RESULTS CONCERNING THE NUTRIENT SOIL CONTENT ON SOIL TREATED WITH INDUSTRIAL RESIDUES

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Abstract: *The study presents the results of soil treatment with industrial mineral residue on the nutrient soil content. Two industrial residues were tested by treating luvosoil, a low fertile acid soil, with different doses of residue. These two mineral sources have resulted from the magnesium products industry and contain in their composition magnesium and calcium as well as low contents of trace elements such as iron, copper, manganese and zinc. The residues have resulted in the industrial process of manufacturing magnesium compounds from dolomites. The difference between the two residues types lies in the double magnesium content, established for the wall crusts of the reactor. Because of their alkaline reaction and nutritive elements content, the two residue types can be revaluated in agriculture. The experimental alternatives consist of four different doses from each residue, without or with nitrogen addition (ammonium nitrate) to the soil. In order to establish the effects of soil treatment with residue, the available content of soil nutrients were determined. The available nutrient soil content was analysed by using the EDTA extraction method for calcium and magnesium along with atomic absorption spectrophotometry. After extraction by Egner-Riehm-Domingo method phosphorus was determinated by UV-VIS spectroscopy and potassium by atomic absorption spectroscopy.The trace elements were analysed using the acid mixture digestion method followed by absorbtion spectrometric determination. The results show that increasing the residue doses, the available potassium content rises. Nitrogen supplement increase the potassium content till 49%.The available calcium content rises proportional with the administered residue doses for both types. Nitrogen contribution increases the values by 13% for residue A and 63 % for residue B. The dynamics of available magnesium content is similar to that of calcium. The increases represent 20 % for residue A and 75% for residue B. The originality of this paper consists in the utilization of the residues resulted from the magnesium products industry in agriculture as soil fertilizer. The importance of this study lies in the fact that, on the basis of the obtained results, a new technology to improve soil quality can be conceived by specifying the suitable dose, usage manner and application frequency of the tested residues. The usefulnes of the research is represented by the utilization of large amounts of residues, obtained from the magnesium compounds industry,as fertilizer for low fertile soils.*

Key words: *fertilizer, mineral residues, soil, available nutrient content, soil quality*

INTRODUCTION

The industrial process of manufacturing magnesium compounds, from dolomites by carbon dioxide leaching, generate important amounts of residues (TAUBERT, 2001; TAUBERT, 2002). The composition of these residues includes precipitated calcium carbonate and magnesium carbonates (in ratio of 3:1 till 4:1) as well as impurities from the raw material, such as iron, manganese, copper and zinc (RADULESCU et al., 2005; TAUBERT et al., 2006).

The alkaline reaction and the important mineral content – essential and trace elements – of these waste can be valuated in agriculture as soil amendment and fertilizer for acid soils with low fertility (RADULESCU et al., 2007; TAUBERT et al., 2008; TAUBERT et al., 2008).

The main objective of this study is to present the influence of residue type and doses on the nutrient soil content. The paper reports the effects of two residue types and several doses on luvosoil, with or without nitrogen contribution. Two types of addings were experimented, one resulted as waste from the industrial process (A) and the second one moulded as crusts deposed on the equipment walls (B).

MATERIAL AND METHODS

Luvosoil, having a pH of 6.65 and a rather low fertility was collected, air-dried, crushed, mixed and put into pots, each containing 1 kilogram soil. The soil was treated before sowing with two types of residue in different amounts, having the compositions presented in table 1.

Table 1.

Composition of the experimented industrial mineral residues

Specification	Waste A	Crusts B
Ca content, %	28	19
Mg content, %	7	14
Fe content, mg/kg	1850	880
Cu content, mg/kg	1.9	51
Mn content, mg/kg	136	51
Zn content, mg/kg	2.6	50

The experimental alternatives pursued by this research consist of four different doses for each residue (A_1 - A_4 ; B_1 - B_4) and also a control alternative (C_0) consisting of untreated soil. The description of the experimental alternatives is presented in table 2.

All the experimental alternatives took place in three replicates, one being without nitrogen treatment (R) and the other (R_N) treated with 134 mg N/kg soil as ammonium nitrate. All the pots were sown with thirty wheat grains. The vegetation period pursued was that of green plant representing twelve weeks, in order to establish the influence of the residue treatment on soil nutrient content.

In order to establish the effects of soil treatment with residue on soil, the available content of soil nutrients was determined.The analysed soil nutrients were phosphorus, potassium, calcium, magnesium as essential nutrients and iron, manganese, copper and zinc as trace elements.Calcium and magnesium soil content were analysed by using the EDTA extraction method along with atomic absorbtion spectrophotometry.After extraction by Egner-Riehm-Domingo method phosphorus was determined by UV-VIS spectroscopy and potassium by atomic absorbtion spectroscopy.The trace elements were analysed using the acid mixture digestion method followed by absorbtion spectrometric determination.

RESULTS AND DISCUSSION

Results regarding the essential nutrient content in soil as a result of the residue treatment , in accordance with the experimental alternatives shown in table 2, are presented in table 3. R represents the average values of the three replicates without nitrogen contribution and R_N the average values of the three replicates treated with nitrogen supplement as ammonium nitrate.

