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Migration of biogenic units from soil and productivity of corn at different methods of fertilizing

Goal. To investigate the effect of bacteri cation and fertilization of maize plants on the migration of nutrients from the soil and the yield of the crop. **Methods.** Laboratory, lysimetric, field, mathematical and statistical. **Results** The data of lysimetric and field experiments indicate that the combination of the use of microbial preparation polymicrobacterium, mineral fertilizers in the dose N90R90K90 and lupine siderate results in the formation of optimum indices of the content of compounds of nutrient elements in the arable and subterraneous layers of sod-podzolic soils due to the reduction of the losses of nutrients by soil . This contributes to increasing the yield and quality of corn grain.

Key words: corn, organic and mineral fertilizers, biogenic elements in the soil, yield.

Immovable crops formed under the pressure of the agrarian market, short-crop rotation, saturated crops, a decrease in the proportion of crops, ungrounded chemistry and a number of other negative factors are now suppressing positive soil-forming processes and depleting soils [8]. The soddy podzolic soils, which occupy more than 60% of the territory within Ukrainian Polissya, are vulnerable to the powerful anthropogenic impact of modern crop production technologies [4]. In recent years, the state of their fertility has deteriorated, as the modern agricultural branch of the Polissya region is oriented towards the growth of market-attractive agricultural crops. In this case, such components of agricultural systems as rational fertilization, scientifically grounded alternation of crops in crop rotation, the return of nutrients, the reproduction of soil fertility, etc. are ignored.

Among the most common market-oriented crops in soddy podzolic soils in the Polissya area are corn for grain, which has a significant productive potential, which is realized in compliance with the scientific and technological conditions of cultivation. Synthesis of humus compounds is possible only in the presence of organic matter in the soil. However, its introduction to the soil is now limited due to a sharp decrease in manure application, ignoring crop rotation, minimizing grass growing areas, burning straw, etc. As a result, processes of dehumidification are actively taking place. An important condition for the efficient use of mineral fertilizers, and especially nitrogen, is the presence in the soil of fresh organic matter [10].

The use of siderates makes it possible to significantly improve the balance of organic matter in the soil, reduce the risks of water and wind erosion, effectively combat the weeds, solve the problem of increasing the fertility of soils in the fields of farms far removed from the crop farms that are acutely felt deficiency of organic fertilizers [2].

The popularity of the use of microbial drugs for optimizing the composition and functioning of microbial soil grouping is gaining momentum. Agronomically valuable microorganisms introduced into the soil of agrocenoses actively influence the formation of the root system of cultivated plants, significantly increase its absorption and absorption capacity and assimilate the compounds of nutrient elements [7].

The purpose of the research is to determine the impact bacteri- sation and fertilization on the migration of biogenic elements from the soil and yield of culture. **Research methods.** The research was conducted during 2009 - 2013 in field and lysimetric experiments on the basis of the Institute of Agricultural

Microbiology and Agro-Industrial Production of the National Academy of Sciences of Ukraine. Ground - sodomy-podzolic with a content of humus of 1,1%, P₂O₅ (according to Kirsanov) - 179 mg / kg, K₂O (under Maslova) - 70 - 90 mg / kg of soil, amount of absorbed bases of 5.4 mg · eq / 100 mg of soil, pNsol - 4.9. The area of the sown area is 102 m², the accounting area is 63 m².

The method of placement of sites is renamed. The lysometric experiment was conducted according to the methodical manual of Golubev [1]. Sown area of the cell - 3.8 m². The layer of soil of one cell has a height of 155 cm, a total mass of 10.5 tons. Repeatability in both experiments is 4 times.

The effectiveness of various types of fertilizers for cultivating corn in the chain of crop rotation was investigated: winter wheat - corn - wheat year - clover. Scheme of experiments: 1 - without fertilizers; 2 - intermediate siderate; 3 - N90P90K90; 4 - N90P90K90 + Siderat; 5 - manure of cattle (40 t / ha).

In experiments, the Kikukun 4244 hybrid was used, which is a medium-maturing group (FAO 240), universal for use, plastic to vegetative conditions. Agrotechnology of cultivating culture is generally accepted for the region.

As green manure fertilizer used green mass of lupine, which you svari as an intermediate crop after harvesting winter wheat.

Mineral fertilizers applied in the form of ammonium nitrate (34,5%), superfacta - the simple granulated (19,5) and potassium chloride (60%).

