Original Article

Information And Energy Assessment Of Genesis And Fertility Soil

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Abstract

The genesis and fertility of soils are determined by the processes of transformation, migration and accumulation of matter, energy and information. It is proved that these processes determine the intensity of the development of podzol formation in soils, gleying, and the soddy process.

It is shown that it is more profitable to grow on more cultivated soddy-podzolic soils, from an energy point of view. Winter wheat, on less cultivated - perennial grasses. On less cultivated soils, there is a greater risk of crop failure under adverse weather conditions.

It is proposed to carry out an information assessment according to the multiple correlation equations. It is proved that the information-energy assessment of soils is necessary for the correct characterization of the genesis and fertility of soils.

Keywords. Soil, energy, information, soil genesis, fertility

Goals and objectives of the study. The purpose of the study was an information-energy assessment of the genesis and fertility of soils.

The objectives of the study included studying the influence of their energy state on soil properties, assessing the impact on soil properties, processes and regimes of the relationship between soil properties, their information characteristics.

Research objects. Soddy-podzolic soils of the Moscow region and ordinary chernozems of the Krasnodar Territory were chosen as the objects of study (2, 3, 4, 6).

The research methodology consisted in assessing the agrochemical and physicochemical properties of soils, their complexing ability (1, 5), the rate of processes (9), soil microbiological activity (7), salinity (12) of the root zone of plants (11), in the calculation relationships of soil properties (5, 8, 10).

Experimental part

The genesis and fertility of soils are determined by the transformation, migration and accumulation of matter, energy and information. These factors determine both the totality of soil properties and the processes and regimes occurring in soils: Σ properties = K[P][kiXi], where Σ is the totality of soil properties k [P], the totality of rock properties and the degree of their influence on the genesis and fertility soils, kiXi is the totality of soil formation factors and their influence on the rock in the processes of soil genesis and evolution.

At the same time, the degree of influence of individual factors on the breed, the duration of their influence and the sequence of influence with the manifestation of synergistic and antagonistic effects are of great importance.

From our point of view, the geophysical fields of the Earth and the microbiological activity of soils are additional factors of soil formation. At the same time, the influence of soil formation factors on the rock is determined by the

intensity of their impact, duration, sequence of influence of individual factors with the manifestation of synergistic and antagonistic effects. In all cases, in the processes of genesis and evolution of soils, the processes of transformation, migration and accumulation of matter, energy and information take place.

Energy assessment of the genesis and fertility of soils

All processes occurring in agrophytocenoses and in biogeocenoses proceed with the transformation, migration and accumulation of matter, energy and information. They determine changes in soil properties, processes and regimes occurring in soils. Simultaneously, in different parts of the system, processes occur with the accumulation of matter, energy and information and with their loss.

At the same time, in accordance with the Delgado principle, any reaction is accompanied by the absorption and release of matter, energy and information. Some components of water-soluble organic substances decompose, others absorb the released components of matter, energy and information and complicate their structure.

For all components of biogeocenoses, there are minimum amounts and states of matter, energy and information, optimal and maximum allowable for their development. Their transformation, migration and accumulation are closely interrelated.

The accumulation of energy in the soil, in humus, in microflora and in phytomass depends on the cultivated crop and soil fertility. This is confirmed by the data in the following table.

Table 1 The energy intensity of humus and the productivity of field crops on soddy podzolic soils, depending on the degree of their cultivation

culture	Option	Humus, million kcal/ha	Energy intensity of phytomass, million kcal/ha
winter wheat	OK1	209	22,8
perennial herbs	OK3	270	41,2
	OK1	210	37,7
	OK3	283	60,9

As can be seen from the presented data, the energy intensity of phytomass is significantly higher under grasses than under winter wheat, both on poorly cultivated and well-cultivated soils. The energy intensity of the phytomass of grown plants more often correlates with the energy intensity of humus, the mineralogical composition of soils and is inversely proportional to the amount of energy that plants must expend to achieve the planned bio-productivity: $Y = \Sigma K1X1$, where K1 is the energy costs of plants for the consumption of N, P, K, etc., X1 is the number of consumed elements.

Both the absorption of energy in the soil and the accumulation of energy in the yield of individual crops depend on the cultivation of soils, i.e. profitability of growing individual crops. This is illustrated by the data in the following table.

Table 2 Energy efficiency of growing individual crops on soddy-podzolic soils of varying degrees of cultivation

Fertility level	Culture	Alienation with harvest, kka/ha
OK	wheat	10632000
	herbs 1st year	24149000
OK	wheat	5537000
	herbs 1st year	44344000

As can be seen from the presented data, it is more profitable to grow less demanding crops on less fertile soils.

On soils of varying degrees of cultivation and unequal risk of crop failure under adverse weather conditions. This is illustrated by the data in the following table.

