THE EVOLUTION OF SOME NUTRIENTS OF STAGNIC LUVOSOIL FROM HILLY ZONE OF OLTENIA

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Abstract: *The researches have been carried out at Experimental Centre for Pastures Gorj with the aim of observing the effect of different fertilizer doses on the nutrient content of soil under several crops. There researches are in the first year in this hilly area of Oltenia and they are part of COST European Researching Program 869 regarding the ways of reducing nutrient and soil losses from soil and mitigation of ground water and surface water pollution.This paper is a novelty for this area and for our country due to the researching during two years of the evolution of the nutrient content from the soil, N, P, K, slope soil reaction in order to diminish erosion losses. The researching method has consisted of researching the evolution of soil reaction and total nitrogen, mobile phosphorus and potassium contents of a slope soil within 2009-2010 period with the following experimental variants: not fertilized control; N162P81K100 with corn; N138 with corn; not fertilized control with sown pasture; N162P81K100 with sown pasture; N138 with sown pasture; not fertilized control with natural pasture; N162P81K100 with natural pasture; N138 with natural pasture. The determinations have been made using the most advanced researching methods in Europe, according with I.C.P.A. regulations and the European Directive on soil quality. The practical implications have consisted in giving the most appropriate solutions for fertilizer applying to corn, sown pasture and natural pasture as well as for mitigation the soil and nutrient losses. The paper is original because it uses a new researching method in soil quality appreciation namely, the evolution of soil nutrient content. Thus, the paper has, both a theoretical scientifical importance in establishing the dynamics of soil nutrients in correlation with the fertilizer doses and a practical importance in order to elaborate solutions for fertilizing these crops within slope area of Gorj District.The paper is part of the Researching Project T.E. 103 nr. 118/2010.*

Key words: *stagnic luvosoil, agrochemical features, soil acidity, total nitrogen, available phosphorus, available potassium, NPK, natural pasture, sown pasture*

INTRODUCTION

Soil agrochemical features are modified by technology practices. Their long term evolution under the action of natural factors and cropping measures without fertilizers or amendaments tend to a dynamic equilibrium characterized by equalization of inputs and outputs of energy and substance (BORLAN Z., 1984). This balance determines the decreasing of nutrient concentration within soil and of free energy till minimal levels that tend to be kept constant.

Bringing free energy, the fertilizers come across with the natural process of soil evolution as much as the inputs are more frequent and important quantitatively. As a result, the soil system undergo instable termodynamic stages that are variable as time that are favorable for vegetal production (LAERMANN, 2007).

From these unstable phases, the soil tend to recover to more stable statuses with the site natural factors.

The applying of different chemical fertilizers and the decreasing of free energy take place on several ways as follows: increased absorbtion of soluble substances in plants, their removal toward depth of the soil profile, their incorporation within stable organic and mineral compounds, transforming in gases (RICHARDS, 2007).

The pollution phenomena that unfold into the soil are the result of not correlation of fertilizer aplication with the vegetal production results, the substances and the free energy that were applied are not properly used by the plants and are spread in the environment polluting it; due to this fact there is need to know the evolution of soil nutrients and its reaction (HEYZLAR, 2009).

MATERIAL AND METHODS

In order to know the evolution of some soil nutrients of stagnic luvosoil from the hilly zone of Oltenia there has been set up a stationary trial with different fertilizer doses and crops at the Experimental Centre for Pasture Preajba – Gorj. This experiment has researched the evolution of soil reaction and the soil available phosphorus and potassium contents during 2009 and 2010.

The stagnic luvosoil from Preajba Gorj is located on a 6% slope, it has a silty-sand/silty-clayey texture, a moderate to low acid reaction at the surface (pH=5.29-5.46), average supplied by nitrogen (Nt=0.14-0.17%), very low supplied by available phosphorus (P=0.35-2.27 ppm) and low supplied by available potassium (K=41.2-51.6 ppm) and an average content of micronutrients, Cu, Zn, Fe.

