ORGANOMINERAL FERTILIZERS ON THE LIGNITE SUPPORT – ECOLOGICAL SOURCES OF BALANCED FERTILIZATION OF CROPS IN SUSTAINABLE AGRICULTURE

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Abstract. Obtain high yields on soils with low humus requires systematic fertilization with organic fertilizers to ensure restoration of the reserve of soil humus. Since organic fertilizers are insufficient, and the classical chemical production in time and chemical pollution of soil and groundwater in recent years has taken a large, particularly in countries with advanced agriculture, industrial production of humic fertilizers on lignite support, leonardit and peat. These inferior coal capacity caloric content but with little significant humic acids facilitates the production of fertilizer effects of fertilizers and higher costs relatively lower than those of classical chemical.
In Romania, based on a range of humic fertilizers on lignite support from research conducted by National Research - Development Institute for Soil Science, Agrochemistry and Environmental Protection, Bucharest, was made in a RELANSIN project, in collaboration with SNLO Tg. Jiu a production of these fertilizers with a capacity of over 7000 tonnes / year, which came into service in 2008. In the paper presented the characteristics of fertilizers, the economic efficiency and possibilities to increase crop production on soils with low humus content.

Key words: organomineral fertilizers, lignite, effectiveness

Introduction

Fertilizers produced by industrial-type processes are the most important technical means to influence for plant growth by applying them directly in soil or on plants.

The main category of fertilizers used in modern agriculture are chemicals that are over 90% of industrial production and are used to based fertilized on cultivated land. In this way, essential nutrients elements are introduced into the mass of the explored soil by roots plant to ensuring the growth to average increase yields by 2-3 times compared to that obtained in the unfertilized soils [2].

Following the effectiveness of chemical fertilizers the global production of their to recorded a substantial growth in recent years, from 32 million tonnes in 1961 to 170 million tonnes in 2010-2011 (L. Maine, 2010).

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Scientific research conclusions and a series of effects recorded in agricultural practice highlight after long periods of use of chemical fertilizers and some negative effects from the most important are:

- Reducing or maintaining a low level of organic matter including humic substances formed by natural way in biocenosis processes by which soil acquires many features of fertility and ecological environment.

- Soils and ground water pollution with some chemicals residual accumulated during lengthy chemical fertilization period with negative consequences for soil evolution, environmental protection and quality indices of harvest.

Interest in scientific research in various countries to mitigate the negative effects of fertilization with chemical fertilizers and knowledges gained on the properties of humic acids and their importance in defining the many features that make the soil fertility has led to the idea of using inferior coals containing with large amounts of humic acids in as raw material for production of fertilizer organomineral.

Brown coal (lignite, leonarditul) with low heat capacity as a fuel (in 1400-1800 Kkal / kg coal) but containing large amounts of non-metamorphosed or partially metamorphosed free humic acids into humic than 25-30% fully justifies their use for the manufacture of organo-mineral fertilizers with significant ecological features.

Today in many countries: America, Japan, China, Israel, Spain, Russia, are many companies that produce humic fertilizers on industrial level.

Given the fact that these fertilizers are used on land growing by technologies including actions to improve plant nutrition in environmental conditions may be estimated that fertilization with humic fertilizer is evolving as a new global strategy.

In Romania the research to produce humic organo-mineral fertilizers started four decades ago [3, 18] and it was continued till now within the framework of some interdiciplinary supported by many scientific researches institution, universities and factories.

These fertilizers have been created as a result of needed fertilization systems improvement to improve fertility sands, eroded soils, soils luvic and other soils with low humus content and all sands developed for irrigation.

At present, are authorized 6 types of humic fertilizers on lignite support which are produced, in a pilot installation more than 7000 t fertilizers per year, put into operation in 2008, built at Tg. Jiu by the National Research-Development Institute for Soil Science and Environmental Protection – ICPA, Bucharest, in cooperation

with National Lignite Society, Oltenia, Tg Jiu, within the framework of the Relansin project, 2003-2005.

At the same time with the starting of this installation function, at present being in the final (and modernization) stage, a real base has been created to extend the production of fertilizers on lignite support in Romania [8].

