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CONSIDERATIONS ON ENERGETIC EFFECT TO CROP PRODUTION ON ERODED SOILS

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Abstract

At the current stage of the development of society, there is an increasing need for food, which favours the production in agriculture, the intensive use of agricultural techniques, increased norms of fertilizer, in order to avoid the deficit of nutritive elements and to decrease soil fertility. Soils with varying degrees of erosion are often employed in agricultural production; the share of highly eroded soils in the Republic of Moldova is of 114,000 ha (14.5%). Thus, with 1% increase of the agricultural production, the energy expenditure is increased by 2-3%. As a result, there appears the need to develop and implement energetic-economic, energetic-profitable and natural resource protection technologies in the agricultural production system. The solution of the identified difficulties consists in the initial awareness of the mutual relationship between the latter and the adaptation of the existing agricultural technologies to the contemporary ones, whose distinctive character consists in using information technologies in agriculture production. This involves quantitative assessment, management and optimization of energy flow in agro-ecosystems. As a result of scientific investigations carried out within the Institute of Pedology, Agrochemistry and Soil Protection "Nicolae Dimo", geo-information technologies were implemented in order to estimate the types of degradation and the energy analysis method in agriculture, so as to contribute to lower energy costs in agricultural production and to reduce the soil degradation process through erosion.

Key words: crop production, energetic effect, soil erosion.

INTRODUCTION

To develop a balanced ecological system on the performance agriculture, indispensable, the major value has analysis of agro ecological landscape capacity analysis and its potential biological structure. However, we must not forget that soil organic matter is one of the basic accumulators and natural resources of energy on Earth.

Based on the fact that environmental conditions have worsened, have been intensified degradation processes of fertility and soil quality, and appropriately reduced the productivity in agriculture. On the result, the energy and education status of their rational management are very current.

Results on the energy reserves of the organic matter of soil are found at many scientists [1, 3, 4], it is proved the global role of humus as a colossal geochemical accumulator, the main keeper the solar energy of the Tere's surface. The Total reserves of energy that link to the humus of the soil cover are equivalent or even to some extent prevail over its accumulating in the surface of the fitomass.

From the point of ecological and agronomical view at the same level of energy reserves of the humic substances is important and actual to estimate that part of the energy of soil organic matter that which can be mobilized on the processes of transformation and which participating in circulation of substance and energy, is used by living organisms for vital processes, appropriate, determine crop productivity, influence on soil processes and its fertility.

In the frame of developing modern technologies for precision farming and performance is required to estimates the natural potential and anthropogenic of soil resource, energy potential of soil organic matter as energy accumulator towards crop productivity of these soils.

An important condition for dealing with the ecological crisis is ecologisation of agriculture, managing the processes of reproduction of soil organic matter and its energetical potential.

MATERIAL AND METHOD

The researches were performed at experimental stations of soil science and soil erosion of Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo", village Ursoaia, district Cahul, on slopes with an inclination of 4° - 6° and East and West exposition, with length of 400 m.

Based on ecological and economic situation were researched for cultivation of perennial grasses on highly eroded cernoziom. Mixture of perennial grasses was composed of *Bromus inermis Lezss* and *Onobrichis viciifolia Scop*.

Plant growth and development depends, as we know, the nutrient content in soil, and the rate of plant development, their ability to use soil nutrients for crop formation, depend on the requirements for fertilizer plant.

For these reasons, in the experience we used two groups of fertilizers: organic fertilizers, as manure (bovines) and chemical fertiliser (Ammophos, potassium sulphate and ammonium nitrate) the dose of 60 kg / ha of active substance for each primary element (NPK).

Determination of the energy potential of soil organic matter and energy content of the production of perennial irburi (dry grass) was determined using the method of calculating the structure and potential energy of organic matter of the soil from agricultural landscape [2].

RESULTS AND DISCUSSIONS

Assignment of land at high risk for erosion in the agricultural cycle requires careful attention to the development of crop rotation scheme and required to perform agricultural work in order to be mitigate maximal the degradation of soil quality and fertility.

At the begining of the experience to growing perennial grasses was found that the humus content was 2.1% decreasing during seven years after from weeding cultivation and cereal crops with 1.1%. All this took place, especially, result of washing the surface layer at the expense of rainfall.