The clime is continental temperate, with evident mediterranean influences: the average multiannual temperature is 10.3^0C and 433.1 mm rainfall, uneven percolative, with drought during July and August.

There was researched the evolution of: soil reaction, available phosphorus, total nitrogen, available potassium with the corn, sown pasture and natural pasture of three variants from each crop: not fertilized control, N138, N162P81K100 (NPK), during 2009 and 2010.

RESULTS AND DISCUSSIONS

The evolution of soil reaction

In the natural way, without inputs, the pH value of soil decreases from the begining of spring till the middle of summer due to natural processes of nitrification into the soil that eliberate hydrogen protons and then it increases step by step till the begining of winter (BORBORIS, 2010).

The applying of chemical fertilizers, especially nitrogen determines the decreasing of the pH value (acidification)as a result of nitrification, fertilizer physiological reaction and the bases consumption along with fertilizers or their leaching as a result of combination with NO_3^- ions.

On the stagnic luvosoil from Preajba the soil reaction has had an acidification tendency both with the not fertilized variant because of rainfall that leaches the bases cations and, especially with the variants where chemical fertilizers were applied, N138 with the corn crop. There is interesting that there were recorded higher decreases of the pH values at the top of the slope than the base of it (table 1).

Table 1

The evolution of the soil reaction under different crops and fertilizer doses

Fert. dose	Corn					Sown pasture					Natural pasture				
	2009		2010		Diff.	2009		2010		Diff.	2009		2010		Diff.
	A	B	A	B		A	B	A	B		A	B	A	B	
Not fertili zed control	5.01	5.30	5.00	5.25	-0.07 -0.05	4.80	5.10	4.75	5.10	-0.05 -0.00	5.00	5.20	4.95	5.10	-0.05 -0.10
N138	5.05	5.15	4.90	5.10	-0.15 -0.05	4.95	5.10	4.80	5.00	-0.05 -0.10	4.80	5.15	4.70	5.10	-0.10 -0.05
N162 P81 K100	5.12	5.20	4.95	5.10	-0.17 -0.10	4.85	5.00	4.70	4.95	-0.15 -0.05	4.90	5.05	4.90	5.00	-0.00 -0.05

A – top of the slope; B- base of the slope

The pH value has been modified both by the fertilizers that were applied and by vegetal debris that remained from natural pasture. Under the corn crop, no matter the fertilization, at the top of the slope the total nitrogen content has decreased from 0.09 - 0.107% to 0.08-0.127% due to runoffs on slope while at the base from 0.110-0.122% reached 0.122-0.127% under natural and sown pastures, the content of total nitrogen has decreased yet less than with the corn crop. Thus, with the fertilized sown pasture it decreased from the top of the slope from 0.123 – 0.135% to 0.118-0.125% while with the not fertilized variant it has decreased from 0.124 to 0.110%.

At the bottom of the slope there was recorded with these crops, too, an increasing of the total nitrogen content due to the soil brought by erosion by 0.006-0.02% (table 2).

Table 2

The evolution of the total nitrogen content (%) under different crops and fertilizer doses

Fert. dose	Corn Nt(%)					Sown pasture Nt(%)					Natural pasture Nt(%)				
	2009		2010		Diff.	2009		2010		Diff.	2009		2010		Diff.
	A	B	A	B		A	B	A	B		A	B	A	B	
Not fertilized control	0.095	0.118	0.080	0.120	-0.015 +0.110	0.124	0.136	0.110	0.141	-0.014 +0.008	0.095	0.110	0.080	0.120	-0.015 +0.011
N138	0.101	0.118	0.080	0.122	-0.021 +0.004	0.135	0.138	0.125	0.148	-0.010 +0.010	0.101	0.118	0.080	0.122	-0.021 +0.004
N162 P81 K100	0.107	0.120	0.096	0.127	-0.011 +0.007	0.123	0.131	0.118	0.140	-0.005 +0.009	0.107	0.120	0.096	0.127	-0.011 +0.007

A – top of the slope; B- base of the slope

The evolution of the available phosphorus content.

