

SOME ASPECTS OF THE ECOLOGICAL RECOVERY OF THE STERILE DUMPS FROM MEHEDINTI MINING ENTERPRISE

R. MOCANU, Ana Maria MOCANU

University of Craiova, Libertatii 19,
Corresponding author: mocanuromulus@yahoo.com

Abstract: The researches made on the ecological recovery of the sterile dumps from Mining Enterprise of Mehedinti, Husnicioara quarry have had as goal the capitalisation of these lands that were degraded by surface mining in order to extract lignite; with this domain there are not any researches so far. The researches that unfolded on these sterile dumps are quite new and these sterile dumps are different in comparison with the ones from Gorj District due to their sandy texture. The material and the researching method have consisted of: the identification of the main soil types; the study of the physical and chemical features of these soils; field experiments with different crops in order to increase the organic matter content; trials with manure and chemical fertilizers; trials with different woody species and crops. Accounting the physical and chemical features of these terrains that are not favorable for plant growing the main objective of the research was to increase the organic matter content. The using of organic and chemical fertilizers have had

a high importance for the different crops on the sterile dumps. Without fertilizers the wheat and corn crops do not grow at all. Among the fertilizers that were used, the best results were given by: manure, urea, organio-mineral fertilizer on lignite base. The sunflower grows on the sterile dumps with no fertilizer yet with very low yields. The pulses are beneficial on the sterile dumps and among them the alpha-alpha gives the best results: 861 kg hay/ha with no fertilizer and 4.717 kg hay/ha with 25 t/ha manure + $N_{96}P_{64}$. Along with this crop the peanuts and chickpea can be cropped on the sterile dumps. On the sterile dumps from Husnicioara Mehedinti there have grown well acacia and poplar. The paper is new, original and very important for solving the problem of ecological recovery of the sterile dumps. The classic method of evaluation of soils „Romanian system of soil evaluation” the anthropic soils from mining quarries (sterile dumps) are considered to have almost the same productive potential with a natural soil as well as the evaluation marks.

Key words: open cut mining, lignite, coal basin, mining technical fitting out, biological recovery, fertilizers, compost.

INTRODUCTION

Among all extractive industries, the most aggressive form of soil degradation is the surface mining that develops (after UNESCO data) 1.4-1.7 times faster than other industrial branches (TOTH, 1983). Due to this process there take place a reversing of the geological strata, the migration of the nutritive elements, landscape degradation, the place of former lands being taken by sterile dumps that are classified as anthropic protosoil or entantrosoil (SRTS 2003). The surfaces occupied by these sterile dumps are around 18,433 ha (HUIDU, 2002, DUMITRU, 2002).

In these conditions the ecological recovery of these terrains is very necessary and impose various researches that have to find the most proper solutions for capitalising the local conditions.

MATERIAL AND METHODS

In order to establish solutions for the ecological recovery of the sterile dumps from Husnicioara quarry, District Mehedinti (that differs as lithological strata and exploitation type

in comparison with the ones from Rovinari and Motru zone) we have performed several researches within 1999-2005 period on these sterile dumps.

The soil where the trials were set up

The sterile dumps from Husnicioara quarry are classified, after SRTS 2003 as sandy entantrosoil and occupies a surface of 699 ha having as bedrock marble, silt and, especially sands being located on the first terrace of Danube.

The soil profile has four layers S₁, S₂, S₃ and S₄, with a sandy texture and coal debris.

The soil nitrogen supplying is very low (0.2-0.5% humus and 0.08-0.2% total nitrogen). They are very low supplied by phosphates that are available to plants (4.52 – 15.93 ppm P) and low to middle supplied by potash (33.51-50.85 ppm K). The soil reaction is low alkaline (pH 7.9-9.0). The evaluation mark is 10.2 and the quality class is Vth.

From this rough characterization there results that these soils are not favorable for plant growth and there is need to find special measures in order to improve their fertility (MOCANU, 2007).

The researches that have been carried out have envisaged the ecological recovery of these sterile dumps by using an assortment of crops on a chemical and organic fertilizers background as well as some species of plants designated to keep firm the slopes of the sterile dumps.

There were used the following crops: wheat, corn, sunflower, alpha-alpha and peanuts that have been fertilized by different doses of chemical fertilizers that were applied alone or along with manure, 25 t/ha.

