

METHODOLOGICAL CONCEPT OF POTENTIAL FERTILITY PLANIFICATION UNDER IRRIGATIONAL CONDITIONS

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Abstract

In this work a new methodological concept of potential fertility planification and rehabilitation under irrigational conditions. Using this method, a model of potential fertility planification was elaborated, which was verified with the usage of lysimetres. It was determined that black earth's fertility can be reestablished only using ecosystems' capacity of reestablishing their own productive and reproductive potential after elimination of destructive processes, including replacement of classical methods of investigation with using the methodology proposed in this study in the area of agro technology. It was ascertained that in case of alienation from biological mass of plants with more than 68%, the diminution of effective fertility of soil has a specific character: during 5-7 years, when the cultivated plants' pregnancy diminishes achieving one particular level, after that, it remains constant despite of the fact that the intensity of alienation process is still the same.

The results of our investigation were verified in conditions of lysimeters installed in the State Hydro meteorological Service area.

Key words: concept, fertility, metodologie, planification

The process of soil fertility reestablishment is studied with various methods. The most important ones are those of radiation balance and of optimization curves of investigated factors. These methods are equally used when we need to increase the harvest or when we need to reestablish and maintain soil fertility.

Nowadays, the process of degradation surcease and of soil fertility enhancement is understood as a simple elimination of soil nutrients deficit. Nutrients are necessary for harvest development and are calculated when they are needed. As a result, soil fertility in our country has never had any essential and stabile enhancement until now.

The motives why there was not any improvement in soil fertility are as follows:

1. In majority of cases while evaluation of organic substance balance and of nutrients, there is no attention paid to nitrogen circulation in soil ecosystem, presuming that asymbiotic, nitrogen fixing florula assimilates with insignificant quantity of nitrogen from the atmosphere.

In reality, asymbiotic, nitrogen fixing florula assimilates with significant (40-50 kg/ha) nitrogen quantity from the atmosphere (Korduneanu P.N., 1985). Being established the fact that the quantity of asymbiotic nitrogen in soil, after the introduction of straws can increase more than ten times than mentioned above. It was also determined that the quantity of accumulated asymbiotic nitrogen is in direct.

MATERIAL AND METHOD

The methodology consists of the analyses of the results attained by lysimetres with typical ratio with the volume of vegetal residues incorporated in soil (Korduneanu P.N. 1985). In fact, the asymbiotic nitrogen input is evident, if we analyze the process of soil fertility reestablishment that has degraded when left in fallow soil (Têrycè An., Sergentu E., Balan Tatiana, Čerbari V., 2005). In this case, vegetation is presented with growing of gramineous plants and we cannot admit that fertility reestablishment happens due to asymbiotic nitrogen (as well as when growing berries). It comes out that soil fertility would not be improved, if there were not the process of asymbiotic nitrogen assimilation from the atmosphere.

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2. In actual vision, the process of soil fertility reestablishment is seen as a simple reestablishment of organic substance balance in the ecosystem of soil by its incorporating in soil. A big mistake is when fertilizer hoppers are administered issuing from the harvest planned.

From our point of view, in order to reestablish soil fertility it is necessary to pay attention to reestablishment and/or maintenance of microbial system of soil which preconditions the process of soil formation. The realization of our suggestion in investigations and in agricultural practice would lead to a real solution of this scientific problem; because only by natural soil fertility improvement can we attain rich harvest and a stabile soil and environmental ecosystem. Reckoning it in, we propose a new concept of soil fertility reestablishment black earth and of the information synthesis of this problem.

RESULTS AND DISCUSSIONS

The concept is a mathematical model that depicts the natural process of soil formation having the possibility of its planification by modeling of different steps of organic substance balance deficit in soil ecosystem.

In the result of our experimental studies and synthesis we have determined:

1. In the experiment to evidence the method of investigation as the ecosystem's property to establish it while negative impact elimination (Coronovski A., Tèrycè A., Rusu Maria, Jabin V., 2008, Dediu, I.A., 2006).

2. New methodology (Coronovski A., Tèrycè A., Rusu Maria, Jabin V., 2008) used in our studies corresponds with the principle of microbiological system functionality (Guzev V. S., 1989) and with the legitimacy of the dominant types dynamics of soil microorganisms (Daubaras A.P., 1989). It does not lead to destabilization of the ratio between the types of microorganisms from soil, and keeps safe all the genetic proprieties of soil.

