PHOSPHORUS AND ITS MOBILITY IN THE ACID SOILS OF GORJ COUNTY

Gh. CRAIOVEANU, Violeta CARIGOIU, Lucica SÎRBU

The Office for Pedological and Agrochemical Studies, Gorj
Tg-Jiu, Calea Bucureşti nr. 75, judeţul Gorj, telefon/fax. 0253214858,
Corresponding author: OSPAGORJ@YAHOO.COM

Abstract: *The purpose of the research was establishing the quantity of mobilized phosphorus within the acid soils, the quantity of mobilized phosphorus by neutralizing the acidity and the quantity of phosphorus that must be supplementary administrated in order to reach an optimal supply for the soil. The results are a synthesis of the specific analytical data that resulted from the studies and the soil researches made at 1:10000 scale; a follow up will be made at a 1:5000 scale. The working procedures both on the field and in laboratory were created by The National Institute for Research and Development for Pedology, Agrochemistry and Environment Protection – I.C.P.A. Bucharest, and the materials that were used are the ones specified by the procedures. The update is done by the correlation between the soil acidity generally regarded and especially the mobile aluminum and the blocked phosphorus quantity. The specialized documentation underlines the fact that the acidity is blocking the phosphorus without adding any quantitative specifications. For agricultural practice the research results specify the phosphorus quantity that can come out of neutralizing the acidity, as well as the phosphorus add-ins in order to reach an optimal level in the soil. Acyditity neutralization can be done by periodical liming in the correct amounts. The amendment amount are based on agrochemical studies performed for this purpose. The importance of the present research result from the practical implications, in the sense of saving up a part of the phosphorus necessary for a certain growth (the quantity that is mobilized by neutralization), to which we must add that a range of physical and chemical indexes are also enriched. The soil chemistry data (pH,Ah,SH,Al,P), has been studied on a surface of 106476 hectares, representing the acid soil surface of Gorj County with a pH smaller than 5.8. The results can be applied for all Romanian soils that are acid due to excess mobile aluminum.*

Key words: *phosphorus mobility, aluminum, acid soils.*

INTRODUCTION

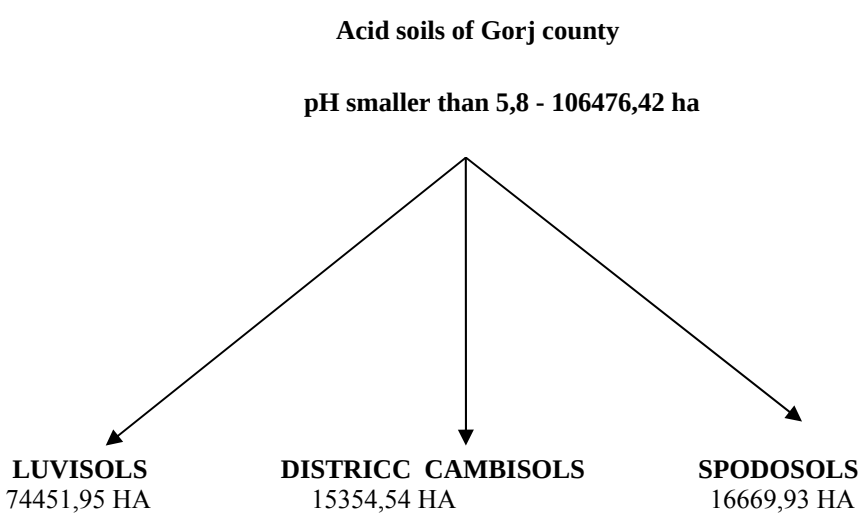
The soils that were researched are the ones with a pH that is lower than 5.8 in the first 50 cm, no matter of the way they are used in agriculture. The surface of these soils are of 106476.42 hectares and can be fount in the Romanian Classification System in three soil classes (picture 1):

- Luvisols Class – 74451.95 hectares;
- Distric cambisols Class – 15354.54 hectares;
- Spodosols Class – 16669.93 hectares;

MATERIALS AND METHOD

The methodology of working in the field and in the laboratory for obtaining the primary data were those studied by ICPA, Bucharest.

The results of this paper are those of a statistical process.



Picture 1 Acid soils of Gorj

RESULTS AND DISCUSSIONS

a. Soil acidity and the phosphorus provisioning state:

The performed analysis were: soil reaction (pH), hydrological acidity (Ah – me/100 soil g), total acidity (SH – me/100 soil g), mobile aluminium (Al – me/100 soil g), mobile phosphorus (P2O5 – ppm).

The chemical acidity indexes grouping (pH, Ah, SH) and the mobile phosphorus content has been performed on acid soil from all the three classes (Luvisols, Distric Cambisols and Spodosols) – on content domains of mobile aluminium: <0.8 me/100 g of soil, 0.81-4.00 me/100 g of soil and 4.1-10 me/100 g of soil.

