COPPER MINING WASTE, A SOURCE OF OLIGOELEMENTS FOR AGRICULTURE

B. BORCEAN, L. BOTOŞ

Banat's University of Agricultural Science and Veterinary Medicine„King Michael I of Romania" from Timisoara

300645,Timişoara, Calea Aradului 119, România;carmendanet@yahoo.com

Abstract. *The examined material is the mining waste resulted from the banatite mining exploitations in South -Western Romania – Sasca Montană – Moldova Nouă region. This waste material contains important amounts of microelements (manganese, cobalt, boron, molybdenum, copper, zinc and others) and macro-elements (phosphorus, calcium, magnesium, sulphur). At the moment, the material is deposited in waste dumps of thousands of tones. It results of this paper that this mining waste contains mainly compounds of silicon (31.89%) and calcium (13.13%), followed by iron (5.32%) and aluminium oxides (1.25%) and sulphur (1.42%). The content of oligoelements found in the samples analyzed by I.C.I.M. Bucharest varies as follows: Copper 0.08 -0.1%, magnesium 1.7 – 2.4%, molybdenum 0.004 – 0.005%, zinc 0.02 – 0.07% and others. The graded composition of the material in the mining waste is: gravel 10%, coarse gravel 25%. The researches regarding the use of this material in agriculture were carried out on the territory of Sasca Montană, a region where the average annual temperature is of 11.5 °C according to the Meteorological Station Oraviţa and the annual precipitations are of 680 mm. The area belongs to the moderate temperate continental climate of Banat sub-type with submediterranean nuances. The mining waste was analysed on two cultures, maize and triticale. The soil type is a stagnic preluvosoil, having a poor acid reaction of between 0 – 160 cm (pH-5.71), with a moderate humus reserve. The effect of using 1 tone mining waste under the conditions of a differentiated fertilization with $N_0P_{50}K_{50}$, $N_{60}P_{50}K_{50}$, $N_{120}P_{50}K_{50}$ and $N_{180}P_{50}K_{50}$ was studied for both crops. The average increase in crop registered for the fertilization levels due to the use of mining waste was of 30% for triticale and of 22% for maize grains. The nitrogen fertilizers were well used by both cultures, both on a mining waste basis, and on a basis without mining waste. The average triticale crop for the two cultivation variants increased with 44% for the variant fertilized with N_{60}, with 87% for the variant fertilized with N_{120} and with 118% for the variant fertilized with N_{180}, under the conditions of a uniform fertilization with $P_{50}K_{50}$. For maize the crop increase when fertilized with nitrogen was of 56% for the variant fertilized with N_{60}, of 90% for the variant fertilized with N_{120} and of 121% for the variant fertilized with N_{180}. The fertilizers were better used on a base of mine waste, because of the calcium contained in the material which partially neutralized the soil acidity.*

Key words: *banatite mine waste, source of oligoelements for plants.*

INTRODUCTION

The analyzed material is the mining waste resulted from the banatite mining exploitations in South -Western Romania. The material contains important amounts of oligoelements, as well as macro-elements necessary for plants.

The material deposited in Sasca Montană, Caraş Severin County, in a waste dump of thousands of tones, may be used in agriculture, its heavy metals content being between the limits admitted by the Experts Committee of the Public Health Department in Berlin.

The graded composition of the mining waste used is the following: gravel 10% and coarse gravel 25%. To be noticed, regarding the chemical composition, are the compounds of silicon (31,89%) and calcium (13,13%), followed by iron (5,32%) and aluminium oxides (1,25%), sulphur (1,42%).

The content of oligoelements found in the samples analyzed by I.C.I.M. Bucharest varies as follows: Copper 0,09 -0,1%, magnesium 1,5 – 2,3%, molybdenum 0,003 – 0,005%, zinc 0,01 – 0,06% and others.

Until the material will be used either by re-flotation, in the industry, or as source of oligoelements in the agriculture, the mining waste negatively affects the environment by: polluting the air as the wind spreads the fine material from the surface of the mine waste; polluting the surface and underground waters; affecting the health of plants, animals and human beings.

The negative effects of the particles spread by the draught on the pants consist in injuring their epidermis and, by doing this, causing an assimilation surface shrinkage. The negative effects on the human being consist in affecting the mucous membrane of the alimentary tract and of the respiratory system.

MATERIAL AND METHODS

The chemical composition of the mining waste according to I.C.I.M. Bucharest is given in Table 1.

Table 1

The element content of mining waste from Sasca Montană

Element	The content in % in the mining waste	
	Test 1	Test 2
Si	41	53
Al	2	11
Fe	1,5	5
Ti	0,2	0,25
P	0,08	0,06
Ca	25	32
Mg	2,4	1,7
Mn	0,11	0,09
S	0,30	0,47
As	0,001	0,003
Bi	0,1	0,005
Mo	0,004	0,004
Cu	0,1	0,08
Zn	0,07	0,02
Cr	0,002	0,004
Ni	0,001	0,002
H_2O	8,0	9,0

There have also been detected tracks of B, Pb, Cd, Se and Ag.

The experiments were done on a soil of the type stagnic preluvosoil having a pH value of 5,71 and a humus content of 3,18%. The tests were done by OSPA Timișoara.

The experiments were bifactorial, organized according to the subdivided plot method, with three repetitions and the following factor graduations:

A Factor – the mining waste quantity used on a base of $P_{50}K_{50}$; a_1 – Mt – mining waste O; a_2 – mining waste 1 t/ha.

