Resource conservation, organic materials, bioconversion, resource-saving effect, solid organic waste.

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DVOYEMNISNA MODEL humus Soil environment agroecosystems

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The results of modeling humus soil based on flows and stocks of carbon in soil humus and organic carbon nehumusnoyi nature - organic residues and organic fertilizers.

Humus, carbon productivity, the model dynamics.

Formulation of the problem. Agro-ecosystems should be governed by man. Any increase productivity of agro-ecosystems requires increasing energy costs, including human. They go on to maintain energy potential agro-ecosystems or change the conditions for its implementation.

The value of the flow of human energy depends on the goal that puts producer of agricultural products, mainly to maximize revenue by reducing the energy intensity of production. This is achieved or reduction of energy consumption at a fixed level of performance or rapid productivity growth to increase energy. The first problem is solved by rational organization of labor and production, replacing energy-intensive operations more energy efficient, second - increasing levels of system performance[1]. The latter is defined bioclimatic potential, soil fertility, socio-economic conditions.

Easy and effective measure of increasing productivity agro-ecosystems is the humus content in the soil [2]. If the functioning of agro-ecosystems humus content increases, then we can talk about increasing levels of system performance. If the humus content in the functioning of agro-ecosystems is not changed, the system does not change their performance levels, and if the humus content decreases, the system operates with reduced levels of performance.

Analysis of recent research. According to the research [3-6] simulation humus can be carried out based on the flows and stocks of carbon in soil humus and organic carbon nehumusnoyi nature (organic residues and organic fertilizers). Spending articles humus are: use of simple substances hydrolysis humus (amino acids, amines, amides) plants for their growth and development; mineralization of humus microorganisms; humus loss as a result of erosion.

Articles flow is humus, manure and compost as a source of nutrients; leaving stubble in the field (of straw, crop stalks, tops and other similar organic residues); of mineral nitrogen fertilizers to improve factors humification of plant residues (8-10 kg / t stubble); root system remaining in the soil after harvest of the main crop; syderalnyh sown crops (green manure); Root selection of organic substances (eskudat); microorganisms or soil microfauna (up to 14 t / ha); mesofauna soil.

The purpose of research. Modeling humus soil environment during operation agro-ecosystems.

Results. We know that Modeling humus can be carried out on the basis of different variants of models that describe the flows and stocks of carbon in soil humus and organic carbon nehumusnoyi nature (organic residues and organic fertilizers) [3-6]. We have chosen a model based on two containers, which is shown in Fig. 1.

Changing the carbon content of humus in the soil can be determined by a system of equations [7]

$$\begin{cases} V\dfrac{dY}{dt} = \Pi V - k_y YV - k_{yx} YV = \Pi V - YV\left(k_y + k_{yx}\right) = \Pi V - k_T YV; \\ V\dfrac{dX}{dt} = k_{yx} YV - k_x XV; \end{cases} \quad (1)$$

where: $k_y YV$ - Annual carbon mineralization nehumusovoyi nature of the soil, kg / year; $k_{yx} YV$ - Annual carbon humification nehumusovoyi nature of the soil, kg / year; $k_x XV$ - Annual carbon mineralization of humus in the soil, kg / ha year.

