest with the natural pasture that was fertilized by NPK, of only 0.45 t/ha.

The nutrient losses have been calculated analysing the runoff water and soil after suming these two values. This way, the nitrogen losses have recorded values between 0.82 and 4.16 kg/ha, the highest losses being recorded, again, with the not fertilized corn and the lowest with the natural pasture fertilized by NPK due to the better development of it.

The phosphorus losses are lower as compared with the nitrogen ones, of 0.029-0.126 kg/ha/year; lower values were recorded with the natural pasture and sown one, after fertilization by NPK, due to more vigurous growing of plants and root system.

The potassium losses have a little bit higher values than the phosphorus ones yet they are lower than the nitrogen ones having values of 0.21 with the natural pasture to 0.74 with the not fertilized corn.

The microelements, iron, manganese, copper and zinc have reduced values in comparison with the macroelements at the level of grames per hectare, the highest values being recorded with iron and manganese and the lowest with copper and zinc. There can be emphasized that the presence of phosphorus in the applied fertilizers contributes to the reduction of zinc, iron and manganese losses due to formation of low soluble compounds.

Also, with the case of micronutrients, the highest losses are recorded with not fertilized corn in comparison with natural or sown pasture.

CONCLUSIONS

The soil and nutrient losses were researched on a luvic soil at Preajba-Gorj researching field.

The soil losses due to erosion were reduced with natural and sown pasture, of 0.45-0.68 t/ha and high enough with not fertilized corn, of 4.72-5.26 t/ha;

The fertilizer doses, especial $N_{138}P_{81}K_{100}$ have determined a more vigurous growing of plants and the mitigation of soil losses;

Along with the surface losses there were taken away nutrients, both macroelements and microelements;

The most affected by the surface runoff was the nitrogen that is lost, annually, between 0.82-4.16 kg/ha, more with wide row crops that are fertilized with nitrogen than natural or sown pastures;

The phosphorus and potassium are lost in lower rate, reaching subunit values and lower with natural or sown pasture in comparison with wide row crops like corn;

The microelement losses have reduced values than macroelements, of grammes per hectares. The presence of phosphorus within fertilizers contributes to the decreasing of iron, manganese and zinc losses.

In order to avoid the soil and nutrient losses with slope soils there must be avoided the cropping of wide row crops.

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Table 1

Soil and nutrient losses in 2009 at Preajba – Gorj

Variant	Liquid Runoff m^3/ha	Eroded soil t/ha	Humus Kg/ha	Nitrogen kg/ha			Phosphorus kg/ha			Potassium kg/ha		
				water	soil	total	water	soil	total	water	soil	total
Natural pasture – ctrl.	571.3	0.62	13.2	0.12	0.86	0.98	0.015	0.02	0.03	0.09	0.12	0.21
Natural pasture N_{138}	533.2	0.51	12.5	0.10	0.72	0.82	0.011	0.018	0.029	0.11	0.17	0.28
Natural pasture $N_{138}P_{81}K_{100}$	578.4	0.45	10.8	0.10	0.70	0.80	0.009	0.02	0.029	0.11	0.19	0.30
Sown pasture ctrl	601.5	0.68	15.4	0.14	0.92	1.06	0.011	0.020	0.031	0.08	0.17	0.25
Sown pasture N_{138}	582.7	0.60	14.1	0.12	0.84	0.96	0.017	0.026	0.043	0.10	0.22	0.32
Sown pasture $N_{138}P_{81}K_{100}$	552.8	0.55	12.3	0.11	0.80	0.91	0.014	0.022	0.036	0.14	0.22	0.36
Corn ctrl	821.5	5.26	176.5	1.72	2.44	4.16	0.017	0.021	0.038	0.21	0.31	0.55
Corn N_{138}	794.3	5.01	157.9	1.70	2.01	3.71	0.054	0.072	0.126	0.24	0.46	0.68
Corn $N_{138}P_{81}K_{100}$	756.6	4.72	144.3	1.51	1.85	3.36	0.041	0.058	0.099	0.32	0.43	0.74

Table 2

Microelements losses (Fe, Mn, Cu, Zn) in 2009 at Preajba – Gorj

Variant	Liquid runoff m^3/ha	Eroded soil t/ha	Fe g/ha			Mn g/ha			Cu g/ha			Zn g/ha		
			water	soil	total	water	soil	total	water	soil	total	water	soil	total
Natural pasture – ctrl.	571.3	0.62	2.8	8.5	11.3	0.35	18.0	18.35	0.67	0.78	1.45	1.03	2.31	3.34
Natural pasture N_{138}	533.2	0.51	3.2	13.6	16.8	0.47	19.6	20.07	0.82	1.44	2.26	1.44	2.86	4.30
Natural pasture $N_{138}P_{81}K_{100}$	518.4	0.45	2.2	9.5	11.7	0.29	16.2	16.49	1.01	1.60	2.61	1.72	3.11	4.83
Sown pasture ctrl	601.5	0.68	1.7	12.5	14.2	0.42	17.2	17.62	0.79	1.11	1.90	1.33	2.07	3.40
Sown pasture N_{138}	582.7	0.60	2.8	21.6	24.4	0.56	20.3	20.86	1.21	3.42	4.63	1.84	2.78	4.62
Sown pasture $N_{138}P_{81}K_{100}$	552.6	0.55	2.0	18.3	20.3	0.35	15.6	15.95	1.56	4.01	5.57	1.88	3.39	5.27
Corn ctrl	821.5	5.26	11.2	64.5	75.7	0.73	116.4	117.13	2.61	5.23	7.84	2.61	13.14	15.75
Corn N_{138}	794.3	5.01	12.6	83.8	96.0	1.09	134.3	135.39	2.01	5.01	7.02	2.22	12.01	14.23
Corn $N_{138}P_{81}K_{100}$	756.5	4.72	9.3	56.4	65.7	0.66	105.2	105.86	2.25	4.54	6.69	1.84	10.58	12.42

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