The opportunity to obtain the organo-mineral fertilizers from lignite in Romaia due to the important lignite reserves in Romania, in the large missing exploitations of Oltenia, with organic matter (OM) content of 60 – 69 %; humic acids SiO_2 and other mineral substances 15 – 30 %; humic acids (AH) 25 – 30 [8,11].

In this paper was presented the fertilising qualities of the organomineral fertilizers on lignite support with prospects of manufacturing in the industrial system for use in large-scale in farms of Romania.

Materials and methods

Organo-mineral fertilizers on lignite support presented in this paper are technology mixtures of powder of coal-rich in humic acids with urea or urea and ammonium phosphates.

There have been two types of fertilizers:

♣ organo-mineral fertilizers on lignite support granulated in successive layers with amide solution;

♣ organo-mineral fertilizers on lignite support granulated in successive layers of humic acids extracted from lignite as potassium humates.

General technological scheme for manufacture of these fertilizers is shown in Figure 1.

Research conducted includes two parts:

♣ Compositions and fertilising characteristics of fertilizers made;
♣ The effectiveness their of plant nutrition and soil fertility features.

1. Results and discussion

Assortment of organomineral fertilizers on lignite support carried by the technological scheme shown in Figure 1 differs in composition compared with used technology, the content of natural coal and soluble humic acids and mineral nutrients content.

Table 1.1 presents the composition of organomineral fertilizers called L-200 L-300, SH-210 and SH-120 containing humic acids as naturally form existing in lignite and are granulated in successive layers with amide solution.

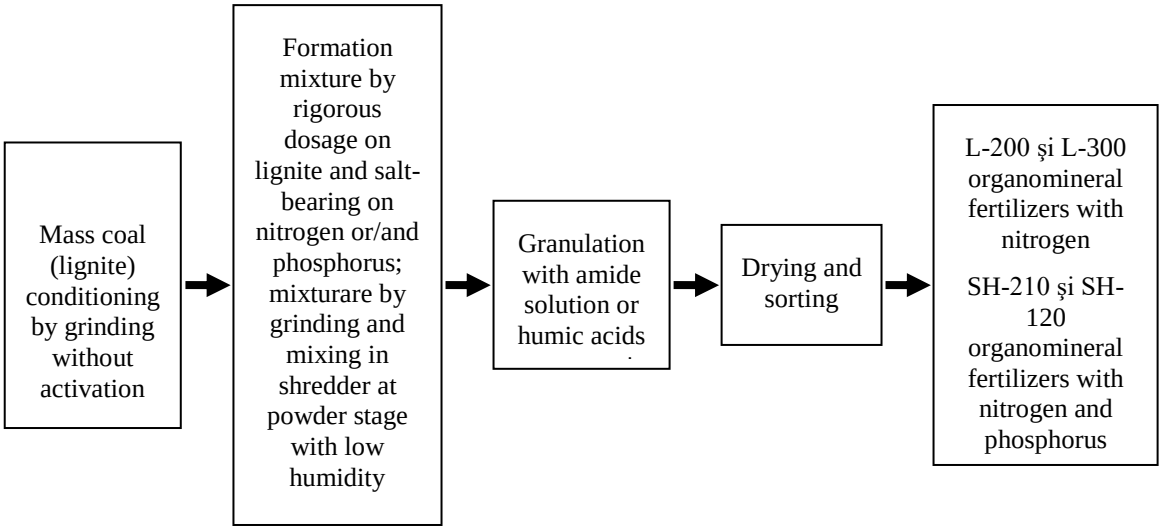

Figure 1. – General technological scheme for organomineral fertilizers on lignite support in the form of technology mixtures with nitrogen-bearing salts or nitrogen and phosphorus [8, 9]

Table 1.2 presents the composition of organomineral fertilizers called L-200 HK, HK L-300, SH-210 SH-120 HK and HK containing humic acids both in naturally form and as potassium humates form representing a significant share in humic mass.

Potassium humate extracted with potassium hydroxide from lignite containing: 58 - 60 g/l free humic acid; 0.8 g/l heterocyclic nitrogen, 9.6 g/l K_2O and some microelements from coal, has a essential effect on quality of new humic fertilizers.

Spectral analysis of potassium humates extracted from lignite to attest similar quality on humic acids from lignite to those resulting from natural products humification (Dorneanu et al. 2010).

