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EFFECT OF THE CULTIVATION OF LEGUMES ON THE DYNAMICS OF SOD-PODZOLIC SOIL FERTILITY RATE

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DOI: https://doi.org/10.30525/978-9934-588-11-2_4

In order to preserve and increase soil fertility, as well as to increase agroecological resistance to adverse anthropogenic factors, it is essential to accumulate organic matter in the soil. Due to the sharp decrease in the number of livestock in the farms of Ukraine, it is almost impossible to address this problem only by introducing manure. Therefore, it is necessary to find ways to restore and maintain the optimal level of soil fertility by means of the application of alternative methods of accumulation in the soil. One of the main resources and promising direction in solving this problem can be the cultivation of perennial legumes [3, p. 106-110].

Perennial legumes are one of the factors, which enable to stabilize the processes occurring in the soil – plant – animal – human system. A large phytomeliorative role of perennial legumes on the arable land, the optimal ratio of plowed land, hayfields and pastures will contribute to the elimination of destructive processes that occur in agricultural landscapes, reduce erosion and increase soil fertility and crop yields [4, p. 18-21; 7, 30-34].

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It should be noted that perennial legumes improve the fertility of soil, protect it from wind and water erosion, leave dry roots and nutrient residues in the soil (from 40 to 100–120 kg/ha). Their root system contains between 2.5–3 and 4% nitrogen (per dry substance). After its dying and decomposition, nitrogen stocks in the soil increase by 150-200, sometimes 300 kg/ha. Accumulated in the root system and crop residues of leguminous crops, nitrogen in the soil is well absorbed by other crops involved in rotation [2, p. 53-57].

The scientists claim that the use of leguminous crops, perennial grasses that can improve soil fertility and form high yields in crop rotations facilitate a solution to the issue of providing livestock feed and organic fertilizers – crop production. Therefore, most farms develop these important agricultural sectors from a comprehensive perspective.

At the same time, perennial grasses enrich the soil with organic matter and biological nitrogen, which stabilizes its fertility. The manufacture of their products is economically justified [5, p. 9].

Nitrogen is an important element for plant growth and development. Perennial grasses, especially legumes, in terms of nitrogen accumulation in the soil, are a very good precursor to many major cultivated plants [1, p. 391-393].

According to the calculation of scientists, in the conditions of the Central Forest-Steppe of Ukraine alfalfa for three years of life is able to absorb from the air 735 kg/ha of nitrogen, enriching the soil in the amount of 598 kg per 1 hectare [6, p. 54-57].

The soil cover of the experimental field is represented by sod-podzolic surface-gleyed soil on the slope of the north-western exposure with steepness of 1-3°. Prior to the sowing of legumes, the research plot was characterized by the following indicators: humus content – 2.4% (low), alkaline hydrolyzed nitrogen – 67.1 mg/kg of soil (very low), mobile phosphorus – 75.6 mg/kg of soil (medium), exchangeable potassium – 66.0 mg/kg of soil (low). The soil reaction was very acidic and acidic (pH of the salt extract is 4.4–4.8), hydrolytic acidity – 5.8–6.0 mg-EQ per 100g of soil. The amount of calcium absorbed in the soils was 6.3 mg-EQ, magnesium 2.5 mg-EQ per 100 g of soil, indicating low base saturation.

The scheme of two-factor experiment provides for the three levels of fertilizing. Mineral fertilizers were applied at-ground in the form of ammonium nitrate, granulated superphosphate and double manure salt in early spring. The size of seedling plots was 15 m^2, accounting plots – 10 m^2. In addition, perspective varieties of legumes such as cow clover – Darunok, alsike clover – Rozheva 27, birdsfoot deer vetch – Aiaks, alfalfa – Andi, were sown and released.