Table 2

Description of the experimental alternatives

Experi-mental alternative		N contrib. mg/kg	Mineral supplement / kg soil						
			Dose Mg	Ca mg	Mg mg	Fe mg	Mn µg	Zn µg	Cu µg
A_1	R	-	179	50	13	0.33	24.3	0.47	0.34
	R_N	134	179	50	13	0.33	24.3	0.47	0.34
A_2	R	-	357	100	25	0.66	48.7	0.93	0.68
	R_N	134	357	100	25	0.66	48.7	0.93	0.68
A_3	R	-	714	200	50	1.32	97.4	1.86	1.36
	R_N	134	714	200	50	1.32	97.4	1.86	1.36
A_4	R	-	1429	400	100	2.64	194.7	3.72	2.72
	R_N	134	1429	400	100	2.64	194.7	3.72	2.72
B_1	R	-	263	50	37	0.23	13.4	13.2	13.4
	R_N	134	263	50	37	0.23	13.4	13.2	13.4
B_2	R	-	526	100	74	0.46	26.8	26.4	26.8
	R_N	134	526	100	74	0.46	26.8	26.4	26.8
B_3	R	-	1053	200	147	0.93	53.6	52.6	53.6
	R_N	134	1053	200	147	0.93	53.6	52.6	53.6
B_4	R	-	2105	400	295	1.85	107.3	105.2	107.3
	R_N	134	2105	400	295	1.85	107.3	105.2	107.3

The results show an increase of the available potassium soil content, between 10-49%, for all the alternatives treated with residue B and nitrogen addition. The available calcium content rises proportional with the administered residue dose for both types. Nitrogen contribution increases the values by 13% for residue A and 63% for residue B. The dynamics of available magnesium content is similar to that of calcium. The increases represent 20% for residue A and 75% for residue B, for the alternatives with nitrogen supplement. The highest experimented waste dose (A_4, B_4) improves significant the available calcium and magnesium content.

The presence and dose of residues in soil and their trace elements content affects the available trace elements soil content. The results presenting the influence of residue type and doses on available trace elements in soil content are shown in table 4.

A low increase of iron content was established only for the alternatives treated with residue B and nitrogen supplement, representing 9% (B4). An increase of the manganese soil content was established only for the alternatives with residue B and nitrogen contribution, representing 18% (B3). Opposite to the manganese soil content, the available zinc content in soil was considerable only for the alternatives treated with residue A and nitrogen supplement . The highest value show an increase of 44% (A3). A similar situation to the manganese soil content, was found for the available copper soil content. Only the alternatives treated with residue B and nitrogen supplement generated an increase of the soil content (20%- B3).

Table 3

Effects of residue treatment on soil available macroelements content

Experimental alternative		P content		K content		Ca content		Mg content	
		ppm	%	ppm	%	ppm	%	ppm	%
C_0	R	16.99	100	129.1	100	2315	100	392.3	100
	R_N	19.02	100	87.58	100	2204	100	357.3	100
A_1	R	19.97	118	118.3	92	2410	104	394.4	101
	R_N	15.88	83	93.86	107	2268	103	365.2	102
A_2	R	17.93	106	112.8	87	2423	105	396.0	101
	R_N	18.33	96	90.22	103	2282	104	374.7	105
A_3	R	15.57	92	117.9	91	2601	112	443.0	113
	R_N	17.63	93	94.87	108	2334	106	399.9	112
A_4	R	17.75	104	97.50	76	2396	103	420.6	107
	R_N	18.53	97	85.49	98	2491	113	429.9	120
B_1	R	14.79	87	105.9	82	2153	93	361.8	92
	R_N	13.92	73	96.62	110	2245	102	359.0	101
B_2	R	17.83	105	106.3	82	2362	102	420.9	107
	R_N	15.79	83	116.2	133	3135	142	519.5	145
B_3	R	20.76	122	141.6	110	3403	147	556.1	142
	R_N	17.05	90	119.5	136	3148	143	499.3	140
B_4	R	22.27	131	134.1	104	3579	155	592.5	151
	R_N	16.04	84	130.6	149	3585	163	624.5	175

CONCLUSIONS

1. Considering the obtained results, the two experimented industrial residues can be used in certain doses, with or without nitrogen supplementation, as fertilizer to enrich the nutrient soil content.

2. The considerable content of magnesium and calcium in the residue composition induces in soil the available nutrient content for a balanced plant nutrition.

3. Because of their composition, both residue types can be used as fertilizer containing calcium and magnesium , as well as trace elements such as iron, manganese, copper and zinc. The enhance of the available essential and trace elements in soil content by treating soil with the suitable residue dose intensifies it's role as fertilizer.

4. In accordance with the upper results, treating soil with residue B in presence of nitrogen contribution ,enriches meaningful the soil available macro- and trace element content.

Table 4

Influence of residue type and doses on available trace elements soil content

Experimental alternative		Fe content		Mn content		Zn content		Cu content	
		ppm	%	ppm	%	ppm	%	ppm	%
C_0	R	350.7	100	51.90	100	35.39	100	4.167	100
	R_N	353.9	100	44.30	100	30.65	100	4.053	100
A_1	R	344.8	98	47.95	92	28.50	81	3.745	90
	R_N	355.7	101	45.12	102	27.54	90	3.894	96
A_2	R	367.9	105	45.14	87	34.82	98	3.930	94
	R_N	362.4	102	44.62	101	39.36	128	3.842	95
A_3	R	336.3	96	45.68	88	27.62	78	3.824	92
	R_N	346.4	98	46.02	104	44.21	144	3.963	98
A_4	R	347.0	99	45.86	88	31.89	89	3.920	94
	R_N	359.2	102	47.53	107	33.70	110	4.206	104
B_1	R	330.2	94	54.34	105	33.70	95	3.495	84
	R_N	255.7	72	32.86	74	34.36	112	2.715	67
B_2	R	373.6	107	49.36	95	34.80	90	4.747	114
	R_N	370.6	105	47.47	107	29.51	96	4.30	106
B_3	R	366.5	105	54.46	105	33.83	96	4.236	102
	R_N	373.6	106	52.24	118	33.14	108	4.848	120
B_4	R	372.1	106	49.05	95	32.97	93	4.473	107
	R_N	385.4	109	49.10	111	29.56	96	4.702	116

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