B Factor – the nitrogen dose: b_1 - N_0 ; b_2 – N_{60}; b_3 – N_{120}; b_4 – N_{180}.

RESULTS AND DISCUSSIONS

The triticale crop results are presented in Table 2.

The year was climatically favourable for the triticale crop.

The use of mining waste in doses of 1 t/ha, determined a 30% crop increase as an average for the tested fertilization levels, that means an increase with 556 kg/ha, this being, statistically, a very significant difference.

The nitrogen fertilizers used on a constant base of P50K50 were very well used. By using a dose of N60 there has been obtained a crop increase of 44 %, increase which was amplified by the dose of N120, reaching 87%. The highest crop increase was of 118 %, obtained by using the highest dose of nitrogen, which was of N180

The crop differences for all variants of fertilization with nitrogen were very significant as compared to the reference variant, which was not fertilized with nitrogen.

Table 2

Crop results obtained for triticale

A Factor Mining waste dose	B Factor B – nitrogen fertilization level on a base of $P_{50}K_{50}$				Average factor A			
	N_0	N_{60}	N_{120}	N_{180}	Crop Kg/ha	%	Difference Kg/ha	Significance
Mt. Mining waste 0	1105	1611	2151	2530	1849	100		
1 t/ha mining waste	1515	2175	2748	3195	2408	130	559	XXX

DL5% = 173 kg/ha
DL 1% = 214 kg/ha
DL 0,1% = 332 kg/ha

Average factor B

Specification	N_0	N_{60}	N_{120}	N_{180}
Crop kg/ha	1310	1893	2449	2862
%	100	144	187	218
Dif. Kg/ha	-	583	1139	1552
Signification	-	XXX	XXX	XXX

DL 5% = 125 kg/ha DL1% = 168 kg/ha DL0,1% =234 kg/ha

The results obtained for maize grains are given in Table 3.

The presented data underline the favourable effect of the mining waste on the maize crop. The average crop increase for the fertilization levels was of 22%, which means a crop difference of 736 kg/ha, that is, statistically, a very significant difference.

The nitrogen fertilizers used in average on the two agrofonds on a constant base of $P_{50}K_{50}$ increased the crop with 56% in the variant fertilized with N_{60}, with 90% in the variant fertilized with N_{120} and with 121 % in the variant fertilized with N_{180}.

The crop differences as compared to the reference variant were very significant, that is of 1250 kg/ha in the variant fertilized with N_{60}, of 2011 kg/ha in the variant fertilized with N_{120} and of 2680 kg/ha in the variant fertilized with N_{180}.

The high crop increase for the variants fertilized with nitrogen can be explained by the neutralization effect on the soil acidity generated by the mining waste having an alkaline reactivity.

Table 3

Crop results obtained for maize grains

A Factor Mining waste dose	B Factor – Nitrogen fertilization level on a base of $P_{50}K_{50}$				Average factor A			
	N_0	N_{60}	N_{120}	N_{180}	Crop kg/ha	%	Difference Kg/ha	Significance
Mt. Mining waste 0	1750	2990	4008	4601	3337			
1 t/ha mining waste	2690	3950	4455	5200	4073	122	736	XXX

DL5% = 235 kg/ha
DL 1% =281kg/ha
DL0,1% =344 kg/ha

Average factor B

Specification	N_0	N_{60}	N_{120}	N_{180}
Crop kg/ha	2220	3470	4231	4900
%	100	156	190	221
Dif. Kg/ha		1250	2011	2680
Significations		XXX	XXX	XXX

DL 5% =178kg/ha DL1% = 239 kg/ha DL 0,1 =305 kg/ha

CONCLUSIONS

The mining waste resulted from the banatite exploitation in Sasca Montană region, deposited in waste dumps of thousands of tones, represents at the time an important source of pollution for the surface and underground waters, as well as for the air, plants and animals.

Its oligoelements and macro-elements content shows that it can be used in agriculture, as its heavy metals content is within the limits admitted by the European Community.

The use of an average dose of 1 t/ha for the tested fertilization levels (N_0, N_{60}, N_{120} and N_{180} used on a constant base of $P_{50}K_{50}$) increased the triticale crop with 30% and the maize grains crop with 22%.

The fertilizers used on the agrifond containing mining waste were well used by both cultures, because of the alkaline reaction of the mining waste used on a soil having an acid reactivity.

BIBLIOGRAPHY

1.AVARVAREI I., ,DAVIDESCU V., MOCANU R., GOIAN .M , CARAMETE, C., RUSU M., Agrochimie, Ed.Sitech, 1997,p.168-188.

2. BORCEAN I., BORCEAN .A., GOIAN M., Mine sterile of banatite from the southern part of Banat country, a valuable amendment and source of elements. Proceedings of the Symposium Restoration Ecology Timișoara. Ed.Orizonturi Universitare, 2001, p.98.

3.GOIAN M., BORCEAN I., PÎRȘAN P., Surse minerale de oligoelemente. Lucr.șt.USAMVB Timișoara, vol.XX, 1992.

4. MUNTEAN L.S., BORCEAN I., AXINT M., ROMAN GH., Fitotehnie. Ed. Didactică și Pedagogică, București 1995 p.70-120,158-183, 230-240.

5. ROGOBETE GH., ȚĂRĂU D., Solurile și ameliorarea lor. Harta solurilor Banatului. Ed. Marineasa, Timișoara, 1997, p.166-173