INFLUENCE OF SYSTEMATIC FERTILIZER ON BIOLOGICAL ACTIVITY OF GRAY FOREST SOIL

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The organic matter of the soil largely determines its fertility, because it contains all the necessary plant nutrients in the most convenient combinations. During decomposition, organic matter serves as a source of ash nutrition for plants, especially nitrogen. Humic acids are involved in biological weathering, in the formation of soil profile and structure, long retain nutrients, stimulate root growth and promote the development of microorganisms, increasing the intensity of the biological cycle of substances.

The transformation of organic matter in the soil has a clear dependence on the system of fertilizer application. It is believed that intensive land use in agricultural production is accompanied by a decrease in humus reserves in soils, and the introduction of organic fertilizers is a significant lever of its accumulation. But along with the improvement of humus and physicochemical properties of the soil, organic fertilizers do not always provide sufficient nutrients available to plants. Therefore, agriculture offers fertilizer systems in which organic fertilizers are supplemented with mineral.

According to the classification, important indicators that characterize the humus condition of the soil are - humus reserves in the arable layer of the soil, its nitrogen supply (ratio C: N), the degree of humification of organic matter (Orlov DS, 1985). Analysis of the obtained data shows that the stock of humus in the soil for the period of research is reduced on the option without fertilizer in the percentage of 8% relative to the initial content, due to the presence in the field crop rotation of row crops. The use of fertilizers slows down the rate of humus loss, and the application of manure both separately and in combination with mineral fertilizers to a greater extent than the use of mineral fertilizers alone.

It was found that the effective accumulation of humus in the soil occurred with organo-mineral and organic fertilizer systems. Systematic application of organic fertilizers (60 t/ha of manure) provided expanded reproduction of this indicator, its stock was at the level of 36,5 t/ha, for the organo-mineral system (60 t/ha of manure + $N_{80}P_{60}K_{80}$) – 35,6 t/ha. In the variant without fertilizer application and only mineral fertilizers in the norm $N_{80}P_{60}K_{80}$ per 1 ha of arable land there is a decrease in humus reserves by 12 and 9 % relative to the initial level (32,4 t/ha).

According to our research results, the degree of humification of organic matter was at a high level, except for control (without fertilizers) and mineral fertilizer system. This indicator was most favorable for the application of organic fertilizers both separately – 36,0 % and in combination with mineral – organo-mineral fertilizer system (60 t/ha of manure + $N_{80}P_{60}K_{80}$) – 34 %.

The most important indicator of the intensity of biochemical processes occurring in the soil is the formation of carbon dioxide. Although the amount of CO_2 produced by the soil depends on many factors and does not reflect its absolute content in the soil, but it can serve as an indicator that characterizes the degree of decomposition of organic matter. Soil "respiration" reflects the sum of all metabolic processes that produce CO_2 as a result of O_2 fixation. Decreased soil respiration levels may indicate that soil conditions, such as temperature, humidity, aeration, available forms of N, limit biological activity and decomposition of organic matter. The limiting factor may be the concentration of organic matter or the toxic effects of pollutants on living organisms.

The intensity of soil biological activity in terms of carbon dioxide release depends on soil type, humidity, temperature, as well as the presence of organic matter and the ratio of carbon to nitrogen. The rate of mineralization of fresh soil organic matter is judged by the value of this indicator.

In our research, long-term use of organic and mineral fertilizers in crop rotation significantly increased the total number of microorganisms in the soil. The result was increased decomposition of organic matter and increased release of CO2 from the soil. In all cases, the same pattern was found: the highest biological activity in terms of the intensity of CO2 emissions was characterized by areas where the soil was systematically enriched with fresh organic matter. The intensity of biological processes in the organo-mineral system increased by 67% relative to non-fertilized variants (115 mg / 1 m2) and by 30% relative to mineral (140 mg / 1 m2) systems without the use of organic fertilizers.

