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Influence of new domestic fertilizers and growth regulators of plants on microbiological processes in soil

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The purpose. To investigate effect of new organo-mineral fertilizers and growth regulators of plants on microbiological processes in soil. **Methods.** Stationary and short-term field and laboratory probes. Conventional methods of probes are applied, as well as dispersing, correlative, and variational analysises are used. **Results.** At application of new organo-mineral fertilizers and growth regulators of plants the content of general microbial mass in soil of rhizosphere of corn and soya bean increased, phytotoxicity of soil dropped, numerosity of microorganisms-amonificators decreased. **Conclusions.** Application of new OMF and GRP stimulated growth of nitrogen-fixing organisms, enriched soil with accessible to plants joints of nitrogen.

Key words: *soil, fertilizer, microbiological processes, organo-mineral fertilizers, growth regulators of plants.*

One of the modern ways of preserving and improving land productivity is the introduction of energy-saving technologies into agricultural production using new domestic fertilizers and growth regulators of plants that do not pollute the environment [1, 3].

Depending on which types of microorganisms prevail in the soil. it will be less or more fertile. The soil fertility depends to a great extent on the activity of soil microorganisms. Therefore, in our research it is logical to question the influence of growth regulating plants on the formation and functioning of microbial coenoses. Despite the importance of this issue, it remains little studied until now [4, 8].

The purpose of the study is to study the effects of new organo-mineral fertilizers and plant growth regulators on microbiological processes in the soil.

Materials and methods.

During 1996-2014, we studied the effects of new fertilizers and growth regulators on the yield and quality of crops and their impact on microbiological processes in the soil [5].

Field experiments with mineral fertilizers are carried out on typical black earths of the average slurry APG "Promin" of Vasylkivsky district of the Kyiv region. Field experiments with organo-mineral fertilizers and growth regulators, where microbiological processes were studied in soil, were conducted on gray forest soils of the experimental field of the Institute of Agroecology and Natural Resources with wheat wheat "Collective 3", soybean "Gorlitsa", corn hybrid "Hoverla 1".

The size of the sown area with fertilizers was 100 sq.m. with four-time repeat, with organo-mineral fertilizers, growth regulators and microbiological preparations 30-50 sq.m. at four-time repetition [10].

Gray forest soils of the experimental field of the Institute of Agroecology and Nature Management have the following agrochemical characteristics: the content of humus on Tyurin - 1.18%, easyhydrolyzed nitrogen by Cornfield - 64-86, mobile phosphorus - 110-140 and moving potassium - 70-110 mg / kg of soil according to Kirsanov and Mocigin, the hydrolytic acidity is ionometrically 1.34 mg / ekv / 100 g of soil, pH - 4.8-5.1.

Chernozem typical medium-slab APG "Promin" before the laying of experiments had the following agrochemical characteristics: the content of humus - 3,5-3,8%, pH - 5,8-6,0, hydrolytic acidity - 1,9-2,2 mg-eq / 100 g of soil, easilyhydrogenated nitrogen - 126-140 mg / kg, mobile phosphorus - 140-195, moving potassium - 145-168, calcium - 12,2-14,2, magnesium - 1,7-2,0 mg / kg of soil.

The number of microorganisms of the main taxonomic and ecologo -trophic groups in the rhizosphere of plants was determined by the method of soil suspensions on nutrient media: nitrogen fixators - on the Bezazotnogo environment of Vinogradsky; ammonifiers - miazopeptidic agar; micromycetes - on the medium of Chapek; biological activity of the soil - on the content of the total biomass of microorganisms by the rehydration method; the intensity of soil breathing - by the method of Staffnova, cellulose-destructive activity - by the Kristensen method, phytotoxicity of the soil - by the method of A.M. Grodzinsky.

Characteristics of fertilizers and preparations. The chemical composition of ammophos-34 is as follows: total nitrogen - 10 + 1, total phosphorus - 34 + 2, calcium - 12 + 2, magnesium - 20 + 2%.

Characteristics of new domestic fertilizers and plant growth regulators are given in our article "Bulletin of Agrarian Science" No. 2 for 2017.

Results and discussion.