3. The artificial creation of organic substance balance leads to microbiological system's instability of soil and to diminution of its fertility, and to unjustified expenses (Coronovski A., Tèrycè An., Jabin V., Rusu Maria., 2010).

4. The planification of norms for fertilizer hoppers has to be based on the natural fertility and on the natural balance of organic mass from soil.

The planification of norms for fertilizer hoppers based on the planified harvest leads to functional instability of soil ecosystem, provoking negative tendencies in soil formation processes.

5. The positive influence of fertilizer types on the soil formation process decreases: undecomposed organic mass > decomposed organic mass or in the process of

decomposition > decomposed organic mass + mineral fertilizers.

6. The effective enhancement of soil fertility is maximal possible in conditions of complementally usage of mineral fertilizers, however, we do not recommend this method because it can have a negative impact on soil formation process.

7. The usage of classic method in investigation does not give a stabile soil fertility improving result (Černikov V.A., Milašenko M.Z., Sokolov O. A., 2001, Dumitraško M.I., 1987).

The results attained in the present study and from other scientific sources are in the base of a new model of planification and improvement of soil formation process. The model is based on the fundamental property of ecological system to reestablish its main characteristics after negative impact elimination (this property has also the soil (Tèrycè An., Sergentu E., Balan Tatiana, Čerbari V., 2010) as an ecologic subsystem of earth ecosystems). The model encompasses two components:

1. Mathematical model of the legitimacy between vegetal mass reproductions in the soil ecosystem.

2. Mathematical model of humus reproductions in soil ecosystem.

These models reckon in the following parameters:

Biological planified harvest (including radicular system);

The coefficient that expresses the quantity of vegetal organic dry mass used in soil after harvesting;

Radicular system's mass. According to some authors' calculations, for crops it constitutes approximately 35% from biological harvest;

Total content of carbon in radicular system and vegetal mass used in soil;

Atmospherically nitrogen quantity accumulated in soil by nitrogen fixing microorganisms. Reckoning it in, it was calculated that for 100 g of carbon used in soil, the microorganisms asymbiotically fix in soil 2.85 g of atmospherically nitrogen;

Medium content of nitrogen in plant's body.

Thus, the proposed models are based on the natural process of reproduction of organic substance in the soil ecosystem. I.e., the quantity of the organic substance produced in ecosystem (in optimal conditions of the development and activity of microbial system of soil and plants) in the preceding vegetal season has to be smaller or equal to the actual one.

In case of a total alienation of the biological harvest, the models show us that the level of the

reproduction diminishes, but is more than zero. Thus, the reproduction is assured of radicular system's mass and of nitrogen fixing bacteria's activity. Black earth's fertility cannot be imagined without their main component humus, as a result of the activity of decomposing microorganisms of soil. Mathematical modeling of the process of humification (biochemical decomposing of dead organic substance) with the formation of humic substance includes the following parameters:

The planified humus content;

The resulted humus content after descomposing of the preceding crop's mass;

The mineralized humus quantity;

The new made humus quantity;

The coefficient that expresses the quantity of organic mass used in soil;

The coefficient that expresses the humified part of the crop's mass;

The real planified harvest.

In continuation, in order to make an analysis of the model, we present its verification by soil formation process simulation.

Initial data: soil – black earth typical moderate; humus content – 3,3%; cereal plants: initial biological harvest – 145 units/surface unit.

We need to model the dynamics of soil fertility for different percentage of usage of vegetal residues in soil (in graphical form – figures 1-3).

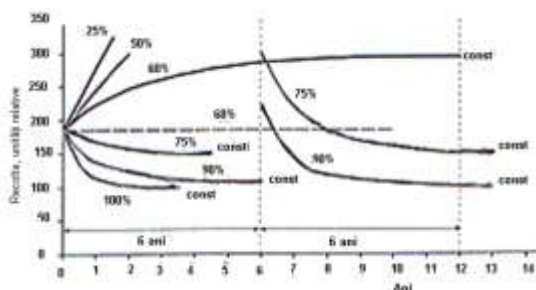


Figure 1. The dynamics of the generation of crop's organic mass for various grade of its alienation

As we see, the harvest tends to growth to its real potential, if the vegetal mass alienation's degree does not exceed 68%. In case of overtopping this degree, the total harvest diminishes until one particular degree, after that it remains constant. This degree depends on the quantity of nitrogen from the atmosphere and on the mass of plants' radicular system. Analyzing the intensity of total harvest diminution, it can be stated that for any vegetal mass alienation's degree with more than 68%, the period when the harvest level becomes constant is approximately 5-6 years. This period coincides with the periods when the Israelite from the Books of the Old Covenant laid land fallow (Bible, the Books of the Old).