The available phosphorus content has evolved in function of the fertilizer doses applied and the crop. Thus, with the corn crop, in 2009 it was of 7.86-10.92 ppm P at the top of the slope and 5.72-9.88 ppm P at the base of the slope, higher with the N162P81K100 dose.

In 2010 the available phosphorus content has decreased at the top of the slope and it increased at the base of the slope.

With the natural and sown pasture, in 2009, there was recorded a lower content of phosphorus at the top of the slope than at the base of the slope; this tendency was maintained in 2010. Thus, with the N162P81K100 dose, in 2009, at the top of the slope the phosphorus content was of 7.28 ppm and at the base of the slope 9.36 ppm and in 2010 at the top of the slope there was recorded a lower value, of 6.33 ppm while at the base of the slope there was recorded a higher value, of 10.22 ppm that show the phosphorus has migrated from the top of the slope toward base along with runoff.

With the not fertilized control there is recorded the same tendency (table 3).

Table 3

The evolution of the soil available phosphorus content (ppm) under different crops and fertilizer doses

Fert. dose	Corn					Sown pasture					Natural pasture				
	2009		2010		Diff.	2009		2010		Diff.	2009		2010		Diff.
	A	B	A	B		A	B	A	B		A	B	A	B	
Not fertilized control	7.80	5.77	6.27	6.54	-1.53 +0.83	7.05	7.25	5.61	8.14	-1.44 +0.89	7.80	5.77	6.27	6.54	-1.53 +0.83
N138	10.92	9.36	7.62	10.36	-3.30 +1.00	7.29	5.20	5.28	6.32	-1.42 +1.12	10.92	9.36	7.62	10.36	-3.30 +1.00
N162 P81 K100	9.88	9.88	9.10	10.41	-0.78 +0.53	7.28	9.36	6.33	10.22	-0.95 +0.86	9.88	9.88	9.10	10.41	-0.78 +0.53

A – top of the slope; B- base of the slope

The evolution of the available potassium content.

The available potassium soil content has been high as compared with the phosphorus, respectively 41-377 ppm yet, ussually, over 100 ppm that indicates a well supplied degree by potassium.

Under the corn crop the potassium content has evolved as follows:

- it has decreased from the top of the slope toward the base of the slope, from 248 to 216 ppm with the variants fertilized by NPK and from 168 to 134 ppm K with the N138 variant and from 98 to 81 ppm with the not fertilized control;

- it has increased at the bottom of the slope with all variants in 2009 as compared with 2010;

With the natural and sown pasture there was recorded the same evolution of the available potassium, its content decreasing from the top to the base of the slope at a smaller scale. Thus, with NPK at the top of the slope there were 120 ppm K in 2009 and in 2010 there were 115 ppm K while at the base of the slope there were 106 ppm K in 2009 and it reached 126 ppm K in 2010.

Table 4

The evolution of the soil available potassium content (ppm) under different crops and fertilizer doses

Fert. dose	Corn					Sown pasture					Natural pasture				
	2009		2010		Diff.	2009		2010		Diff.	2009		2010		Diff.
	A	B	A	B		A	B	A	B		A	B	A	B	
Not fertilized control	98	154	81	132	-17 -22	47	50	41	47	-5 -3	144	161	121	146	-23 -15
N138	168	190	134	165	-34 -25	100	106	84	101	-16 -5	80	198	71	184	-9 -14
N162 P81 K100	248	377	216	322	-32 -55	120	106	115	126	-5 +16	172	265	180	275	+8 +10

A – top of the slope; B- base of the slope

CONCLUSIONS

The soil reaction change in time due to climatical conditions yet, especially, as a result of applying several doses of fertilizers, mainly nitrogen; it also, changes with the not fertilized control due to leaching of bases cations.

The available phosphorus content decreases at the top of the slope yet at the base of the slope it increases due to runoff that bring fertile soil. Phosphorus losses from the top of the slope are lower with natural and sown pasture.

The potassium content on these soils show an average supplying degree and it is more taken away downward than phosphorus.

The most lost on these slope soils is the nitrogen applied as fertilizers.

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