The influence of mineral fertilizers - Tukosumushi, Ammofos-34 and Ammophos-52 on the number of microorganisms of the main ecological and trophic and systematic groups manifested itself differently under different crops. As is known, pedotrophic microorganisms are involved in the transformation of the water-soluble fraction of organic matter of the soil and most adequately reflect the general development of microflora in the soil [6, 9]. In our experiments, the highest number of pedotrophic microorganisms (6.9 million CFUs per 1 g soil) was detected by the use of mineral fertilizers under the wheat wheat.

For the use of different types of ammophos, the number of the specified group of microorganisms was lower than for the introduction of the MRL, but it exceeded the indicators of unchecked control by 1.5-1.7 times. The number of amylolytic bacteria in the soil of all experimental variants was little different. Organotrophic microorganisms most actively developed on the basis of a variant of the NDC. Significant difference between variants was found regarding the number of phosphate mineralizing microorganisms capable of dissolving tricalcium phosphates. In the application of Ammofos-34 and Ammofos-52, it was 2.3 to 2.9 times higher than the control (Table 1).

In the soil under corn, the largest number of pedotrophic, amylolytic and phosphate mineralizing microorganisms was detected in the use of MRLs, where it was 3-4 times higher than that of control. The development of micromycetes showed no significant difference between the variants. The largest number of sulfate-reducing bacteria was in the use of Ammofos-52, and the lowest - in the soil of uncontrolled control.

In the application of mineral fertilizers (ammophos-34, ammophos-52 and NPK) under wheat crops, the number of phosphate-motilizing agents increased by 4.0-5.9 and sulfate-reducing microorganisms by 7.3-17.6 thousand CFUs per 1 g of soil, the content of Azotobacter increased in 2,0-3,6 times, pedotrophic in 1,5-5,0 times.

The density of Azotobacter in the control soil was also low, the introduction of mineral fertilizers positively influenced its development.

Thus, in the conditions of field experiments, the amount of microorganisms in the soil changed under the influence of both introduced fertilizers and cultivated crops. In general, pedotrophic microorganisms developed more actively in the use of NRLs. By the number of amylolytic and organotrophic microorganisms, the difference between the variants of the experiment was insignificant. New fertilizers, in comparison with RPC, have contributed to the more active development of phosphate-mineralizing bacteria.

Pedotropic microorganisms actively developed in the ground for the use of Endophyta, where their number was 1.9 times greater than that of control. After Gumysol they were 1.3 times more. The use of Endophyte and Gumysol has impacted on the development of cellulosicidal microorganisms, which play an important role in the transformation of plant remains. The number of the latter after the endophyte was twice as high, and after Gumisol almost 3 times greater than the control (Fig. 1).

It was established that during non-crown cultivation of OMD crops the content of the total microbial mass in the soil increased by 16.32 - 46.35 in corn crops and 5.21-35.2 μg C / g soil in soybean crops, respectively, by 17, 13-52.52 and 4.07-18.75 for control (fig.1).

Humic acids in the OMD have a positive effect on the biological activity of the soil.

At the same time, the phytotoxicity of the soil decreased on corn crops at 0.47-2.55, and under soybean crops by 1.57-5.21%. Conducting the analysis of phyto-toxicity of the soil on the similarity of the seeds on the soil plate showed that OMD and PPP positively affect the reduction of soil phytotoxicity. The intensity of soil breathing was the lowest in the control, in each variant on corn crops it was 28.96 and in soybeans 31.87 mg CO2 kg of soil. In the application of OMD and PPP, the intensity of soil respiration was higher in all variants than on control both in maize and soya crops.

Increasing the intensity of soil breathing as an integral agroecological indicator of biological activity relative to the control variant indicates an increase in the activity of soil biocenosis as a whole, which means that there is an elevated decomposition of organic matter.

When using Gumysol in soybean root soils, the number of microorganisms of ammonifiers that expand proteins to ammonium compounds that are available to plants, oligotrophiles and micellar forms of microorganisms, including many products of biologically active substances, is increasing. Although the increase in the number of mushrooms may indicate phytopathogenesis.

In the application of Gumysol in soil under soybean and corn there is a tendency to increase the content of the total microbial mass, which indicates an increase in the activity of soil biocenosis in general. In particular, 1.5-2 times the activity of cellulose decomposition in the soil increases.

The phytotoxicity of the soil under corn is completely removed, and under the soya soil solution it even gets a stimulating effect on the germination of the seeds of cereal crops.

