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# INFORMATION AND ENERGY ASSESSMENT OF GENESIS AND FERTILITY

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**Annatation:**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 development of podzolization in soils, gleiing, and the sod process.
It is shown that on more cultivated sod-podzolic soils it is more profitable to grow, from an energy point of view. Winter wheat, on less cultivated soils - perennial grasses. On less cultivated soils there is a greater risk of yield decline under unfavorable weather conditions.
It is proposed to carry out an information assessment using multiple correlation equations. It is proved that information and energy assessment of soils is necessary for the correct characterization of the genesis and fertility of soils.

**Key words:** soil, energy, information, soil genesis, fertility

**Аннотация:**Генезис и плодородие почв обусловлены процессами трансформации, миграции и аккумуляции вещества, энергии и информации. Доказывается, что эти процессы определяют интенсивность развития подзолообразования в почвах, оголения, дернового процесса.
Показано, что на более окультуренных дерново-подзолистых почвах выгоднее выращивать, с энергетической точки зрения. Озимую пшеницу, на менее окультуренных – многолетние травы. На менее окультуренных почвах больше риск падения урожая при неблагоприятных погодных условиях.
Предлагается информационную оценку проводить по уравнениям множественной корреляции. Доказывается, что информационно-энергетическая оценка почв необходима для корректной характеристики генезиса и плодородия почв.

**Ключевые слова**: почва, энергия, информация, генезис почв, плодородие

The aim of the study was the information and energy assessment of the genesis and fertility of soils.
The objectives of the study included studying the influence of the energy state of soils on their properties, assessing the influence of the relationships between soil properties and their information characteristics on the properties, processes and regimes of soils.
Research objects
The objects of the study were sod-podzolic soils of the Moscow region and ordinary chernozems of the Krasnodar Territory (2, 3, 4, 6).
The research methodology consisted of assessing the agrochemical and physicochemical properties of soils, their complexing capacity (1, 5), the rate of processes (9), the microbiological

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activity of soils (7), salinity (12) of the root zone of plants (11), and calculating the relationships between 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. In this case, the degree of influence of individual factors on the rock, 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, additional factors of soil formation are the geophysical fields of the Earth and the microbiological activity of soils. In this case, the influence of soil formation factors on the rock is determined by the intensity of their impact, duration, sequence of impact of individual factors with the manifestation of synergistic and antagonistic effects. In all cases, the processes of soil genesis and evolution involve transformation, migration and accumulation of matter, energy and information.

Energy assessment of soil genesis and fertility

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

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

For all components of biogeocenosis, there are minimum permissible quantities and states of substance, energy and information for their development, optimal and maximum permissible. Their transformation, migration and accumulation are closely interconnected.

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

Energy capacity of humus and productivity of field crops on sod-podzolic soils depending on the degree of their cultivation

| Culture | Option | Humus, million kcal/ha | Energy intensity of phytomass, million kcal/ha |
|---|---|---|---|
| winter wheat | $OK_1$ | 209 | 22,8 |
| | $OK_3$ | 270 | 41,2 |
| perennial grasses | $OK_1$ | 210 | 37,7 |
| | $OK_3$ | 283 | 60,9 |

As can be seen from the presented data, the energy capacity of the phyto mass is significantly higher under grasses than under winter wheat, both on poorly cultivated and well-cultivated soils. The energy capacity of the phyto mass of cultivated plants often correlates with the energy capacity 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.

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

Table 2

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Energy efficiency of growing individual crops on sod-podzolic soils of varying degrees of cultivation

| Fertility level | Culture | Alienation with yield, kca/ha |
|---|---|---|
| OK | wheat | 10632000 |
| | grass 1st year | 24149000 |
| OK | wheat | 5537000 |
| | grass 1st year | 44344000 |

Fertility level Crop Alienation with yield, kca/ha

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

On soils of varying degrees of cultivation, there is also an unequal risk of yield loss under unfavorable weather conditions. This is illustrated by the data in the following table.

Table 3

Risk of yield loss on sod-podzolic soils under unfavorable weather conditions, million kcal/ha

| Culture | Degree of culturalization | Risk of crop failure, % |
|---|---|---|
| winter wheat | $OK_1$ | 99,0 |
| | $OK_3$-2 | 96,7 |
| 1st year grasses | $OK_1$ | 70,0 |
| | $OK_3$-2 | 45,1 |

Informational assessment of soil genesis and fertility

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 both substance, energy and information. Soil fertility and crop yields depend to a large extent on the relationships between soil properties. Thus, according to our data, the following relationships were observed for sod-podzolic soils in the pH range of 5.5-8.0: Zn = 22,8 – 3,2 pH; $R^2$ = 0,82; F = 12,3; Cu = 5,48 – 0,59 pH $R^2$ = 0,86; F = 17,6.

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

Table 4

Correlation between humus content and the content of mobile phosphates and manganese in sod-podzolic soils (n = 34)

| Hummus, % | P O, mg/100g | 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 decreases sharply. As a rule, the content of mobile forms of one element in the soil is associated with several soil properties. Thus, according to the data we obtained, the dependence of the content of humus (U) in sod-podzolic soil depended on the amount of phytomass entering the soil X1 (c/ha), on the amount of calcium entering the soil –

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X2 (kg/ha), on the ratio in the plant residues of the predecessor C/N ($X_3$): U = 0,74 + 0,03$X_1$ – 0,03$X_2$ + 3,5$X_3$; R = 0,31; elasticity coefficient for U – $X_1$ = 1,01; для У – $X_2$ = -1,12; для U – $X_3$ = 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 relationships are manifested. Information is carried by the relationships of matter, 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 with an increase in the number of variables. According to our data, it should be taken into account that certain relationships are valid only in certain limits of independent variables. In this case, the relationships differ for soil-memory and soil-moment. From a practical point of view, it is important that both optimal soil properties and MAC and MPL depend on the relationships. In this case, 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 is manifested: a decrease in income per 1 ruble of costs, a decrease in yield growth per 1 ruble of costs, a decrease in improvement in product quality per 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 grain depending on the doses of fertilizers applied

| Option | Increase in gluten content per 1 kg NPK | Increase in protein content per 1 kg NPK |
|---|---|---|
| $N_{30}$ $P_{30}$ $K_{30}$ | 0,03 | 0,03 |
| $N_{120}$ $P_{120}$ $K_{120}$ | 0,04 | 0,01 |

According to our data, for sod-podzolic soils of the Moscow region, with a fertilizer dose of 174 and 313 kg of active ingredient per 1 ha, the yield increase 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 sod-podzolic soil, with the introduction of NPK for use by crops at 2% PAR and 3% PAR, the alienation from the field with the harvest 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 equal to 0.39 and 0.22.

According to the data we have obtained, the law of diminishing returns manifests itself not only with unreasonably high doses of exposure to 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 sequential interrelations.

Changes in the state of soils

It is necessary to take into account the intensity of the impact on the soil and the duration of the impact, as well as the sequence of the impact on the rock and soil of individual processes, including energy and information.

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

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