Table 3 The risk of crop failure on soddy-podzolic soils when

adverse weather conditions, million kcal/ha

Culture	Degree of culture	Risk of crop decline, %
winter wheat	OK1	99,0
	OK3-2	96,7
herbs 1st year	OK1	70,0
	OK3-2	45,1

Informational assessment of the genesis and fertility of soils

All substances contain energy and information. They are used by plants, microflora and soil with different efficiency. Any process of transformation, migration and accumulation is accompanied by a change in matter, energy and information.

Soil fertility and crop yields largely depend on the relationship between soil properties. So, according to our data, for soddy-podzolic soils in the range of pH = 5.5-8.0, the following dependences were manifested: Zn = 22.8 - 3.2 pH; R2 = 0.82; F=12.3; Cu = 5.48 - 0.59 pH R2 = 0.86; F = 17.6.

At the same time, interrelations between several properties are manifested in soils. This is illustrated by the data in the following table.

Table 4 Relationship of humus content with the content of mobile phosphates and manganese in soddy-podzolic soils (n = 34)

Humus, %	PO, mg/100 g	Mn, mol/l 10
1,17±0,06	4,79±0,47	0,30±0,21
1,19±0,09	25,45±1,80	0,03±0,03
1,86±0,05	4,64±0,94	1,40±0,40
1,76±0,04	55,40±20,10	0,34±0,17

As can be seen from the presented data, with an increase in the content of phosphates in soils, the content of water-soluble manganese sharply decreases.

As a rule, the content of mobile forms of one element in the soil is associated with several soil properties. Thus, according to our data, the dependence of the content of humus (U) in soddy-podzolic soil depended on the amount of phytomass X1 entering the soil (c/ha), on the amount of calcium entering the soil - X2 (kg/ha), from the ratio in the plant residues of the precursor C/N (X3): Y = 0.74 + 0.03X1 - 0.03X2 + 3.5X3; R = 0.31; coefficient of elasticity for Y - X1 = 1.01; for Y - X2 = -1.12; for Y - X3 = 0.54.

According to our studies, it is advisable to consider information relationships in the soil-plant system, in the structure of the soil cover, in the horizons of the soil profile, between the properties, processes and regimes of soils. As a rule, direct, reverse and sequential connections and interconnections are manifested. Information is carried by interrelations of substance, energy and information, transformation, migration and accumulation, between solid, liquid and gaseous phases. As a rule, the relationships between soil properties were described by regression equations. However, they are valid only in certain intervals of dependent and independent variables and differ as the number of variables increases.

According to the data we received, it should be taken into account that certain relationships are valid only within certain limits of independent variables. At the same time, the relationships differ for soil-memory and soil-moment. From a practical point of view, it is important that both the optimal soil properties and the MPC and MPC depend on the relationships. The past determines the present, but the future also determines the present.

With an unjustified increase in fertilizer doses in soils, the law of diminishing returns manifests itself: a decrease in income by 1 ruble of costs, a decrease in crop growth by 1 ruble of costs, a decrease in the improvement in product quality by 1 ruble of costs. This is illustrated by the data in the following table.

Table 5 Changes in the content of gluten and protein in winter wheat graindepending on the doses of applied fertilizers

Option	OptionIncrease content	Content increase

	gluten per 1 kg NPK	protein per 1 kg NPK
N30 P30 K30	0,03	0,03
N120 P120 K120	0,04	0,01

According to our data, for soddy-podzolic soils of the Moscow region at a fertilizer dose of 174 and 313 kg a.i. per 1 ha, the increase in yield in kg per 1 kg of NPK was 2.5 and 0.8 for wheat; for barley - 3.7 and 2.6.

According to our data, on well-cultivated soddy-podzolic soil, when NPK was applied for use by crops of 2% PAR and 3% PAR, alienation from the field with a crop was 29.3 and 25.3 million kcal/ha, respectively, or per 1 centner of NPK - 0.14 and 0.08. For the maximum yield, these values were 0.39 and 0.22.

According to our data, the law of diminishing returns manifests itself not only with unreasonably high doses of impact on the soil of a substance, but also of energy and information.

Conclusion. In all processes occurring in soils, there is a transformation, migration and accumulation of matter, energy and information with the manifestation of direct and consistent relationships. Changing the state of the soil

ΣKiXi = Σk1 matter + k2 energy + k3 information, taking into account their interrelationships and the manifestation of synergistic and antagonistic effects, where k is the degree of influence.

At the same time, it is necessary to take into account the intensity of the effect on the soil and the duration of the effect, as well as the sequence of impact on the rock and soil of individual processes, incl. energy and information.

The necessity of taking into account the parameters of energy and information is proved when assessing the optimal properties of soils and the maximum permissible concentrations of toxicants, the maximum permissible levels of impact on the soil-plant system of anthropogenic and geophysical fields of the Earth.

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