Table 1.1 Composition and characteristics of organomineral fertilizers on lignite support granulated in successive layers with urea solution, made from installation in SNLO Tg. Jiu approved for use in Romanian agriculture

No. crt.	Specification	UM	L-200	L-300	S H-210	SH-120
1	**Compozition**					
1.1	Humic acids	%	16.0	10.0	17.0	22.7
1.2	Nitrogen (Nt)	%	22.0	28.0	20.55	9.15
1.3	Phosphorus (P_2O_5)	%	-	-	9.75	16.50
1.4	Potash (K_2O)	%	0.255	0.197	0.226	0.307
2	**Properties**					
2.1	Cation exchange capacity	me/100 g	48.0	35.8	41.0	55.7
2.2	Apparent density	g/cm3	0.738	0.707	0.720	0.813
2.3	Grain size (1-5 mm)	%	82.0	86.0	79.3	88.6

Table 1.2 Composition and characteristics of new organomineral fertilizers granulated in successive layers with potassium humate, which is pending approval and will be manufactured in the SNLO Tg. Jiu upgraded installation

No. crt.	Specification	UM	L-200 HK	L-300 HK	SH-210 HK	SH-120 HK
1	**Compozition**					
1.1	Humic acids	%	29.9	24.3	28.5	26.4
1.2	Nitrogen (Nt)	%	23.49	29.21	21.97	10.47
1.3	Phosphorus (P_2O_5)	%	-	-	9.75	16.50
1.4	Potash (K_2O)	%	2.80	2.80	2.80	2.80
2	**Properties**					
2.1	Cation exchange capacity	me/100 g	96.3	75.2	70.3	83.9
2.2	Apparent density	g/cm3	0.823	0.782	0.801	0.852
2.3	Grain size (1-5 mm)	%	89.9	92.3	88.9	93.5

Fertilising qualities of organomineral fertilizer on lignite support

▪By their characteristics, organomineral fertilizer have effects of enhanced plant nutrition, of improvement of soil fertility properties and prevent a significant degree of pollution of soil by fertilization.

▪Because potting humic compounds and salts with nutrient in organomineral matrix which increases the adsorption and cation exchange capacity of the soil, these fertilizers are the main feature high mobility of the elements that contain them, either through solubility, either through constant change in ion form on elements of humaţes with other ions in soil solution and by partial mineralization.

▪Because of carboxyl functional groups (-COOH), phenolic hydroxyl (-OH), carbonyl (> C ═ O) and metoxylilic (-OCH3), humic acids can bind different metal ions in soil solution (B, Fe, Cu, Mo, Zn), giving rise to chelates with important role in plant nutrition and soil fertility status[9].

▪In more recent research has found that agents humic chelates act as physiologically active substances, they can enter the plant roots and are transported to the leaves. Between supply soil solution with humic chelating agents and their absorption by plants was identified the existence of a perfect parallelism quantitatively.

▪Research conducted proving the effectiveness of humic acids and humic chelates in germination and vegetative growth stimulation. It shows a strong increase of the root system.

▪Humic acids compounds with metal ions (Ca, Mg, Fe, Al) are insoluble in water, formed precipitates - film or micro accumulation on place training. As a result of humic acids from organomineral fertilizers on lignite support, contributes to formation of main binder of colloidal particle of agglutination of clay minerals, fine dust and sand.

Thus, by the participation of the humic acids in the formation and cementing of the micro aggregates and macro aggregates, hard coal organomineral fertilizers contribute greatly to the development of the soil structure. This correlates with the increase of porosity in a favorable ratio between the non capillary space available for rainfall or irrigation water infiltration and capillary space which holds large amounts of resisting water equivalent to 3-5 times the total weight of organic matter (humus).

Effectiveness of organomineral fertilizers to classics chemical fertilizers

In tables 2 and 3 are listed the types of organomineral fertilizers obtained in installation realized within RELANSIN project in technology samples on manufacturing of several tens of tons.

Organomineral fertilizers on lignite support successively granulated with urea solution constituted the objective to build the pilot instalation in Targu Jiu within Relansin program and have been tested a great number of years on different soil types achieving effective results [8].

