THE INFLUENCE OF BANATITE MINING STERILE ON THE BEAN AND POTATO CROPS ON A TYPICAL PRELUVOSOIL FROM MOLDOVA NOUA

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Mining sterile from banned exploitations in South-West Romania contains considerable amounts of trace-elements (Mn, Mo, Cu, Zn, etc.) and macro-elements (Ca, Mg, S, and P) that ca be valorised on agricultural crops. Alkaline reaction of the material recommends it for applications on acid reaction soils. This paper presents results obtained for bean grains and potato by applyng a dose of mining sterile on a constant phosphorus and potassium background P_{60} K_{60} *and* P_{100} K_{100} *on the harvest.*

Key words*: mining sterile, micro-elements, macro-element*

In the 2006 - 2008 period research were carried out which aimed to find an answer wheather the sterile banned material resulting from the mining company Moldova-Noua, can be capitalized as a source of trace and macroelements for the agricultural crops.the study for this problem was possible because the material is not radioactive,and the heavy metal content is below acceptable limits throughout Europe.

In favor of using in agriculture this residual material is its alkalin reaction, due to both the high calcium content and the floatation carried out with basic elements.Because of that the mining steril can be used with good results in order to correct the acid soil reaction from the west area of the country, maintaining the control for the content of havy metals.

MATERIAL AND METHOD

a**) Banatite sterile**

The results of the chemical composition of the mining sterile from Moldova –Noua analyses carried out by I.C.I.M.Bucureşti are presented in the *table 1.4.*

The results of the analysis confirm that the material may be used in agriculture as the havy metals content is within the admitted limits.

Predominant are the silicium (31.89 %) and the calcium (13.13 *%)*compounds, followed by ferrum (5.32 %) and the alluminium oxydes (1.25 %).

Granulometric composition of the dumps material: gravel: 10%; coarse grained sand: 25 %; fine sand: 55 %; dust: 10%.

Table 1

Chimical composition of the dump steril

Number of. sample	Chemical elements in procenage of the total substance												
	Cu	Fe	S	TiO_2	Va	Pb	Zn	Cd	Ra	CaO	SiO_2	Al_2O_3	Total
1	0,11	7,23	2,26	0,15	0,017	1,0	0,09	0,001	0,104	20	31,61		61,27
2	0,12	5,47	1,79	0,23	0,30	1,0	0,05	1,0		24	31,56		63,46
3	0,13	5,56	3,80	0,77			0,12	1,0	1,0	18	33,75		60,33
4	0,90	6,40	0,45	0,37	0,020	traces	0,01	0,001	0,002	15	32,65		54,54
5	0,07	3,83	0,61	0,31	0,020	0,01	0,06	traces	0,003	24	32,70		61,00
6	0,09	4,40	0,71	0,24		0,001	0,06	1,0		4	30,39		40,18
7		5,28	1,02	0,36	*						32,12	5,67	43,43
8		4,40	0,71	0,24							30,32	4,32	39,35
Media	0,08	5,32	1,42	0,33	0,01	0,25	0,05	0,38	0,14	13,13	31,89	1,25	54,25

**T he rest until 100% represents water and inert material difficult to determinate.*

b) Soil

The soil type on wich the experiments were carried out is tipical preluvosoil clay-dusty,clay-loam soil, on clays from Moldova-Noua.

Morphological caracters.

Ao 0-24 cm moist yellowish brown (10YR5/4), dry light yellowish brown (10YR6/4) fine granulated disturbed thrught cultivation clay loam point form feromanganese stains,rare cropolites, freqvent slim roots, ferm humid soil, dry rigid soil small very freqvent pores, weak elastoplastic soil, weak adezive soil, weak compact soil slightymoist, clear boundary.

AB 24-45cm moist yellowish brown (10YR4/4), dry yellowish brown (10YR5/4), subangular polyedric,mean moderated developed soil, mean clayey, point form feromanganese stains, rare cropolites, freqvent slim roots, wet friable, dry rigid, freqvent mean pores, weak elastoplastic soil, weak adezive soil, weak compact soil, slightymoist, clear boundary.

Bt_1 45-78 cm moist yellowish brown (10YR5/4), dry light yellowish brown (10YR5/8), prismatic mean soil dezvolted, dusty clay earthen, point form feromanganese stains, freqvent slim roots, wet friable , dry rigid , freqvent mean pores,weak elastoplastic soil, weak adezive soil, weak compact soil, slightymoist, clear boundary.

