Scientific Papers. Series A. Agronomy, Vol. LXII, No. 2, 2019
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

SUPPLYING SOIL IN HUMUS APPLICATION OF WASTE FROM THE PRODUCTION OF ALCOHOLIC BEVERAGES

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Abstract

Organic fertilization is the main agro-technical measure by which the humus regime in the soil is positively influenced. Organic fertilizers are sources of raw material for nutrient humus, but also for the synthesis of stable humus. Both contribute, along with other links of plant culture technology, to maintaining or increasing the humus content of cultivated soils. The article reflects the supply of delluvial chernozem with humus in the application of wine lees, vinasse (waste from winemaking plants) and cereal borhot (waste from the Ethanol Alcohol Production Facility). It has been established that the waste has significantly enriched the soil with humic organic matter. The specific humus increase in the pore layer from 1 ton of waste incorporated as fertilizer was for: wine yeast - 95-99 kg, vinasse - 5-7 kg, cereal borhot - 24-29 kg. The influence of waste on the quality of humus in the soil has been determined and the balance sheet has been calculated.

Key words*: chernozem, wastes, wine yeast, vinasse, grain mashes, humus, soil.*

INTRODUCTION

Organic soil consistency plays a very important role in its physico-chemical and biological functions, serving as an energy and nutritional source for microbial flora and a factor on which the soil fertility status is largely dependent. Humus is the most important deposit and, at the same time, the most important source of carbon and nutrients. Soil utilization and exploitation in agriculture accelerates the processes of decomposition of accumulated organic matter, thus contributing to diminishing their fertility. This process has a universal character and is intense in the first years after the land reclamation. During 100 years Moldavian chernozems lost about 25 percent of accumulated organic matter (Krupenikov, 2008).

In the last 5 years, the amount of organic fertilizer has decreased by 60 times and is 0.1 t/ha, the surface of the alfalfa has decreased by 4-5 times, the vegetal remains on large surfaces are burning. As a result, the balance of humus in the soil is negative (- 0.7 t/ha), and with erosion losses we have an even greater reduction (- 1.1 t/ha) (Andrieş, 1999; 2005). According to the latest estimates, 26 million tons of humus (19 t/ha) are lost on agricultural land annually.

Forecasting calculations show that, if the present situation is maintained, by 2025 the humus content in the soils of Moldova will decrease to a critical level of 2.5-2.8% (Andrieş et al., 2002).

The special importance of the humic state of soils for their productive level as well as for the state of the environment implies the necessity to research new organogenic material in order to determine the evolution of carbon in the agricultural exploited lands by applying accessible and satisfactory precision methods. Organic waste from the soil can be recycled from the production of alcoholic beverages: wine lees, cereal grains, etc.

The literature on waste mentioned above is little or totally lacking. It is worth mentioning that this waste is a very important source for increasing carbon reserves - which serves as a material for the formation of humus and humic acids that improve the nutritional regime of agricultural crops and consequently soil fertility.

The main purpose of the researches was to estimate the humification coefficient of the waste from the production of alcoholic beverages applied as fertilizer and their influence on the humus balance in the soil.

MATERIALS AND METHODS

The studies and researches were carried out during the period 2011-2018 at the Codru Technology and Experimental Station located in the commune of Codru, Chisinau, in two experiments on cambic luto-argilos chernozem. The scheme of experiments is shown in Tables 1 and 2. The chemical analyzes performed have determined the total humus (Tyurin method), humic acids, fulvic acids and humins (Kononova-Belcikova method), optical density of the humic acids (Plotnikova-Panamariova method) and mobile humus content (Tyurin method). The statistical processing of the data was done after B.A. Dospehov.

RESULTS AND DISCUSSIONS

Changing humus content from soil to waste

Organic soil is the most important component of fertility (Tyurin, 1937). Soil humus performs extremely important functions by participating in adsorption processes - desorption of ions necessary for plant nutrition, formation of clay-clay complexes, promoting aeration, penetration and retention of water in the soil, serving as an energy source for microorganisms, increasing the capacity water infiltration and decreases leakage, favors deep root penetration, and reduces human effort to perform soil work (Alexandrova, 1980).

