

Effect of CaCO_3 on the Content Macro and Micro Elements in Soil Type Pseudogley

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Pseudogleys are the soils of acid reaction, relatively small content of humus and scarce availability with phosphorous and calcium. All these seem to be limiting factors of a successful agricultural production. The experiment was set up in order to test the content of N, P, K, Ca, Mg, Mo, Zn and Cu in the pseudogley type of soil. Wheat variety Evropa 90 was sown. The readings of the elements before setting up of the experiment and those after the end of vegetation suggest a considerable impact of calcification on the differing significantly affected changes in pH all through vegetation.

Keywords: pseudogley, soil acidity, chemical elements: N, P, K, Ca, Mg, Al, Mn, Mo, Cu and Zn, calcification

Pseudogley, as a type of soil, takes up some 500.000 ha according to some pedological investigations [9, 10]. Considering a large area of pseudogley soil under inland conditions as well as a range of limiting factors of a efficient agricultural production on such a soil, an attempt was made to improve its quality and thus make it possible to efficiently grow agricultural crops. Three different treatments + control treatment, were applied to the content of N, P, K, Ca, Mg, Al, Zn, Mn to establish effects of the pseudogley calcification on such elements. Changes in pH were also estimated during the experiment.

Experimental part

Material and methods

Soil sample was taken for the experiment from the area of Gornji Milanovac that is characteristic of acid soils and agricultural production made rather difficult.

This sample was granulated and mixed with sand in the ratio 3:1, which means that, allowing for the trial proceeding under highly controlled conditions with the addition of sand, reclamation measures had been taken at the very start towards improving physical properties of soil and its mechanical composition, too. The experiment was carried out in the glasshouse of the Faculty of Agronomy in Cacak. Vegetation containers 9.6 l by volume, were used. Chemical analysis of the soil had been performed before experimentation, as well.

Experimental treatments were increasing CaCO_3 rates expressed in per cent, depending upon soil weight.

Experimental treatments are follows: Control (Preparation soil with the addition of CaCO_3); T₁ (Control + 0.1% CaCO_3 of the soil weight); T₂ (Control + 0.2% CaCO_3 of the soil weight) and T₄ (Control + 0.4% CaCO_3 of the soil weight).

In the treatments with addition of limestone (CaCO_3), granulation amounted to 0.2 mm. Limestone and soil were mixed three weeks prior to setting up of trial. Investigations lasted two years. Sowing of the wheat variety Evropa 90 was performed. The same number of the plants per vegetation container, was used. Each treatment of the experiment was set up in six replications. During the vegetation, pH value was also controlled. Chemical analysis of soil was made upon completion of picking.

The elements contained in soil were determined, as follows:

N – according to Klejdahl;

P_2O_5 and K_2O – using Al method – extraction, P_2O_5 – colorimetrically on spectrophotometer and, K_2O using atomic emission spectrophotometry;

Ca, Mg, Al, Zn, Cu, Mn and Mo – using atomic absorption spectrophotometry;

Depending upon the type of analytical procedure, the analysis of numerical indices was performed on the basis of analysis of variance;

Six significant differences between individual media of the basic factors and between all the interaction effects, were determined using Dunet test.

Results and discussions

The content of elements in the analysed pseudogley and the changes stated upon the calcification, are given in table 1.

The rates of examined macro and micro elements contained in pseudogley soil of the control treatment are in compliance with researches of Savic and Petijevic (1967) [8] for the same type of soil.

If we take a close look at the data in table 1, we can notice a differing behaviour of the elements content in the analysed soil, as the result of calcification levels applied. In general, calcification affected a differing increase in the content of all the elements in soil except Al.

The content of N, Ca, Mg, Cu, Zn, Mn and Mo indicated but a little increase with increase of Ca rates applied, whereas the content of K and P indicated the highest increase using calcification with 1 g in relation to the control treatment. The remaining calcification rates applied led to a higher content of elements, nonetheless such a content was lower than that achieved using calcification with 1 g (figs. 1 and 2).

Parallely with increase in the content of Ca, that of Al indicated an abrupt fall, taking into account that in the treatment with 2 g Ca, Al content had already been entirely immobilized.

Brkovic and Perovic (1995) [3] came to similar results stating that in the control treatment on the pseudogley soil in kosovo, the content of mobile Al was 10.6 mg/100 g of