Bt_2 78-115 cm moist light yellowish brown (10YR5/8), dry yellow brounish (10YR6/6), prismatic mean soil dezvolted, mean clay-loamy, point form feromanganese stains , freqvent slim roots, wet friable , dry rigid , elastoplastic soil , weak adezive soil, weak compact soil, slightymoist, clear boundary.

c) Experiment field of the potato and bean cultures

The experiments were of bifactorial type with three repetitions. The factors graduation for the bean culture was the following:

Factor A – The mining sterile quantity applied on a constant $P_{60}K_{60}$ background:

- a_1 - Mt. - sterile 0 $P_{60}K_{60;}$
- a_2 - steril e1 t/ha $P_{60}K_{60}$;
- a_3 - sterile 2 t/ha $P_{60}K_{60}$;
- a_4 - sterile 3 t/ha $P_{60}K_{60}$.

Table 2

Chemical and physical characteristics of the clay - dusty and clay-loamy preluvosoil in the Moldova Noua clays

Horizons	Ao	AB	Bt_1	Bt_2
Depths (cm)	0-24	24-45	45-78	78-115
Coarse grained sand (2.0 – 0.2 mm) %	0,6	0,5	0,4	0,3
Fine sand (0.2 – 0.02 mm) %	38,0	38,8	26,1	35,5
Dust (0,02 – 0,002 mm) %	33,2	31,7	38,3	25,1
Argilă loam(under 0.002 mm) %	28,2	29,0	35,2	39,1
Texture	LP	LL	TP	TT
Density (D g/cm^3)	2,48	2,43	2,51	2,52
Apparent density(DA g/cm^3)	1,29	1,26	1,31	1,29
pH in H_2O	5,60	6,25	6,60	6,70
Carbonates ($CaCO_3$ %)	-	-	-	1,1
Humus (%)	2,55	2,13	-	-
No. of bacteria: mil/100 g sol uscat	-	-	-	-
Total nitrogene (%)	0,108	0,094	-	-
Mobil phosphorous (ppm)	28	28	-	-
Assimilable potassium (ppm)	100	100	-	-
Exchange bases (S_B me la 100g sol)	23,9	14,1	13,8	14,9
Exchangable hydrogene (S_H me la 100 g sol)	2,3	1,8	2,3	2,0
Cationic exchange capacity (T me la 100g soil)	26,2	15,9	16,1	16,9
Saturity degree of the bases aţie în baze (V %)	91,2	88,7	85,7	88,2
Na^+ (me la 100 g soil)	-	-	-	-
Exchangeble Na^+ (% din T)	-	-	-	-

Factor B – nitrogene doses*:*

- b_1-No;
- b_2-N_{50};
- b_3-N_{100}.

The used variety was Ardeleana.

The former plant was the winter wheat culture.

The phosphorous and potassium fertilizators as well as the sterile were applied under the summer tilling at a depth of 20-22cm.

The sawing was carried out in the third decade of April, when the soil temperature was 8 - 10°C.

On the sawing day the seed was treated with Nitagin, 4 doses for the seed quantity per ha.\The sawing c was carried out in simple rows, at 50 cm distance, at a sawing depth of 4-5 cm with a grain density of 45 germinable grains/m^2.

The experiments were of bifactorial type with three repetitions for the potato culture. The factors graduation was the following:

Factor A – the sterile mining quantity applied on a constant $P_{100}K_{100}$.found:

- a_1 - Mt. - steril 0 $P_{100}K_{100}$;
- a_2 - steril 1 t/ha $P_{100}K_{100}$;
- a_3 - steril 2 t/ha $P_{100}K_{100}$;
- a_4 - steril 3 t/ha $P_{100}K_{100}$;

Factor B –nitrogen dose:

- b_1-No;
- b_2 –N_{100};
- b_3 - N_{200};
- b_4 - N_{300}.

The used variety for potato was Desiree wich was grown in the area of autumn-winter consumption.

The potato crop was planted preceding wheat crop .Summer plowing was performed at a deph of 30 cm.

By that plowing was incorporated into the soil, fertilizers with phosphorus, potassium and mining sterile.

Planting was conducted when 10 cm soil temperature was achieved by 6 to 8 ° C. The distance between rows was 70 cm and planting depth was 4-6 cm, over which was formed a bilon with a height of 15-17 cm .

Planting density was 55,000 nests / ha. Before shooted the erbicid used was Gesagard 4 kg/ha.

RESULTS AND DISCUSSIONS

In *table 3* are presented the synthesis results recorded at the bean culture in the application of mining sterile banatite and fertilization with N, P, K.

With reference to the influence of climatic conditions, follow that the most favorable year was 2006 and the worst was in 2007.

The micro and macroelements content of mining sterile was well capitalized by bean culture.