Research conducted by Rossi - Plena plots were seeded on untreated - SNAM and seeds, processed polka - bakterin — drug, Boavista which is the bacterium *Paenibacillus polymyxa* KV Foz formability properties and own properties that stimulate growth.

Soil samples from the layers 0 – 20 and 20–, and 40 - were taken to pieces and prepared for analyses according to ISO 11464 – 2001. The content of humus analube - whether by the method of Tyurin (DSTU 4289:2004); ammonia nitrogen — photolorimetric - tion method (DSTU 4729:2007); nitrate nitrogen — odometrical method (DSTU 4729:2007); mobile connections of phosphorus and about - mine potash according to GOST 4405:2005; rnal — method ZNO (GOST 26483 – 85); GDAL - cally acidity — by method of Kappen [9].

Activity nitrogen fixation and emissions dinteren oxide in the soil of maize were determined gasochromatographic [4].

Harvesting and statistical processing of the results were carried out for B.O. Uspehovy [3] using Microsoft Office Excel software.

Research results. Vertical migration of biogenic elements. The results of the study of the losses of compounds of biogenic elements in washing waters indicate a significant effect on this process of practically all investigated factors (Fig. 1).

So, for the introduction of mineral fertilizers into the soil, there are considerable losses of nitrates, ammonia, calcium and magnesium compounds. Under these conditions, water-soluble humus compounds and P₂O₅ and K₂O are lost more intensively in comparison with the control. With the use of polymicrobacterium on this agrifon, the intensity of nutrient washout beyond the root-bearing layer of the soil profile is substantially limited. This suggests a better assimilation and greater removal of compounds of nutrient elements with corn crop and their maintenance by increasing the root system inoculation.

The use of green fertilizers reduces the loss of nutrients, water-soluble humus. The microbial preparations used on this agrophon also further restrict the leaching of compounds of biogenic elements beyond the root-containing layer. In our opinion, such a combination of agro-measures is promising, since it is possible to provide introduced into agrocenosis bacteria of fresh organic matter (in contrast to manure, not infected by foreign microorganisms). Under such conditions, agronomically valuable microorganisms can be assimilated as a carbon source, except for the root exudates of corn plants, as well as mineralization products of the sideropal mass.

For the application of mineral fertilizers in the dose N90R90K90 and siderates, a decrease in the intensity of washing of nutrients is observed compared with the removal of mineral fertilizers themselves.

The use of biopreparations on this agrophony contributes to limiting the loss of nitrates, ammonium nitrogen, water-soluble compounds of phosphorus, potassium and humus, indicating an increase the removal of these substances with the crop and the temporary retention of their root system of baked plants.

The use of 40 t / ha of cattle manure is accompanied by the largest loss of nutrients. The use of polymicrobacterium on this background does not affect the changes in the indices of content in the washing waters of phosphorus and potassium compounds. At the same time, there is a tendency to decrease the intensity of washing of other nutrients.

Consequently, pre-sowing bacteria least influence the limitation of nutrient losses in the experiment. Application of mineral fertilizers at a dose of N90P90K90 leads to intensive washing. The addition of mineral fertilizers to green fertilizers and the use of seed treatment with polymicrobacterium substantially limit the loss of soil nutrients and moisture.

Nitrogen fixation. The processes of biological transformation of nitrogen in the soil indicate a favorable or threatening situation on the basis of the action of biotic and abiotic factors. Such processes of nitrogen colonization as ammonification, nitrification, denitrification and nitrogen fixation are carried out by microorganisms, therefore the determination of the intensity of these processes can give an objective assessment of the ecological state of agrocenosis. It should be noted that ammoniation and nitrification are passive processes, therefore, to obtain data on the direction of transformation of nitrogen compounds in the soil, it is enough to determine the potential activity of 2 opposite processes of nitrogen fixation and biological denitrification.

the effect of siderate on the flow of nitrogen fixation in the root zone of corn plants. Pre-sowing seed treatment with polymicrobacterium and further plant cultivation on the background of sideral fertilizers do not provide a synergistic effect due to the fact that this preparation was based on bacteria that are not active nitrogen fixator (Fig. 2). Mineral fertilizers inhibit the process of nitrogen fixation in the root zone of maize plants, which confirms the inappropriate application of such a dose. Restoration of indicators to control values is observed only at the end of the vegetative period. The combination of tufts with siderate to a large extent offset the negative impact of mineral fertilizers on the process of biological fixation of nitrogen atmosphere. However, in the phase of pouring grain, when the mineral nitrogen compounds are assimilated by the plant, stimulation of the activity of nitrogen fixation is observed for the formation of the vegetative mass in this variant. With the removal of manure, high nitrogen-fixing activity in the rhizosphere of plants throughout the vegetative period is ensured.