Modification of soil humus content is the result of two processes with opposite features: on the one hand, mineralization of a fraction of the soil humus takes place in order to provide the microorganisms and plants grown with nitrogen and other necessary elements; on the other - the humus restoration takes place taking into account the remaining vegetal remains in the soil and the organic substances added as fertilizer (Tyurin, 1956).

Research by numerous scientists has shown that the application of organic fertilizers leads to the quantitative and qualitative promotion of soil humus. These are due to organic compounds from biodegradation of fertilizers (Lixandru et al., 2012). For different types of organic waste, there is a question of the accessibility of the humic value of organic matter.

Long-term experiments with different organic waste have a positive effect on soil humus content (Tables 1, 2).

Table 1 shows the data showing the influence of wine waste on humus content in the 0-30 cm layer of cambic chernozem and highlights the following:

Table 1. The influence of waste on the humus content in the 0-30 cm layer of cambic chernozem, % from the table. Technological-experimental station "Codru"

Variant of experience	Average for years 2011-2018	The increase compared to the control	
		%	kg/ha
Control	4.14	-	-
Wine yeast (N_{100}), 13 t/ha per year	4.28	0.14	3724
Wine yeast (N_{200}), 26t/ha per year	4.43	0.29	7714
Vinas (K_{450}), 300 m^3/ha per year	4.39	0.25	6650
Vinas (K_{900}), 600 m^3/ha per year	4.50	0.36	9576
LSD 0.5%	0.12	0.120	3024

Administration of doses of wine yeast (13 and 26 t/ha, equivalent to 100 and 200 kg N/ha per year) leads to a significant increase in humus content. The growth of humus versus control on an average of eight years was 0.14 and 0.29% or 3724 and 7714 kg/ha, respectively.

Applying the 300 (K_{450}) and 600 m^3/ha (K_{900}) wineries leads to statistically significant increases in humus content in all years of experimentation (2011-2018), where the increase on the average averaged 0.25 and 0.36% or 6650 and 9576 kg/ha.

The influence of corn mash on the humus content of the cambic chernozem is shown in Table 2 and highlights the following:

Table 2. Influence of cereal boron on humus content in the 0-20 cm layer of cambic chernozem, % of soil mass. Technological-experimental station "Codru"

Variant of experience	Average for years 2012-2018	The increase compared to the control	
		%	kg/ha
Control	2.96	-	-
Corn mash (N_{120}), 47 m^3/ha per year	3.07	0.11	2772
Corn mash (N_{240}), 94 m^3/ha per year	3.14	0.18	4536
LSD 0.5%	0.09	0.09	2268

Corn mash fertility in a dose equivalent to 120 and 240 kg N/ha led to a significant increase in humus content in the soil. The values of the humus content increase in seven years of experimentation averaged 0.11 and 0.18% or 2772 and 4536 kg/ha.

Table 3. Influence of yeast and wine yeast on the composition of humus in cambic chernozem. Technological-experimental station "Codru", 2018

Variant of experience	C, %				C_{AH} / C_{AF}	E_{AH}, mg/ml	C_{AHM}	G_H, %
	Total	AH	AF	H				
Control	2.27	0.81	0.28	1.18	2.93	27.5	0.78	36
Wine yeast (N_{200}), 26 t/ha per year	2.37	0.82	0.34	1.21	2.43	28.4	0.71	35
Vinas (K_{900}), 600 m^3/ha per year	2.35	0.79	0.31	1.24	2.51	28.0	0.73	34
LSD 0.5%	0.36	0.13	0.03	0.27	0.61	1.85	0.12	-

Table 4. Influence of cereal mash on the composition of humus in cambic chernozem. Technological-experimental station "Codru", 2018

Variant of experience	C, %				C_{AH} / C_{AF}	E_{AH}, mg/ml	C_{AHM}	G_H, %
	Total	AH	AF	H				
Control	1.75	0.73	0.23	0.79	3.28	27.7	0.67	41
Cereal mash (N_{240}), 100 m^3/ha per year	1.74	0.74	0.23	0.77	3.21	26.4	0.67	43
LSD 0.5 %	0.14	0.22	0.09	0.054	0.09	0.79	0.032	-