The chemical fertilizer doses have been as follows: N₆₄, N₉₆, N₁₂₀, N₁₅₀, N₁₂₀P₉₆ with wheat crop; N₆₄, N₁₀₀, N₁₃₆, N₁₆₀, N₁₀₀P₈₀, N₁₃₆P₈₀K₄₀ with corn crop; different nitrogen fertilizer types at N₁₂₀ dose of active ingredient: ammonium nitrate, urea, nitrocalcar, organomineral, foliar with corn crop; N₆₄, N₉₆, N₁₂₀, N₉₆P₆₄ with alpha-alpha crop; N₆₄, N₉₆, N₁₂₀, N₆₄P₆₄ with peanuts crop.

In another experimental cycle there was researched the effect of nitrogen and phosphorus fertilizers as well as the effect of organic fertilizers of compost type and the effect of organic and mineral fertilization (compost + chemical fertilizers).

The manure that was applied on the experiment has had the following chemical composition: 0.68% N, 1.78% P₂O₅, 2.9% K₂O and the compost: 1.75% N, 0.734% P₂O₅, 0.157% K₂O. The compost doses have been of 10, 20 and 30 t/ha with corn, sunflower and chickpea crops.

RESULTS AND DISCUSSIONS

With wheat crop the yields have been low enough even when fertilized by different doses in comparison with the ones from normal soil of the zone (table 1). With the not fertilized control variant there were get 448 kg/ha and with the applying of increasingly nitrogen doses from N₆₄ to N₁₅₀ the yield increases from 889 to 1,606 kg/ha and with N₁₂₀P₉₆ the wheat yield reaches 1,628 kg/ha.

The corn crop does not succeed on the sterile dumps from Husnicioara if no fertilizers are applied, chemical or organic (table 2). With the not fertilized control variant there was obtained no grains yet only vegetal mass. The applying of several fertilizer doses determines the obtaining of grain yields of 1,315 kg/ha with N₆₄ and 2,208 kg/ha with N₁₃₆P₈₀K₄₀ (BORHISEL, 1985).

The corn yields on a 25 t/ha manure background reaches values of 1,068 to 4,064 kg/ha which means doubling over the chemical fertilizers alone.

The sunflower seed yields have recorded, on average during 5 years of trials, low values, from 263 kg/ha with the not fertilized control to 853 kg/ha with N₁₃₆P₆₄K₈₀ much lower

than the yields of zone. The fertilization with the same fertilizer doses yet on a 25 t/ha manure background have determined almost the doubling of the yield, from 515 to 1,536 kg/ha, in the same way as with corn crop (table 3).

Table 1

The average wheat yields during 5 years of experiments (2000-2005)

Variant	Yield Kg/ha	Relative yield %	Diff. Kg/ha	Output/1 kg N	Significance
Not fertilized control	448		-	-	-
N ₆₄	889	100	441	6.0	-
N ₉₆	1,023	198	575	5.9	x
N ₁₂₀	1,411	228	963	8.1	xx
N ₁₅₀	1,606	315	1,158	7.7	xxx
N ₁₂₀ P ₉₆	1,628	358	1,180	-	xxx

DL 5%=471 kg/ha; DL1%=650 kg/ha; DL0.1%=965 kg/ha

With the corn crop

Table 2

The average corn yields during 5 years (2000-2005) as a result of chemical fertilizers applied alone and with 25 t/ha manure background

Variant	Yield kg/ha		Relative yield%		Difference kg/ha		Significance	
	No manure	25 t/ha manure	No manure	25 t/ha manure	No manure	25 t/ha manure	No manure	25 t/ha manure
Not fertilized control	0	1068	-	100	-	-	-	-
N ₆₄	1315	1822	-	170	1315	754	xxx	x
N ₁₀₀	1645	2210	-	206	1645	1142	xxx	xx
N ₁₃₆	1775	2682	-	251	1775	1614	xxx	xxx
N ₁₆₀	1898	3341	-	312	1898	2273	xxx	xxx
N ₁₃₆ P ₈₀	1993	3802	-	355	1993	2734	xxx	xxx
N ₁₃₆ P ₈₀ K ₄₀	2208	4064	-	380	2208	2996	xxx	xxx

DL 5%=606 kg/ha; DL1%=807 kg/ha; DL0.1%=1088 kg/ha (without manure)

DL 5%=689 kg/ha; DL1%=898 kg/ha; DL0.1%=1191 kg/ha (with 25 t/ha manure)

With sunflower crop

Table 3

The average sunflower yields during 5 years (2000-2005) as a result of chemical fertilizers applied alone and with 25 t/ha manure background