In table 1 we can see that the soils of Distric Cambosols class do not have a mobile aluminium content greater than 4 me/100 g of soil, and the Spodosols Class soils do not have a mobile aluminium content greater than 0.8 me/100 g of soil.

Split on soil classes and on a total surface, the acidity indexes show a higher acidity with a higher mobile aluminium content.

It must be underlined that out of the total surface of 106476.42 hectares, 16099.10 hectares have a pH that is lower than 5, and a mobile aluminium content that is between 4.1 and 10 me/100g of soil.

The soil reaction (pH), decreases from 5.59 to 4.96 when the mobile aluminium increases from 0.51 me/100g of soil up to 6.24 me/100 g of soil (Picture 2)

The hydrolytic acidity increases from 3.8 up to 10.4 me/100 g of soil.

The total acidity increases from 4.45 up to 11.87 me/100 g of soil.

For all the three classes of soils, and for all the surface, the mobile phosphorus content decreases as long as the acidity is increasing and, especilly as far as the mobile aluminum content is increasing. For a mobile aluminum content that is lower than 0.8 me the mobile phosphorus content is of 12.12 me and decreasing step by step, getting the a mobile aluminum content that was between 4.1 -10 me/ 100 g of soil (the average of 6.24 me/100g of soil), to drop to 3.33 ppm (picture 3)

There is a ratio of mobile phosphorus blockage of 1.53 ppm for every me of aluminum.

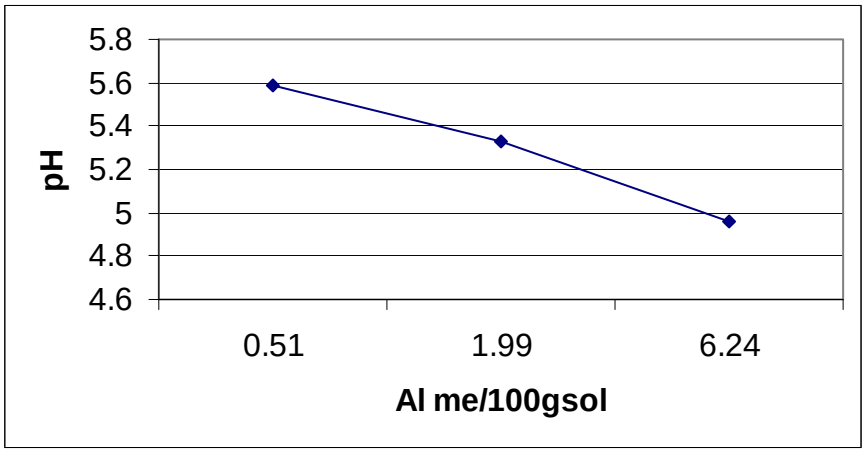
Table 1

Phosphorus mobility of the soils in gorj county taking into accout the mobile aluminium

Nr crt	Specificație	Total surface -ha-	Aluminium content – me/100 g lower then 0,8					
			pH	Ah me/100g	SH me/100g	Al me/100g	P ppm	Surface ha
1	**Total acydity soils**	106476,42	5,59	3,8	4,45	0,51	12,12	17397,44
a)	*Luvosols*	74451,95	5,54	4,1	4,43	0,55	11,10	1496,30
b)	*Districambosols*	15354,54	5,56	3,6	5,88	0,46	19,32	3301,10
c)	*Spodosols*	16669,93	-	-	-	-	-	-

continued table 1

ALUMINIUM CONTENT												
0,81-4,0							4,1-10					
pH	Ah me/ 100g	SH me/ 100g	SH me/ 100g	Al me/ 100g	P ppm	Sur-face ha	pH	Ah me/ 100g	SH me/ 100g	Al me/ 100g	P ppm	Surface -ha-
5,33	4,9	6,68	1,99	7,36	7,36	72979,88	4,96	10,4	11,87	6,24	3,33	16099,10
5,35	5,3	7,09	1,97	6,40	6,40	54119,85	4,94	10,6	12,36	6,28	3,30	6235,76
5,24	5,8	8,15	1,77	5,88	5,88	12053,44	-	-	-	-	-	-
5,38	6,1	6,40	1,80	4,42	4,42	6806,59	4,91	11,5	16,40	6,16	3,08	9863,34