Thus, by application of 1 t / ha sterile $P_{60}K_{60}$ on constant background,on the average levels of nitrogen, was obtained a yield increase of 38% respectively a yield increase by 242 kg / ha.

Doubling the dose of sterile, gain value increased from 58%. The largest gain of 95% and the largest difference in harvest about 608 kg / ha were achieved on a background of 3 t / ha mineing sterile.

Nitrogen fertilizer were well capitalized, crop growth was 28% at the dose of N_{50} and 41% by applying the dose of N_{100}. Differences in harvest of 216 kg / ha and 317 kg / ha are provided as very significant statistically.

In conclusion, in the reference area the largest bean crops are obtained by applying together 3 t / ha sterile, with $N_{100}P_{60}K_{60}$.

In *table 4* are presented the synthesis results of the experimental cycle about influx of mining sterile and chemical fertilization on potato.

With reference to the influence of climatic conditions, the results reveal that in 2006 and 2008 harvests were obtained at close levels as a result of temperature and precipitation in vegetation period relatively close.

In 2007, due to high temperatures and precipitation deficit period of training and increase in size and weight of tubers, yields were lower in all experimental variants.

Mining sterile banatite, applied to $P_{100}K_{100}$ fund, averaged over the four levels of nitrogen fertilization increased the yield by 5% in the variant 1 t / ha; 14% in the variant with 2t/ha and189% in the variant with 3 t / ha.

Differences in crop compared to the version control (no mineing sterile) are provided as statistically significant,in the variant with 1 t / ha sterile and very significant for the variants with 2 t / ha, respectively 3t/ha.

Nitrogen fertilizer were well capitalized, both because of low supply of soil with this element, and for the fact that mining sterile does not contain this element.

On the background of mining sterile and fertilization with phosphorus and potassium, were created conditions for plants to harness more effectively the elements of this material.

In these circumstances, applying a dose of N_{100} was obtained a yield increase by 22%, or 4.24 t / ha, a very significant difference.

By doubling the dose of nitrogen the added value of harvest increased at 33% and an increase in yield was achieved with a very significant difference of 6.33 t / ha.

The biggest increase in yield was achieved with the N_{300} variant, variant where the crop growth was 47%, returning a difference compared to the version control of 8.97 t / ha, provided as highly significant statistically.

In conclusion, the application of mining sterile banatite with chemical fertilizers is recommended in potato crops in the reference area, motivated by increases harvest wich are obtained.

Table 4

Yield results synthesis obtained in experimental cycle 2006-2008 in beans for bean culture

Factor A Experimental year	Factor B Sterile dose	Factor C-Nitrogen dose			Average factor A			
		No	N_{50}	N_{100}	Yield (kg/ha)	%	Difference (kg/ha)	Significance
2006	S_0 $P_{60}K_{60}$	537	641	789	981	100		
	S_1 t/ha $P_{60}K_{60}$	699	895	1108				
	S_2 t/ha $P_{60}K_{60}$	830	1050	1286				
	S_3 t/ha $P_{60}K_{60}$	1001	1378	1552				
2007	S_0 $P_{60}K_{60}$	284	421	580	589	60	392	XXX
	S_1 t/ha $P_{60}K_{60}$	428	552	641				
	S_2 t/ha $P_{60}K_{60}$	524	680	738				
	S_3 t/ha $P_{60}K_{60}$	647	766	802				
2008	S_0 $P_{60}K_{60}$	746	841	954	814	83	167	XXX
	S_1 t/ha $P_{60}K_{60}$	927	1263	1452				
	S_2 t/ha $P_{60}K_{60}$	1079	1640	1306				
	S_3 t/ha $P_{60}K_{60}$	1554	1713	1847				

LSD 5% = 43 kg/ha LSD 1% = 73 kg/ha LSD 0,1% = 136 kg/ha

Average factor B

Yield (kg/ha)	771	987	1088	Significance
Percentage %	100	128	141	
Difference (kg/ha)		216	317	
Significance		XXX	XXX	

LSD 5% = 48 kg/ha LSD 1% = 66 kg/ha LSD 0,1% = 90 kg/ha

Average factor C

	S_0 $P_{60}K_{60}$	S_1 t/ha $P_{60}K_{60}$	S_2 t/ha $P_{60}K_{60}$	S_3 t/ha $P_{60}K_{60}$
Yield (kg/ha)	643	885	1015	1251
Percentage %	100	138	158	195
Difference (kg/ha)		242	372	608
Significance		XXX	XXX	XXX

LSD 5% = 32 kg/ha LSD 1% = 42 kg/ha LSD 0,1% = 54 kg/ha

Table 5

Yield results synthesis obtained in experimental cycle 2006-2008 in potato culture