Later growing perennial grasses increased the protection of soil till 80-90 %, contributed to reducing leakage from the solid surface and soil loss with 30 t/ha/an (Table 1).

Table 1. Amount and cost of washing soil by erosion to the cultivation of crops in strips and monoculture

Slope orientation, of sector	Tilling		Corn		Winter wheat		Pease		Perennial grasses		Culture system in strips	
	t/ha	lei/ha	t/ha	lei/ha	t/ha	lei/ha	t/ha	lei/ha	t/ha	lei/ha	t/ha	lei/ha
Vest I	33.6	2113	27.5	1732	6.7	422	13.1	826	1.0	64	12.8	791
Est II	25.8	2225	21.1	1822	5.1	443	10.0	858	0.8	67	12.1	1122
Vest III	51.7	4022	42.4	3298	10.3	804	17.8	1525	1.7	121	24.1	1793
Est IV	30.9	1887	24.6	1567	6.0	265	9.8	780	0.9	58	10.7	709

It is known that perennial grasses are well developed root system due to which they contribute to improved physical properties, physico-chemical and increasing organic matter content in soil profile.

In our experience the humus content in the unfertilized variant, increased from 2.1% till 2.5% during four years.

In variants where they applied fertilizers, organic matter content increased to 2.84-2.98 % (Table 2).

Soil organic matter has a wide range of tasks relating to the sustainable functioning of soil on the frame of natural ecosystems and agricultural.

Energy potential of their, determine the soil fertility and ecological status.

For characterize of the energy potential were selected following indicators: humus content (C), energy reserves of humic substances (Qh), energy potential of soil organic matter (Q), energy capacity of the soil (E) and energy content of the soil (Ec).

From Table 2 we can see that the cultivation of perennial grasses on highly eroded soil it positively affects the energy potential of soil. Both at the variants fertilized and unfertilized variant the energy potential is characterized, in 2000 year that it has the optimal values from 4633.7 GJ till 4787.6 GJ and it is an increase in the years of study that to the the year 2003 values to be from 5488.6 GJ till 6439.3 GJ. It clear that variants where were applied organic fertilizers, even at one time to the begining of experience is characterized by higher values.

Table 2. Influence of perennial grasses and fertilizers on the structure of the energy potential of strongly eroded chernozem

Variant	Humus content, %	Energy potential of soil organic matter, **Q, GJ/ha**	Energy reserves of humic substances, **Qh, GJ/ha**	Energy capacity of the soil, **E, GJ/ha**	The energy content of the soil, **Ec, GJ/ha**
2000					
Witness	2.41	4633.7	4116.7	1372.2	1440.9
Manure 100 t/ha	2.43	4672.2	4150.9	1383.6	1452.8
Manure 200 t/ha	2.53	4864.5	4321.7	1440.6	1512.6
$N_{60}P_{60}$ annual	2.48	4768.4	4236.3	1412.1	1482.7
$N_{60}P_{60}K_{60}$ annual	2.49	4787.6	4253.4	1417.8	1488.7
2001					
Witness	2.49	5380.5	4253.4	1417.8	1630.5
Manure 100 t/ha	2.52	5445.4	4304.6	1434.9	1650.1
Manure 200 t/ha	2.58	5575.0	4407.1	1469.0	1689.4
$N_{60}P_{60}$ annual	2.52	5445.4	4304.6	1434.9	1650.1
$N_{60}P_{60}K_{60}$ annual	2.65	5726.3	4526.7	1508.9	1735.2
2002					
Witness	2.52	5445.4	4304.6	1434.9	1650.1
Manure 100 t/ha	2.56	5531.8	4373.0	1457.7	1676.3
Manure 200 t/ha	2.93	6331.3	5005.0	1668.3	1918.6
$N_{60}P_{60}$ annual	2.71	5855.9	4629.2	1543.1	1774.5
$N_{60}P_{60}K_{60}$ annual	2.78	6007.2	4748.8	1582.9	1820.4
2003					
Witness	2.54	5488.6	4338.8	1446.3	1663.2
Manure 100 t/ha	2.63	5683.0	4492.5	1497.5	1722.1
Manure 200 t/ha	2.98	6439.3	5090.4	1696.8	1951.3
$N_{60}P_{60}$ annual	2.78	6007.2	4748.8	1582.9	1820.4
$N_{60}P_{60}K_{60}$ annual	2.84	6136.8	4851.2	1617.1	1859.6