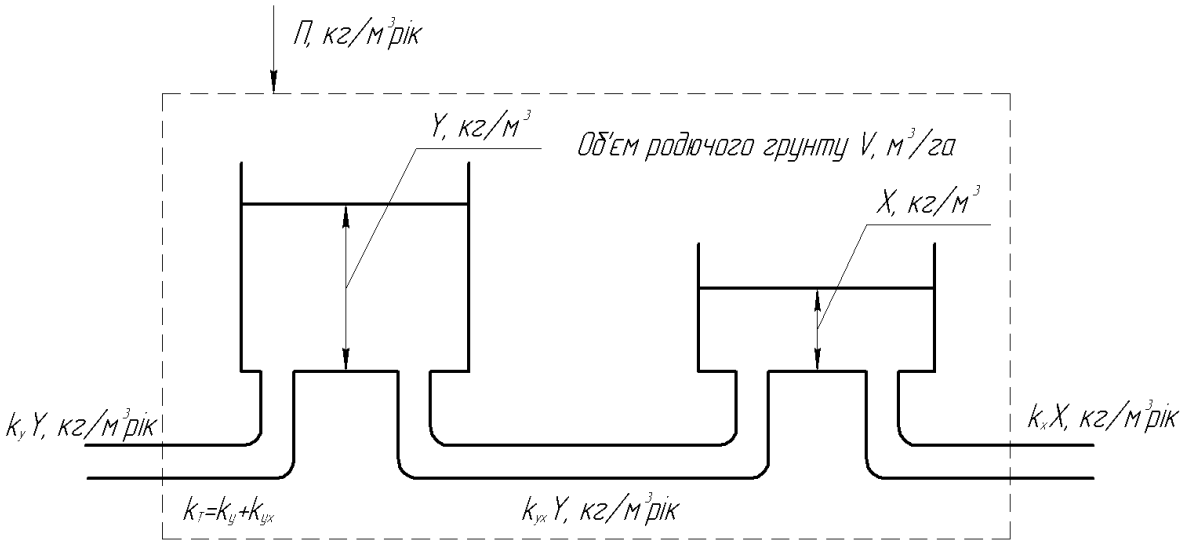

Fig. 1 Calculation of changes in soil carbon content: $П$ - The annual flow of carbon nehumusovoyi nature of the soil, kg / m3 per year; Y - Carbon content nehumusovoyi nature of the soil, kg / m3; X - Carbon content of humus in the soil, kg / m3; V - The amount of topsoil, m3 / ha; k_y - The annual rate of carbon mineralization in the soil nehumusovoyi nature, relative. units. / year; k_{yx} - The annual rate of carbon humification nehumusovoyi nature of the soil, ratio. units. / year; k_x - The annual rate of carbon mineralization of humus in the soil, ratio. units. / year; $k_T = k_y + k_{yx}$ - The annual rate of transformation of nature nehumusovoyi carbon in the soil, ratio. units. / year.

After appropriate transformations on the basis of (1) received general solution of differential equations [7], which is:

$$X = \frac{1}{k_T - k_x}\left(-X_0 k_x + \frac{k_{yx}}{k_T} П - \left(\frac{dX}{dt}\right)_0\right)\exp\left(-k_T t\right) + \\ + \frac{1}{k_T - k_x}\left(\left(\frac{dX}{dt}\right)_0 + X_0 k_T - \frac{k_{yx}}{k_x} П\right)\exp\left(-k_x t\right) + \frac{k_{yx}}{k_x k_T} П. \quad (2)$$

At $t = 0$ the carbon content of humus $X_t = X_0$, While $t = \infty$ humus is:

$$X_t = \frac{k_{yx}}{k_x k_T} П. \quad (3)$$

Based on the equation (2) found that in order to prevent dehumifikatsiyi virgin soil and humus to keep the original, you must make each year in soil carbon in nature nehumusovoyi number:

$$П = \frac{k_x k_T}{k_{yx}} X_0. \quad (4)$$

To test the model presented dynamics of the carbon content of humus, used data GY Chesnyaka and MK Shykuly [8, 9] by Michael stationary experiment for rotation with perennial grasses (see. Table. 1).

According to the comparative table constructed graphs (Fig. 2) on which it can be argued that the presented model of the carbon content of humus in the fertile layer of soil is adequate and allows you to perform relevant calculations.