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	Year	Control		T ₁		T ₂		T ₄		Effect of calcification		
		before after	sowing harvest	before after	sowing harvest	before after	sowing harvest	before after	sowing harvest	ΔX_1 (To-1Ko)	ΔX_2 (To-2Ko)	ΔX_3 (To-1Ko)
N	2012	0.09	0.015	0.09	0.015	0.15	0.02	0.15	0.02	0.0	+0.06	+0.06
	2013	0.09	0.014	0.09	0.015	0.14	0.02	0.15	0.02	-0.001	+0.044	+0.054
P	2012	3.61	0.60	11.49	2.08	15.89	2.55	18.23	3.03	+6.40	+10.33	+12.19
	2013	3.62	0.55	11.45	2.03	15.82	2.47	18.17	3.00	+6.35	+10.34	+12.10
K	2012	11.50	1.91	20.39	3.56	21.03	3.67	22.10	3.68	+7.24	+7.77	+8.83
	2013	11.47	1.90	20.28	3.48	21.00	3.70	22.16	3.70	+7.23	+7.23	+8.89
Ca	2012	0.70	0.11	2017	0.36	3.00	0.45	3.70	0.46	+1.22	+1.91	+2.65
	2013	0.69	0.10	2010	0.32	3.01	0.42	3.82	0.44	+1.19	+2.00	2.75
Mg	2012	1.42	0.23	2.02	0.33	2.21	0.36	2.21	0.35	+0.50	+0.70	+0.67
	2013	1.38	0.22	2.00	0.35	2.20	0.36	2.20	0.35	+0.49	+0.68	+0.69
Al	2012	13.00	10.80	4.30	3.60	0.00	0.00	0.00	0.00	-1.50	-2.20	-2.20
	2013	13.20	9.70	4.70	3.47	0.00	0.00	0.00	0.00	-2.27	-3.50	-3.50
Cu	2012	2.30	0.35	2.70	0.38	3.21	0.71	3.30	0.73	+0.37	+0.55	+0.62
	2013	2.25	0.31	2.60	0.35	3.13	0.70	3.34	0.70	+0.31	+0.49	+0.70
Zn	2012	1.90	0.31	2.37	0.56	4.00	0.71	4.41	0.73	+0.22	+1.70	+2.09
	2013	1.95	0.27	2.40	0.55	4.03	0.69	4.34	0.71	+0.17	+1.66	+1.95
Mn	2012	40.21	6.71	40.32	6.72	40.46	6.89	41.07	7.01	+0.10	+0.15	+0.56
	2013	40.10	6.70	40.25	6.71	40.30	6.79	40.70	7.00	+0.14	+0.11	+0.30
Mo	2012	0.12	0.11	0.14	0.14	0.23	0.21	0.26	0.25	+0.01	+0.01	-0.01
	2013	0.11	0.11	0.14	0.13	0.21	0.20	0.25	0.22	0.00	+0.01	+0.03

Table 1
CONTENT OF SOLUBLE ELEMENTS IN
ANALYSED SOIL AND EFFECT OF
DIFFERING CALCIFICATION RATES

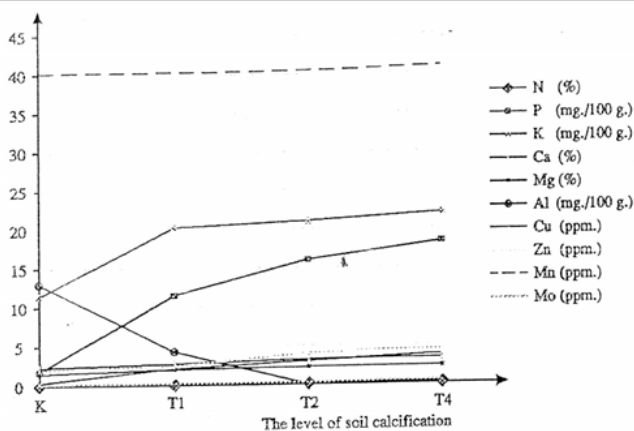


Fig. 1. Effect of calcification on the content of elements during soil preparation in 2012.

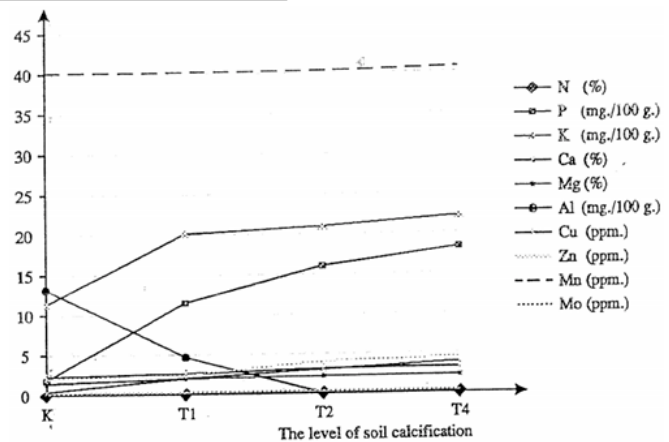


Fig. 2. Effect of calcification on the content of elements during soil preparation in 2013