Energy reserve of the totality of humic substances comes as an indicator to confirm the role of perennial grasses and organic fertilizers to increase the energy value of soil. Just cultivation of perennial grasses led to increased energy reserve in the arable layer with 222.1 GJ after four years of development. The organic fertilizers and chemicals, both, increase the supply of energy values for humic substance in the middle with 120-200 GJ per year. Thus, for 2003 year they were for organic fertilizers 5090.4 GJ, and for those chemical 4851.2 GJ.

Graphical representation of the energy content of soil productivity and energy potential towards the perennial grasses can give us a clearer regarding lair results (Fig. 1, 2, 3, 4).

According to data obtained is noted that the energy potential of soil organic matter at the experimental field have a positive impact on productivity of perennial grasses.

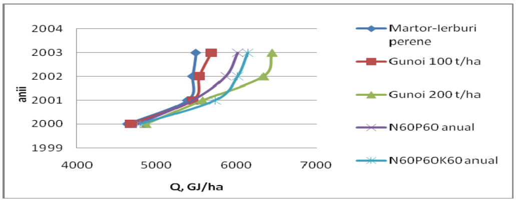

Fig. 1. Potential energy values of soil organic matter based fertilizers in the cultivation of perennial grasses

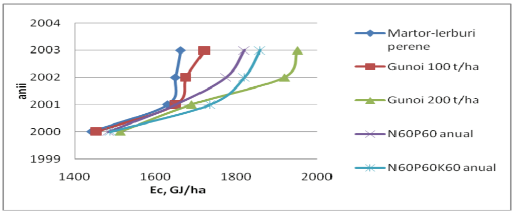

Fig. 2. Values of energy content of the soil according to fertilizers in the cultivation of perennial grasses

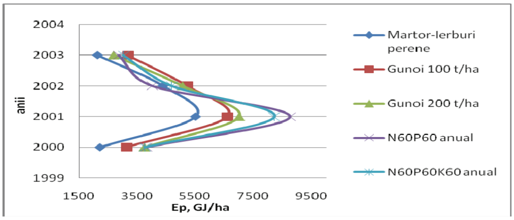

Fig. 3. Energy content in the production of perennial grasses (dry grass) according to fertilizer administered

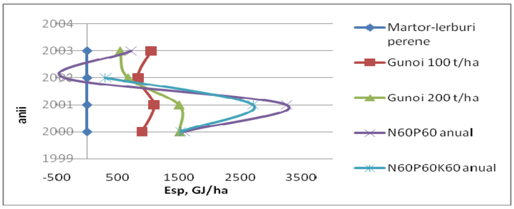

Fig.4. Energy content in addition to production of perennial grasses (dry grass) according to fertilizer administered

On variants where organic fertilizers were applied is obtained uniform yields for whole period of study. The most productively was be the 2001 year when, the harvest in energy units was 6606.6 GJ/ha, 7016.8 GJ/ha, and for variants with chemical fertilizers 8768.2 GJ/ha, 8226.4 GJ/ha. Addition harvest is also the highest this year, it being 1090.6 GJ/ha, 1500.8 GJ/ha and appropriate 3252.2 GJ/ha, 2710.4 GJ/ha.

CONCLUSIONS

Character and direction of orientation of flow of substances and energy in an ecosystem determines the formation of soil fertility, sustainability and the production of this.

Cultivation of perennial grasses on eroded soil ensures protection at 90%. The amount of washing soil is 0.9-1.7t/ha the cost of soil loss being 25-121 lei/ha;

To the perennial grasses cultivation the energy potential of soil organic matter increases with 100 GJ/ha/year;

Due to perennial grasses and fertilizers given, the energy capacity of the soil increases in average with 54 GJ/ha annual. The major effect of energy storage is observed for variants with organic fertilizers 200 t/ha and $N_{60}P_{60}K_{60}$;

Energy potential of soil organic matter ensure the addition to harvest perennial grasses (dry grass) calculated in energy units, equal to 1090.6 – 3252.2 GJ/ha/year.

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