Table 2. Yield increases obtained with organomineral fertilizer granulated with urea solution applied to maize HF-420 grown on psamosol (sandy soil) irrigated on Development Research Centre for Plant Culture on Sands, Dăbuleni-Dolj

Dose of fertilization: N-200; P_2O_5 -100; K_2O-100 kg/ha

No.	Variants	Average production of grains (on 5 years) kg/ha	Yield increases			
			kg/ha	% to		kg grains/ kg fertilizer (N-P_2O_5-K_2O)
				M1	M2	
1	Unfertilized (M1)	2808	-	100.0	-	-
2	Urea.TSP*. Potash salt (M2)	5290	2482	188.4	100.0	6.2
3	L-200. TSP* Potash salt	6210	3402	221.1	117.4	8.5
4	L-300.TSP* Potash salt	6136	3328	218.5	115.9	8.32
5	SH-210 Potash salt	6353	3545	226.2	120.0	8.86
6	SH-120. Urea Potash salt	6359	3587	227.7	120.8	8.96
			620			
	DL 5%		620			
	1%		900			
	0,1%		1180			
	*TSP triple superphosphat					

To highlight the effectiveness and efficiency are presented in table 2 the results obtained from irrigated maize on psamosol at Development Research Centre for Plant Culture on Sands, Dăbuleni-Dolj, since the sandy soil is conventionally considered most suitable for testing the effects of fertilization with different types of fertilizers.

Production increases on maize in the experience mentioned are higher in variants with fertilizers organomineral with 15.9 up to 20.8% compared to fertilization with mineral fertilizers.

These fertilizers are recommended for intensive crop fertilization on soils with low humus content (sandy soils, and eroded Luvisols) to humic improvement.

Table 3 presents the results of testing the effectiveness of H-200 HK and SH -120 HK fertilizers compared with L-200 and SH-120 fertilizers applied to maize grown on luvisol albic (podzolic).

Table 3. The effectiveness of L-200 and SH-120 organomineral fertilizers applied comparatively with L-200HK and SH-120HK on maize on luvisol albic (podzolic) in Development and Research Horticultural Station Tg Jiu - Gorj

No.	Types of fertilizers	Quantity applied			Average production of grains (on 2 years) kg/ha	Yield increases		
		Physical product kg/ha	Active substances %/100 kg	Total on 500 kg physical product kg/ha		kg/ha	Physical product kg/ha	Active substances %/100 kg
1	Martor nefertilizat	-	-	-	2600	-	100.0	-
2	L-200	500	22.0+0+ 0.25+16.0= 38.2	191.3	3200	600	123.0	3.14
3	L-200HK	500	23.5+0+ 2.8+29.9= 56.2	280.3	3700	1100	142.3	3.92
4	SH-120	500	9.2+16.5+ 0.3+22.7= 48.6	243.3	4280	1680	164.6	6.91
5	SH-120HK	500	10.5+16.5+ 2.8+26.4= 56.2	280.4	4450	1850	171.1	6.60
	DL 5%					370		
	1%					518		
	0,1%					703		

Modest doses were applied to highlight the minimum effects of these fertilizers between 500 kg/ha physical product and 191-280 kg active substance in which items were included both NPK and humic acids.

Yields increases obtained with organomineral fertilizers from unfertilized variant were higher from 23.0 to 71.1% significantly distinguishing for granular fertilizers with potassium humates.

Analytical data from preliminary tests shows a higher efficacy of these fertilizers because have a rich content in potassium humates.

These fertilizers are indicate for intensive crops fertilization on all soil types.

Conclusions

On the basis of presented data, it may be estimated that the organo-mineral fertilizers on lignite support, due to their content in humates. have a series of specific properties that impart them higher fertilization qualities as compared to the classical chemical fertilizers;

Incorporation into organo-mineral matrix with humates ensures the assimilation of nutrients at a higher proportion than by applying chemical fertilizers. and the soil chemical pollution degree is significantly reduced;

Use of fertilizers on lignite support presents the advantages that they can economic efficient use, under higher conditions a significant part of the more than 4 milliard tones of coals with humic acids existent in Romania and they can ensure a humic fertilization of an important land area of the more than 7 million ha of humus deficient soils.

An essential economic advantage of production of organo-mineral fertilizers on lignite support is represented by the lower energy consumption and production costs, having in view the contribution of active ingredient in coal which are less than costs of the chemical fertilizers with 22-25%.

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