Variant	Yield kg/ha		Relative yield%		Difference kg/ha		Significance	
	No manure	25 t/ha manure	No manure	25 t/ha manure	No manure	25 t/ha manure	No manure	25 t/ha manure
Not fertilized control	263	515	-	100	-	-	-	-
N ₆₄	496	1036	188.6	205.6	233	521	xxx	xxx
N ₁₀₀	577	1157	219.4	224.5	314	624	xxx	xxx
N ₁₃₆	587	1197	232.4	232.4	324	682	xxx	xxx
N ₁₃₆ P ₆₄	650	1265	247.1	245.6	387	750	xxx	xxx
N ₁₃₆ P ₆₄ K ₈₀	853	1538	324.3	298.3	590	1,021	xxx	xxx

DL 5%=67 kg/ha; DL1%=89 kg/ha; DL0.1%=119 kg/ha (without manure)

DL 5%=99 kg/ha; DL1%=131 kg/ha; DL0.1%=176 kg/ha (with 25 t/ha manure)

With alpha-alpha crop

On the sterile dumps the alpha-alpha crop does succeed even without fertilizers yet with low yields. The chemical and, especially the organic and mineral one contributes to the

obtaining of high hay yields what make us to consider that it is the most suitable crop for the first years on Husnicioara sterile dumps (table 4).

Table 4

The average alpha-alpha yields during 5 years (2000-2005) as a result of chemical fertilizers applied alone and with 25 t/ha manure background

Variant	Yield kg/ha		Relative yield%		Difference kg/ha		Significance	
	No manure	25 t/ha manure	No manure	25 t/ha manure	No manure	25 t/ha manure	No manure	25 t/ha manure
Not fertilized control	861	1112	100	100	-	-	-	-
N ₆₄	1653	2679	191.9	240.9	792	1567	xxx	xxx
N ₉₆	1947	3537	226.1	228.1	1086	2425	xxx	xxx
N ₁₂₀	2378	3766	276.2	338.7	1517	2654	xxx	xxx
N ₉₆ P ₆₄	2883	4717	334.8	424.2	2022	3605	xxx	xxx

DL 5%=214 kg/ha; DL1%=289 kg/ha; DL0.1%=402 kg/ha (without manure)

DL 5%=306 kg/ha; DL1%=412 kg/ha; DL0.1%=555 kg/ha (with 25 t/ha manure)

The applying of 10 t/ha, 20 t/ha and 30 t/ha compost has conducted to the following results:

- with the chickpea crop the yields have been of 728 kg/ha, 791 kg/ha and 926 kg/ha;
- with the corn crop the yields have been of 2,600 kg/ha, 3,325 kg/ha and 3,793 kg/ha;
- with the sunflower crop the yields have been of 708 kg/ha, 1,058 kg/ha and 1,167 kg/ha.

The sterile dumps from Husnicioara can be planted with woody species. The best results have been given by acacia and poplar species. The best results for keeping the slope of the dump firm were given by acacia planted in a X design.

CONCLUSIONS

- the sterile dumps from Husnicioara, District Mehedinti, are classified as sandy entiatrosoil, after SRTS 2003, with a sandy texture and a very low fertility degree;
- the ecologically recovery of the sterile dumps must be performed by applying fertilizers, especially organical;
- without chemical fertilizers the corn crop grows but do not produce grains, the wheat crop gives very low yield as well as the sunflower crop;
- the using of chemical fertilizers yet the mixture of chemical with organical determines the increasing of the yields, almost equal with the ones of the local zone;
- the alpha-alpha crop can be planted in the first year on these terrains which can give low hay yields that can be used in husbandries.

BIBLIOGRAPHY

- BARNHICEL R.J. – 1995. Lime and fertilizer recommendation for reclamation of surface mined soils. University of Kentucky AGR-40.
- DUMITRU M., - 2002. The re cropping of the sterile dumps from Gorj District(romanian). Symposium Targu Jiu.
- HUIDU E., IONEL I., - 2002. The evolution of occupying and reclaiming of terrains affected by surface mining(romanian). Papers of the International Symposium Targu Jiu, 7-8 June.
- MOCANU R. AND COLAB., - 2007. The ecological reclamation of the sterile dumps from Husnicioara, Mehedinti (romanian). Editure Sitech, Craiova. ISBN 978 – 973 – 746 – 8.
- TOTH S., - 1983. Major economic problems in agricultural recultivation after open cut mining.