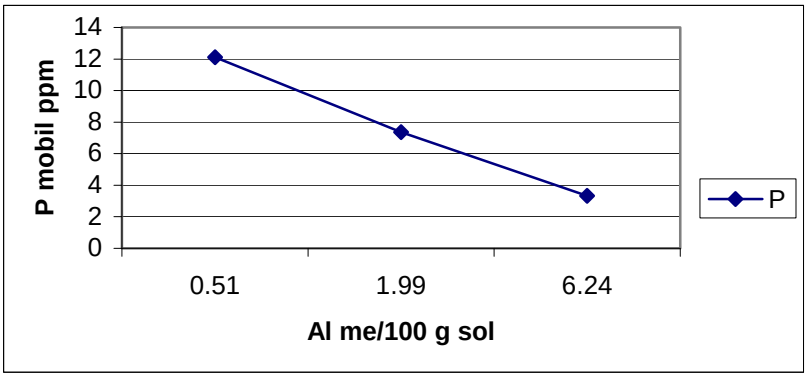


Picture 2. Soil reaction variation taking into consideration the mobile aluminum content

b. Increasing the mobile phosphorus content by neutralizing the amendment necessary and phosphorus fertilizers:

At a mobile aluminum content lower than 0.8 (0.51 me/100g of soil) and a hydrolytic acidity of 3.8 me, the amendment necessary is of 5.7 t/ha. In these conditions 0.78 ppm of the mobile phosphorus is mobilized. The supplementary necessary is of 41.1 ppm (table 2).

For mobile aluminum content between 0.81-4 me/100g of soil (1.99 me/100 g soil) and a hydrolytic of 4.9 me/100 g soil, the necessary amendment is of 11.04 t/ha. In these conditions 3.04 ppm of mobile phosphorus are mobilized.



Mobile aluminium me/100g sol 0.51 ⟶ 6.24
Mobile phosphorus ppm 12,12 ⟵ 3,33
Blocked phosphorus – 1,53 ppm/1me Al

Picture 3. The phosphorus mobility taking account the mobile aluminum content

Table 2

The influence of acidity neutralization upon the increase of the phosphorus content

Aluminium content	Acydity		Initiale P mobil ppm	Limning material	Mobilized P la 1 me Al	P mobile after neutralizing ppm	Suplementary necessary P Ppm
	Ah me	Al me					
<0,8	3,8	0,51	12,12	5,7	1,53	12,90	41,1
0,81 – 4	4,9	1,99	7,36	11,04	1,53	10,40	43,6
4 - 10	10,4	6,24	3,33	15,60	1, 53	12,87	41,13

$Al(OH)_2H_2PO_4 + OH^-$ $Al(OH)_3 + H_2PO_4^-$ ⟶

The supplementary necessary of Potassium for a normal supply is of 43.6 ppm.

For a mobile aluminum content between 4.1-10 me/100 g of soil (6.24 me/100 g of soil) and a hydrolytic acidity of 10.4 me/100 g of soil, the necessary amendments for neutralizing the acidity is of 15.6 t/ha. In these conditions, 9.54 ppm mobile phosphorus is mobilized. The supplementary necessary of phosphorus for a normal supply is of 41.13 ppm.

After neutralizing the acidity (3/4 hydrolytc acidity), the phosphorus quantity that is mobilized is rather small (and this is due to the low phosphorus content), reaching an average of 11.65 ppm.

Table 3

The necessary of phosphor fertilizer on acid soils of Gorj County

Mobile phosphorus-ppm			Phosphorus necessary Kg s.a./ha	Acydity soils ph<5,8	Total Phosphorus s.a. (tone)
After neutralizing	Optimal content	Necessary			
10,4 -12,90 (11,65)	54	41,1-43,6 (42,35)	106	106476	11286

To this possible reserve of the soil, the necessary of phosphorus fertilizer so that the soil reaches a normal supply status is of 106 kg s.a/hectare. For a surface of 106496 hectares, the total fertilizer necessary is of 11286 t s.a.

CONCLUSIONS:

- Acid soils surface in Gorj County with a pH that is lower than 5.8 is of 106476 hectares;
- Acid soils are characterized by the following acidity indexes (averages):
  - Soil reaction (pH) = 4.96-5.59;
  - Hydrolytic acidity (Ah) = 3,10-10,40 me/100 g of soil;
  - Mobile aluminum (Al) = 0.51-6.24 me/g of soil
- Phosphorus mobilization by neutralizing the acidity ratio is 1.53 ppm for 1 me Al;
- The increase in mobile phosphorus content by neutralizing the acidity is between 0.78 ppm and 9.54 ppm, meaning 1.95 kg s.a./ha up to 23.85 kg s.a./ha
- The phosphorus fertilizer necessary for a surface of 106476 hectares (a pH lower than 5.8) with acid soil is of 106 kg s.a, meaning 11280 t s.a for the whole surface.

BIBLIOGRAPHY

1. CHIRIȚĂ D. CONSTANTIN– „Ecopedologie cu baze de pedologie generală" – Editura Ceres, Bucureşti, 1974;
2. MICLĂUŞ V. - „ Solurile podzolite şi podzolice" – Editura Ceres, Bucureşti – 1970;
3. RUSU M. si colab. – „Tratat de Agrochimie" .