For constant maintenance of the harvest on the high degree, it is necessary for vegetal mass alienation's degree be equal to 68%.

Analyzing the dynamics of humus content (figure 2), we see that in case of the alienation of vegetal mass of the harvest with 50%, humus content increases and achieves 6,7% in approximately 125 years, while total harvest level achieves maximal value in 4 years.

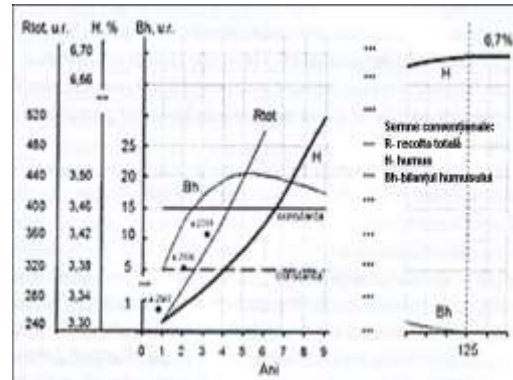


Figure 2. The dynamics of total vegetal mass (Rtot, relative unities), the dynamics of humus generation (H, %) and of humus balance (Bh, relative unities) in case of the alienation of vegetal mass of the harvest with 50% (2007-2009 – relative crops)

In 4 years the positive humus balance also achieves maximal degree, and becomes equal to zero in 125 years. I.e., the accumulation of humus generates all this time, as we see in the figure 2, but its degree can reach 6, 7%.

In case of the alienation of vegetal mass of the harvest with 60% (figure 3), the dynamics of humus balance has approximately the same tendency (figure 2). The intensity of its accumulation is smaller and, because of this, the quantity of humus that can be accumulated achieves 5,0% in 124 years. The total harvest reaches 290 unities (with 100 unities less than the preceding harvest) in 10 years. After that it becomes constant.

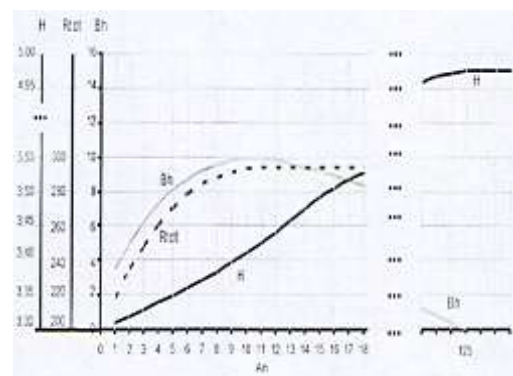


Figure 3. The dynamics of total vegetal mass (Rtot, relative unities), the dynamics of humus generation (H, %) and of humus balance (Bh, relative unities) in case of the alienation of vegetal mass of the harvest with 60%

With the 75% alienation of the vegetal mass, humus balance attains negative value, having its minimal value of 3,7 unities in about 6 years. This corresponds with the attainment of minimal level of total biological mass of the total harvest.

The evaluation of the results of the model in conditions of lysimeters shows us the inaccuracy with about 10-13%.

CONCLUSIONS

The fertility of the black earth can be reestablished only using ecosystems' capacity of reestablishing their own productive and reproductive potential after elimination of destructive processes, including replacement of classical methods of investigation with using the methodology proposed in this study in the area of agro technology.

The model presented reflects precisely (inaccuracy about 13%) and in the dynamics the process of soil formation. Its elaboration is based on the dynamical model of the natural process of soil formation and not on the intervention in its development.

For a better model's performance it is necessary to precise the coefficient of the atmospherically nitrogen asymbiotic accumulation.

It was stated that in case of vegetal mass alienation's degree of plants with more than 68%, the diminution of the soil effective fertility has a specific character: during 5-7 years when the plants' productivity falls, it reaches a particular level, despite of the fact that the intensity of alienation process is still the same.

The identification of the model in soil's natural conditions was not effectuated. Therefore the model can be used only for the observation of soil formation development. With the economic calculations, this model can be used only while strategic elaborations of agro industrial development.

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