Factor A Experimental year	Factor B Sterile dose	FactorC-Nitrogen dose				Average factor A			
		N_0	N_{100}	N_{200}	N_{300}	Yield (t/ha)	%	Difference (t/ha)	Significance
2006	S_0 $P_{100}K_{100}$	18,76	23,33	25,90	28,55	26,06	100		
	S_1 t/ha $P_{100}K_{100}$	19,78	24,90	26,43	29,99				
	S_2 t/ha $P_{100}K_{100}$	21,88	26,58	28,42	30,65				
	S_3 t/ha $P_{100}K_{100}$	22,47	27,61	29,92	31,74				
2007	S_0 $P_{100}K_{100}$	12,68	16,57	18,76	20,70	19,0	73	-7,06	000
	S_1 t/ha $P_{100}K_{100}$	13,82	17,91	19,03	21,57				
	S_2 t/ha $P_{100}K_{100}$	15,83	19,14	21,32	23,69				
	S_3 t/ha $P_{100}K_{100}$	16,97	18,95	22,19	24,90				
2008	S_0 $P_{100}K_{100}$	18,68	24,13	26,29	28,95	19,01	73	-7,05	000
	S_1 t/ha $P_{100}K_{100}$	20,35	25,35	26,96	30,52				
	S_2 t/ha $P_{100}K_{100}$	23,38	27,11	28,97	32,15				
	S_3 t/ha $P_{100}K_{100}$	24,65	28,52	31,00	33,38				

LSD 5% = 1,09 t/ha LSD 1% = 1,56 t/ha LSD 0,1% = 3,44 t/ha

Average factorB

Yield (kg/ha)	19,10	23,34	25,43	28,07
Precentage %	100	122	133	147
Difference (t/ha)		4,24	6,33	8,97
Significance		XXX	XXX	XXX

LSD 5% = 0,85 t/ha LSD1% = 1,38 t/ha LSD 0,1% = 2,49 t/ha

Average factor C

Significance	S_0 $P_{100}K_{100}$	S_1 t/ha $P_{100}K_{100}$	S_2 t/ha $P_{100}K_{100}$	S_3 t/ha $P_{100}K_{100}$
Yield (t/ha)	21,94	23,05	24,93	26,03
Precentage %	100	105	114	119
Difference (t/ha)		1,11	2,99	4,09
Significance		X	XXX	XXX

LSD 5% = 0,98t/ha LSD 1% = 1,56 t/ha LSD 0,1% = 2,68 t/ha

CONCLUSIONS

Researchs conducted during 2006-2008 period on the use of mining sterile banatite derived from the mining company in Moldova-Noua, Caras-Severin, as a source of micro and macroelements for the agricultural crops have led to important conclusions for the reference area and at the national level.

1.Mining sterile banatite contains significant amounts of microelements (manganese, molybdenum, copper, zinc, manganese, etc.) and macroelements (calcium, sulfur, phosphorous, etc.).

The material reaction is alkaline due to the high calcium content and that the flotation was carried out with basic elements. From this point of view, the sterile, can be used with good results to correct acidic soil reaction.The heavy metal content is below acceptable limits throughout Europe. The material is not radioactive.From listed consideration we propose the utilisation of material for agricultural crops.

2. The researchs were conducted on a typical preluvosoil clay-dust/ clay-loam on clays. After climate zoning and classification system of Köppen, the territory where the experiences took place is found in the c.f.a.x. province.

3. Beans grown for grain, reacted favorably to the application of mining sterile, which applied to P60K60 background, in the average nitrogen levels tested, increased the yield by 242 kg / ha, in the variant with 1 t / ha, 372 kg / ha in the variant with 2 t / ha and with 608 kg / ha in variant with 3 t / ha.

Nitrogen fertilizers, were well capitalized on poor soil type supplied with this element, increasing the yield, in the average sterile levels applied and on the P6oK60 fund, with 28% at the dose of N50 and 41% by applying the dose of N100. Differences in harvest of 216 kg / ha and 317 kg / ha are provided as very significant statistically.

4. At the potato crop, the yield increase due to mining sterile banatite was 1.11 t / ha with 1 t / ha sterile dose, 2.99 t / ha on tuber found of 2 t / ha sterile and 4.09 t / ha on found of 3 t / ha sterile mining. The nitrogen fertilizers applied, in average over four agrofouds, have increased crop potato with 4.24 t / ha dose of N100, 6.33 t / ha dose of N200 and 8.97 t / ha dose of N3oo. Differences in all statistical graduation level were provided as very significant.

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