A positive effect of the cultivation of legumes on the rate of fertility of sod-podzolic soil has been established on the basis of the conducted research. The results of experiments have shown that the long-term cultivation of perennial legumes on nutrient-poor soils results in the development of a highly branched root system. As a result, the weight of the root and stubble residues exceeds the weight of the above-ground mass or approaches it. Thus, the yield of the above-ground herb mass for two years of use has amounted to 14.6 c/ha of air dry matter, and the yield of legumes – 14.2 t/ha. The root and stubble residues are amounted to 165.3 and 132 c/ha,

respectively. With a well-developed root mass, a large amount of nitrogen remains in the soil (231.4 and 145.2 kg/ha, respectively), which largely (about 50–70%) compensates for the expenditure of soil nitrogen to form a yield of herbs.

It has been established that the productivity of perennial legumes on average during the years of research with the two-haying use on the variants without fertilizers and with the application of $Ph_{60}P_{60}$ is in the range of 5.03–of 6.47 t/ha of dry weight, 3.62 – 4.98 t/ha of fodder units, 0.79 – 1.08 t/ha of crude protein, 43.3–58.2 GJ/ha of exchange energy.

The highest content of alki-hydrolyzable nitrogen is observed in the soil when growing alfalfa – 80.4 mg/kg of soil, due to the productive activity of symbiotic nitrogen-fixing bacteria of this species of herbs. The nitrogen content in the soil under cow clover was 4.8% lower and amounted to 77.0 mg/kg of soil. The other experimental plots had almost the same nitrogen content – 77.5–77.8 mg/kg of soil that was 3% less compared to the variant under alfalfa. When applying phosphorus-potassium fertilizers on the variants of alfalfa + $Ph_{60}P_{60}$ and alfalfa + $Ph_{90}P_{90,}$ the nitrogen index increased by 10.6 mg/kg of soil. On all variants of the experiment the content of alkaline hydrolyzed nitrogen was very low.

The content of mobile phosphorus on the experiment variants ranged from 80.9 to 83.2 mg/kg of soil (average level) depending on the crop. It has been established that the cultivation of cow clover, alsike clover, birdsfoot deer vetch, alfalfa against Ph_{90} during the study period contributed to the growth of mobile phosphorus in comparison with its content in the soil prior to the sowing of herbs by 4.2–5.9%, in particular, in the variant with alfalfa it was amounted to 5.0 mg/kg of soil. This is due to the fact that the stockpile of phosphorus in the soil is the most stable among other indicators of fertility, and the creation of cover with perennial herbs with a developed root system contributes to the suspension of erosion processes, the content of mobile phosphorus in the soil increases.

Characterizing the balance of nutrients of sod-podzolic soil subject to the cultivation of legumes, the analysis of nitrogen expenditure has shown that this element of nutrition is most heavily used by birdsfoot deer vetch and cow clover – the yield is 105.4 and 100.3 kg/ha, respectively. This is due to the high productivity of these crops. The lowest nitrogen losses are found in alfalfa – 98.6 kg/ha that correlate with the lowest productivity of that variant. The rate of biological nitrogen entering the soil is largely dependent on the efficiency of nitrogen fixation. The highest nitrogen intake from nitrogen fixation is recorded on the variant with birdsfoot deer vetch – 140.8 kg/ha, and the lowest – on the variant with alsike clover – 91.8 kg/ha, which is 34.8% lower compared to the previous variant. The total balance is negative in the variants with alsike clover and amounted to 8.2 kg/ha.

It has been established that phosphorus is the most intensely removed by birdsfoot deer vetch – 320 kg/ha and cow clover – 31.0 kg/ha. Its smallest loss is observed in the variant with alfalfa (25.5 kg/ha). Relative to the potassium regime, this food element is the most heavily used by birdsfoot deer vetch – 91.4 kg/ha. The lowest potassium expenditure is observed in the variant with alfalfa – 71.4 kg/ha, which, in our opinion, is connected with the yield of the crop grown. The balance of potassium

in the soil in the variants with legumes when applying potash fertilizers at the rate of 60 kg/ha is negative.

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