Denitrification. The opposite process of nitrogenization is the emission of dinitrogen oxide as a result of the biological denitrification process. Studies conducted in the dynamics show significant nitrogen losses in the form of N₂O for the fertilization of corn by mineral fertilizers and manure (Fig. 3).

Bacteriation at the initial stages of development stimulates to a certain extent the activity of biological logarithmic denitrification in the soil in all cases, except for experimental variants. This suggests that for small plants of corn available in the soil of nitrogen is quite enough. With the growth and development of plants, microbial drugs continue to actively contribute to lowering the gaseous losses of nitrogen from the soil. This is due to the positive influence of introduced bacteria on the development of maize plants, as a result of which they absorb considerably more nitrogen compounds for constructive metabolism and limit the volumes of nitrates that are a substrate for denaturing microorganisms. It should be noted that polymicrobacterium, which is not stimulates the activity of nitrogen fixation, significantly limits the gaseous nitrogen losses and positively affects the optimization of processes of biological transformation of nitrogen in agrocenosis. Sederates were found to be a powerful limiting factor for the biological denitrification process, especially in combination with pre-seeding bacteria.

Consequently, siderates and microbial preparations, applied separately and in combination, substantially limit the loss of nutrient elements from the soil of agrophytocenoses and can be a powerful agro-effect in optimizing the nutrition of cultivated plants, in particular corn. Manure removal stimulates the process of nitrogen fixation, but causes an increase in the emission of nitrous oxide.

Crop yield and quality. In the middle of 2010-2013, the yield of corn grain at the control was 3.9 t / ha. For the introduction of organic fertilizers - siderate and manure - their effect on yield was one level: the yield increase on average for 4 years was equal to 0.8 t / ha, or 21% compared with the control. In arid 2011 and 2013, the most effective was the use of siderate, whereas in the years with sufficient moisture the highest yield yielded the fertilization of corn with manure.

The application of mineral fertilizers in the middle of the years of research has led to an increase in the yield of maize grain in terms of control of 1.8 times, that is 3 t / ha, and the addition of mineral fertilizers by

means of sideration allowed it to increase twice as compared with control, the increase was 4 tons /Ha. Consequently, the combination of sedimentation and fat in comparison with the mineral fertilizer system made it possible to obtain additional 1 t / ha of grain (Fig. 4).

Pre-sowing inoculation of seeds with poly-myxobacterin provided grain yield increase of 0.4-0.5 t / ha on almost all studied agrofons.

The smallest genuine increase in the use of polymyxacarbaric acid was achieved against the background of 40 t / ha of manure. The insignificant effect of baking on this agrifon can be explained by the competition between the bacteria and microorganisms introduced into the agrocenosis introduced into the soil with manure.

The quality of grain in the protein content increases as a separate application of all investigated elements of technology, and for their integrated application. Mineral fertilizer in combination with siderate improved the quality of grain by protein content by an average of 2%, and the introduction of 40 t / ha of manure contributed to the highest grain content of the protein - 10.6%, which is 2.3% higher than the comparative with control. The inoculation of the seed prior to sowing with polymyxacarbonate did not affect the quality of the grain by the content of the protein, since the bacterial-bioactive agent of this preparation did not affect the nitrogen feed of the plants by acting on plants, but is a producer of growth promoters and mineral and organic cysts - Lot, which transforms hard-soluble phosphorus compounds into forms that are available to plants.

Conclusions

The combined use of such agro-measures as pre-sowing inoculation of seeds with microbial preparation polymyxobacterinum, introduction of mineral fertilizers in the dose N90R90K90 dose and the use of lupine siderate, formed the optimum indices for the content of compounds of biogenic elements in arable and subsoils of the soil, which helps to reduce the losses of nutrients by soil and increase the yield and quality of corn grain. The use of siderates and biopreparations should become mandatory for the use of mineral fertilizers in the technology of cultivating maize on sod-podzolic soils to improve the efficiency of their use.

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