In general, the excess of this indicator for the organo-mineral system was - 67%, organic - 37% and mineral - 22% relative to the control without fertilizers - 115 mg of CO2 per 1 m2 / h. Systematic application of physiologically acidic mineral fertilizers increasing the acidity of the soil, which negatively affected the activity of microorganisms. The release of carbon dioxide on the background of mineral fertilizers was slightly less than on the background of the use of organic fertilizers, the difference was about 12%. Taking as an indicator of the total biological activity of carbon dioxide production, it is impossible to get a complete picture of the intensity of biochemical transformations, as the release of CO2 depends not only on the activity of soil organisms.

The intensity of decomposition of organic matter (fiber) was taken into account by the weight loss of linen tissue to the original, which was placed in a horizontal position at a depth of 30 cm in the zone of intensive development of the root system under corn. Exposure time from the phases of germination-harvesting. To assess the cellulose-destroying activity of the soil, we used the scale proposed by DG Zvyagintsev: 10% - very weak, 10–30 - weak, 30–50 - medium, 50–80 - strong,> 80% - very.

In the case of mineral fertilizers, in the absence of organic energy material, the number of microorganisms and the production of carbon dioxide from the soil surface were sharply reduced. Under such conditions, the lowest percentage of decomposition of linen is observed - 23.5%, which corresponds to the level of low intensity in the phase of ripening corn. The process of fiber decomposition took place intensively in areas with fresh organic matter and with the enrichment of soil microflora within 70%, which corresponded to the gradation of strong decomposition intensity. The use of organic and mineral fertilizers in one system also stimulated the process of fiber decomposition - at the level of 78.5%, which in percentage terms was 47% higher than the values obtained for a purely mineral fertilizer system. It is important that the method of linen fabrics not only demonstrates the activity of cellulose-destroying microorganisms, but also indicates the degree of nitrogen mobilization in the soil.

An integral indicator of the technology of growing crops is their productivity. According to the results of research it is established that with the yield of corn grain under control (without fertilizers) 5.10 t / ha, its highest level is achieved with an intensive organo-mineral fertilizer system - 60 t / ha of manure + N80P60K80 - 9.49 t / ha

For the application of only organic fertilizers (60 t / ha) the yield increase was obtained at the level of 2.9 t / ha against the control (without fertilizers), and for the mineral system (N80P60K80) - 3.01 t / ha.

It should be noted that this trend in the productivity of the main crop products is sufficiently consistent with the indicators of soil fertility and the intensity of the biological processes in it.

The article presents the results of research on the biological activity of gray forest soil depending on the systematic use of organic and mineral fertilizers. It is established that effective reproduction of humus in gray forest soil is provided by organo-mineral (60 t/ha of manure together with $N_{80}P_{60}K_{80}$) and organic (60 t/ha of manure), respectively 36,5 t/ha, and 35,6 t/ha. The application of only mineral fertilizers in the norm of $N_{80}P_{60}K_{80}$ per 1 ha of crop rotation area resulted in a decrease in humus reserves by 9 % relative to the initial level (32,4 t/ha).

The highest degree of humification of organic matter provided the option of applying organic fertilizers (60 t/ha) both separately – 36,0% and compatible with mineral – (60 t/ha manure + $N_{80}P_{60}K_{80}$) – 34 %.

Prolonged use of organic and mineral fertilizers in crop rotation significantly increased the total number of microorganisms in the soil. The result was increased decomposition of organic matter and increased release of CO_2 from the soil. The areas with the highest biological activity and CO_2 intensity were characterized by areas where the soil was systematically enriched with fresh organic matter. The intensity of biological processes in the organo-mineral system increased by 67 % relative to the variant without fertilizers and by 30 % relative to the variant with only $N_{80}P_{60}K_{80}$. The use of organic and mineral fertilizers in one system stimulated the process of decomposition of fiber – at the level of 78,5 %, which in percentage terms exceeded the value of the indicators obtained for a purely mineral fertilizer system.

Keywords: soil biological activity, humus, fertilization, soil fertility, fertilizers