At the time of measurement	Control		T ₁		T ₂		T ₄	
	H ₂ O	KCl	H ₂ O	KCl	H ₂ O	KCl	H ₂ O	KCl
On the day of setting up experiment	4.65	3.45	4.70	3.65	4.82	3.82	5.02	3.97
On the II day from setting up of experim.	4.65	3.45	4.85	3.84	4.92	3.91	5.95	4.94
On the III day from setting up of experim.	4.61	3.42	5.11	3.92	5.87	4.83	6.87	5.96
15 days after setting up of experiment	4.60	3.40	6.20	4.83	7.05	5.52	7.20	6.00
At the stage of flowering	4.60	3.40	6.18	4.81	7.00	5.48	7.20	6.00
15 days upon flowering	4.59	3.38	6.18	4.81	7.00	5.48	7.21	6.01

Table 2
RANGING OF pH VALUES DURING
VEGETATION

soil, whereas in the treatment 5 with calcification applied, Al level could not be established. The results obtained by Bašovic and Milosevic (1964); Lund (1970) and Clark (1982) [1, 7, 4] upon using calcification and alkaline NPK fertilizers also favour these findings.

According to Savic and Petijevic (1967) [8], practically no aluminum existed in the form of free ions at pH=5.0-7.0 while Al solubility noticeably increased at pH=4.5.

Calcification was also found to cause changes in pH value of the pseudogley studied.

The results of pH changes in the soil analysed throughout vegetation period, are given in Tab. 2.

From table 2, it is obvious that differing calcification rates significantly changed soil pH, excepting that in the control treatment (4.59-4.65) which remained unchanged all through vegetation. Calcification done with 1 and 2 g Ca led to a fast increase in pH from 4.6 to a neutral or moderately acid reaction (6.5-7.2), which was achieved 15 days upon setting up of the experiment, to be as such constantly maintained in the later period. Calcification with 4 g had exerted the level from a mildly acid to the neutral

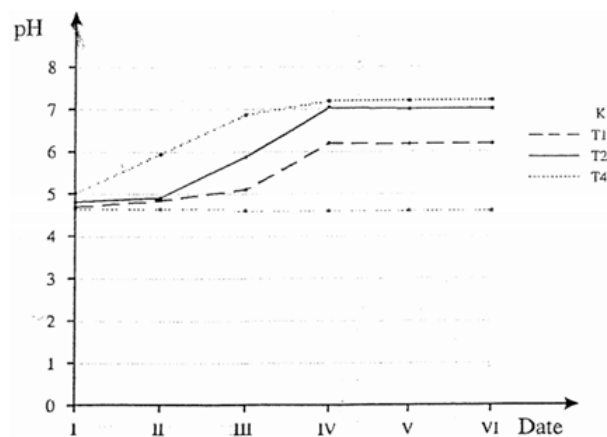


Fig. 3. Dynamics of pH (H₂O) during vegetation

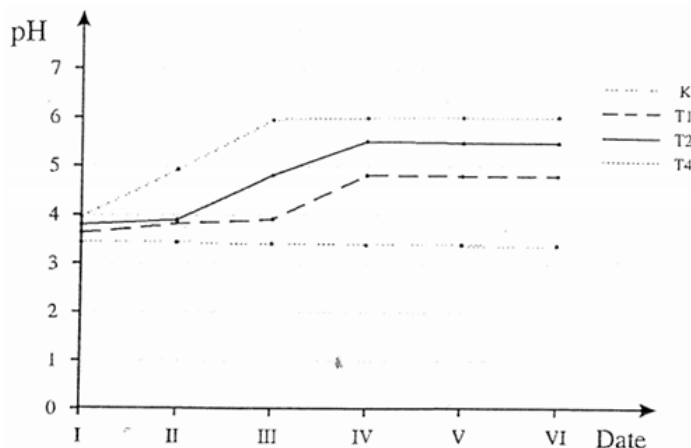


Fig. 4. Dynamics of pH (in KCl) during vegetation
 I date - pH on the day of setting up of the experiment
 II date - pH on the second day upon setting up of the experiment
 III date - pH on the third day upon setting up of the experiment
 IV date - pH on the 15th day upon setting up of the experiment
 V date - pH at the stage of flowering
 VI date - pH on the 15th day after flowering

reaction (6.87-7.2) which was, as such, maintained during a further course of vegetation.

As already mentioned, pH value of the control treatment ranged from 4.59 to 4.65 all through vegetation. By means of the chemical analysis of soil, Al was found to amount to 13.00-13.20 mg/100 g of soil, which may as well be compared with results obtained by Kamprath (1970); Dugalić (1998); Bokan (1999) and Clark (1982) [2-6] with an emphasis on Al as a dominant cation in the adsorptive complex of acid soils of pH=5 or less than that.

Conclusions

Based upon detailed, 2-year studies on the effect of the soil calcification on improving pseudogley acidity, it may be inferred that, except Al, all the chemical elements studied have shown an expressed rising tendency at soil calcification with 1 and 2 g CaCO₃ per 1 g of soil. However, Al has shown an expressed declining tendency meaning that soil calcification with more than 2 g CaCO₃ per 1 g of soil had entirely immobilized this element.

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