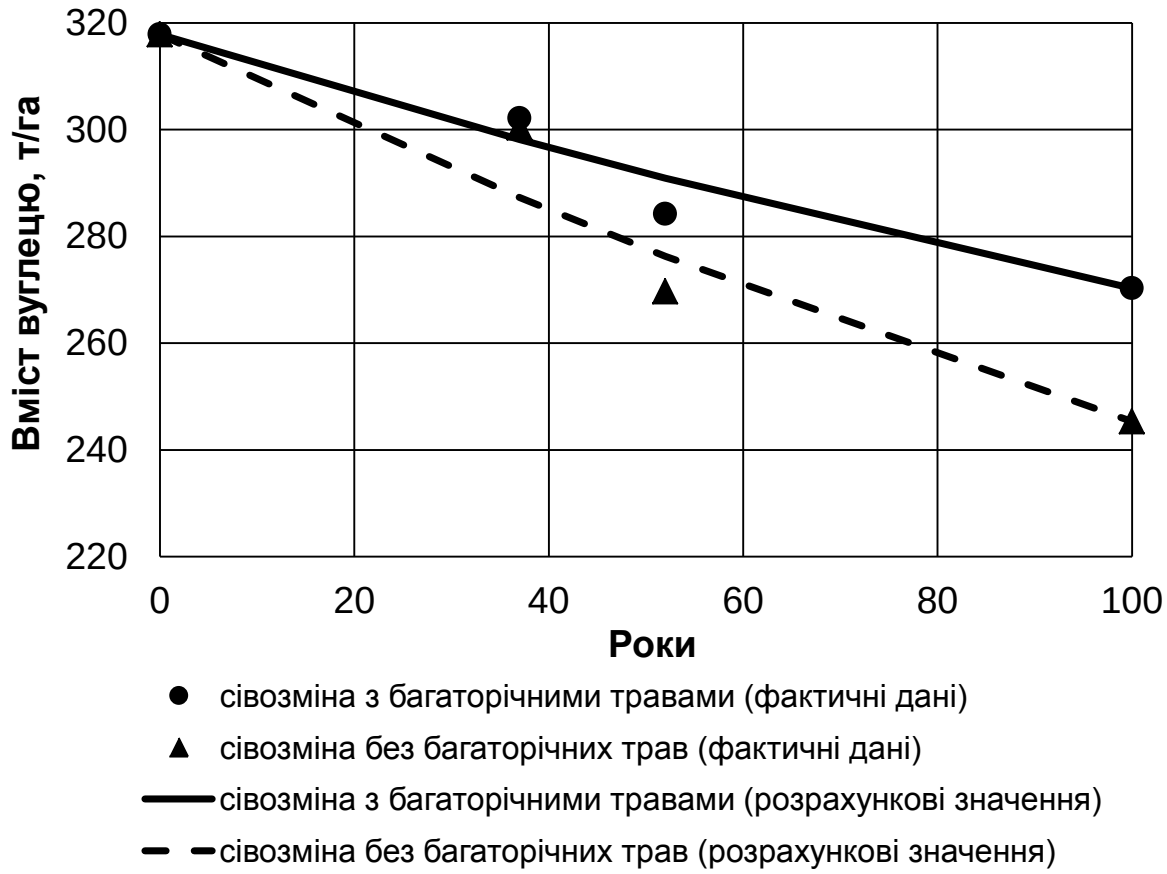

Fig. 2. Comparison of actual and calculated values change carbon humus in the soil.

1. The test results of a mathematical model that describes the change in the carbon content of humus according stationary field experiment in the typical black soil Michael virgin (layer of soil to 1 m).

The time from the start of plowing virgin, years	Reserves of humus and humus in the soil carbon (According Chesnyaka GY) t / ha			
	crop rotation with perennial grasses		without crop rotation of perennial grasses	
	reserves of humus	carbon stocks	reserves of humus	carbon stocks
0	548	317.84	548	317.84
37	521	302.18	518	300.44

52	490	284.2	465	269.7
100	466	270.28	423	245.34

Additional baseline data	crop rotation with perennial grasses	without crop rotation of perennial grasses
The annual flow of carbon into the soil nature nehumusovoyi P t / ha	3.12	2.52
Humification ratio of annual carbon nehumusovoyi kyh nature, relative. units.	0.2	0.2
Ratio of annual carbon mineralization of humus in the soil kx, Rest. units.	.0038	.0044
Annual carbon transformation ratio is not natural humus kT, Rest. units.	1.0	1.0
The initial carbon content of humus in the soil X0, t / ha	317.84	317.84
The initial rate of change in carbon content in humus $\left(\frac{dX}{dt}\right)_0$	-0.4756	-0.725
Constant differential equation C1	-0.096	-0.174
Constant differential equation C2	152.03	203.76
The carbon content of humus in the soil in the steady state Xt, t / ha	165.91	114.26

The time from the start of plowing virgin, years	Calculated according to the proposed model, t / ha			
	crop rotation with perennial grasses		without crop rotation of perennial grasses	
	reserves of humus	carbon stocks	reserves of humus	carbon stocks
0	548	317.84	548	317.84
37	514	298.19	495	287.33
52	502	290.93	476	276.25
100	466	270.28	423	245.34

Rejecting the calculated values of carbon humus estimated the actual index determination (square correlation ratio), which was for rotation with perennial grasses 0.952, and for the rotation without grasses - 0.931.

Conclusion. The model of the dynamics of carbon in humus layer of fertile soil is adequate and allows to calculate the carbon content of humus in the soil. Index determination, based on the estimated value is approaching the calculated values of humus content and actual amounts for rotation with perennial grasses 0.952, and for the rotation without grasses - 0.931.

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Pryvedeny modeling results STATUS humus soil based on flows and stocks of carbon in the soil and humus Organic carbon nehumusnoy nature - ostatkov Organic and Organic fertilizers.

Humus, carbon, proyzvodytelnost, model dynamics.

The simulation humus soil based flows and stocks of carbon in soil humus and organic carbon do not humus source - organic residues and organic fertilizers are given.

Humus, carbon, productivity, model, dynamics.