Table 5. Influence of waste from the production of alcoholic beverages on the soil humus balance in the plowed layer determined by the direct method in the laboratory experiments

Variant of experience	Initial content until the foundation of the experience	The eighth year of experimentation	Balance of humus		
			in years 7-8		annual t/ha
	ha		t/ha	%	
Control	169.6	170.8	- 1.2	- 1	- 0.4
Wine yeast (N_{200}), 26 t/ha per year	184.7	177.6	+ 7.1	+ 4	+ 2.4
Vinas (K_{900}), 600 m^3/ha per year	185.1	176.8	+ 8.3	+ 5	+ 2.8
Cambic cernoziom ("Codru", station, Codru commune)					
Control	74.6	76.1	- 1.5	- 2	- 0.8
Cereal mash (N_{240}), 100 m^3/ha per year	79.1	74.1	+ 5.0	+ 6	+ 2.5

Table 6. The share of humidity and mineralization in 7-8 years of organic matter incorporated into the pore layer with different wastes, kg. Technological-experimental station "Codru", 2018

Variant of experience	Carbon in the soil			Humus obtained from 1 t of waste
	introduced with fertilizers	humifiable	mineralized	
Control	-	-	-	-
Wine yeast (N_{200}), 26 t/ha per year	6084	2981	3684	159
Vinas (K_{900}), 600 m^3/ha per year	4620	2171	1820	8
Control	-	-	-	-
Cereal mash (N_{240}), 94 m^3/ha per year	2980	1669	480	46

Influence of waste from the production of alcoholic beverages on the quality of soil humus. The three groups of humus-forming substances are: humic acids, fulvic acids and humus. The research carried out at station "Codru" on cambic chernozem (Tables 3, 4) demonstrates that the application of yeast, wine and cereal boron does not produce appreciable effects on the composition of organic matter in the soil.

Balance of humus in the soil at the application of waste from the production of alcoholic beverages. In order to maintain the humus in the soil at levels corresponding to maximum possible crops, it is necessary to know, on the one hand, the evolution of its annual mineralization process, on the one hand, the restoration of vegetable residues and the possible addition of organic fertilizers. This means determining the difference between the annual humus gains resulting from the decomposition of rootstocks, stubble, plus organic fertilizers, and annual humus losses through organic carbon mineralization. The

balance is usually expressed in kg of humus per hectare.

We mention that the current state of soil fertility is unsatisfactory and on some of the land - critical. The balance of humus is negative. Humus - one of the main signs of soil fertility as a result of erosion and dehumidification is decreasing. Taking into account the current state of the soil cover, the low level of fertility in the experiments of the laboratory. "Organic fertilizers and soil fertility", it was studied the modification of the humus content in the soil at the application of various wastes from the production of alcoholic beverages.

The application of wine waste (wine and wine lees) led to the creation of a positive humus balance of respectively 2.4 and 2.8 t/ha annually (Table 5). The corn borer applied at a dose of 100 t/ha (equivalent to N_{240}) produced a humus balance of 2.5 t/ha annually.

The share of the humidity and mineralization in the 7-8 years of the organic matter incorporated into the pore layer with different waste from the production of alcoholic beverages is shown in Table 6 and shows the following: from 1 t of wine sprouts incorporated in the soil 159 kg humus, wine - 8 kg and cereal bore - 46 kg.

CONCLUSIONS

Wines, wine and cereal borers experimented in medium doses as organic fertilizers have significantly enriched the soil with humic organic matter. The specific humus increase in the pore layer from 1 tonne of waste incorporated as organic fertilizer consisted of: 95-99 kg wine yeast; 5-7 kg vinas and 24-29 kg grain mash. The degree of humification of the organic matter introduced with the waste was relatively constant, oscillating within 30-42%, with a weighted average humification coefficient of 0.36.

Therefore, 36 percent of the organic material incorporated with the wastes listed in 7-8 years turned into luminescent and fulvic acids. In the process of humification the addition of organic matter to the waste accumulated predominantly with humic acids, which is characteristic for the chernozem soils. The ratio of humic acids: fulvic acids in the experiments performed oscillated between 2.4-3.3.

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