When using Vitalist in soy root soybean, the number of microorganisms of ammonifiers that decompose proteins to ammonium compounds that are available to plants is increasing, which is good, but increasing the number of fungi is a negative process, as it indicates an increased risk of phytopathogenesis.

Vitalist influences the activity of microbial cenosis of the root zone of plants of soybeans and corn, significantly increases the content of the total microbial mass and cellulose-degrading activity. Increases the intensity of "breathing" of the soil, which indicates an increase in the activity of soil biocenosis in general. This is due to an increase in the amount of organic substrate in the form of root extracts and root precipitates, which in turn indicates a high stimulating properties of Vitalist.

In the studies conducted, the content of microorganisms varied from the drug, its dose, culture and weather conditions. Increases the microbial mass content in soil under soybean and maize by 35%, but only at a concentration of 25 l / ha, which indicates an increase in biocenose activity in general. In particular, 3-4 times activates the timetable of cellulose in the soil, but only at a dose of 25 l / ha.

In addition, the drug stimulates germination of the seeds and tends to reduce the toxicity of the soil. Ammonifiers are microorganisms that transform organic compounds of nitrogen into ammonium. Oligotrophs (microflora of scattering) are microorganisms of the last stage of the destruction of organic matter, that is, they absorb nutrients from very rarefied soil solutions (with a low concentration of elements). In the cultivation of corn seeds, on the contrary, Vitalist does not affect microbial price of its root zone and soil. However, a dose of 40 liters per hectare increases the content of total microbial mass, "breathing" of soil and cellulose-reducing activity.

Vitalist increases the number of microorganisms of ammonifiers, which expose proteins to ammonium compounds, which are available to plants, and this is good, but the increase in the number of mushrooms is not good. It completely removes phytotoxicity of soil under soybean, and under the corn the soil acquires even a stimulating effect on the germination of seeds of cereal crops at a concentration of 20 -25 l / ha.

Micromycetes were actively developed in the soil of all experimental sites in the crops in the potato experiment, and the tendency of microorganisms of all species after "Gumisol" (amylolytic in 1.8, cellulose destructive and Azotobacter in 1.5 times more than in control) was observed. The content of Azotobacter was not high, which is possible due to the seasonal development of these microorganisms and a significant decrease in the density of its populations in the autumn period.

In any case, there is no sustained inhibition of the development of the microflora or the negative changes in the composition of the microbial group due to the use of experimental biostimulants.

By the number of amylolytic and organotrophic microorganisms, the difference between the variants of the experiment was insignificant. New fertilizers compared to NPK contributed to the more active development of phosphate-mineralizing bacteria.

The influence of new mineral fertilizers (ammophos-34) in comparison with other types of fertilizers on the number of microorganisms of the main ecological trophic groups was investigated. It was shown that pedotrophic microorganisms were more actively developed in the application of NPK under field research.

In experiments with growth promoters under buckwheat crops, almost all types of microorganisms were more actively developed in the use of Endophyta, in experiments with potatoes when using Gumysol.

Consequently, in the conducted researches under the wheat wheat, the greatest number of pedotrophic microorganisms was when using the NRL. In the application of different types of ammophos, the number of pedotropic microorganisms was lower than with the introduction of NRL, proteus exceeded the uncontrolled control indicators by 1.5-1.7 times.

In the soil under corn, the greatest number of pedotrophic, aminolytic and phosphate-motile microorganisms was detected in the use of NKC, where it was 3-4 times higher than that of control.

Gumizol 12 l / ha positively affects the general biological activity of soybean root and soybean soil biota, increasing either the intensity of respiration (under soybean) or the content of the total microbial mass in rhizospheric corn soils. On the plate of soil from soya, the seedlings of cereal crops are similar.

Influence of growth stimulators of plants on soil microflora, gray forest soils, 2003-2017 gg.

Option to experiment	**The number of bacteria per million gypsum in 1 g soil**		**Cellulose-destroying microorganisms, thousand in 1 g of soil**	**Micromycetes, thousand in 1 g of soil**	**Azotobacter, %**
	Amylolytic	**Pedotrophic**			
The number of microorganisms in the soil under buckwheat					
CONTROL	2,2	29,7	2,0	43,5	12
Endophyte	6,6	57,0	4,6	56,4	10
Gumysol	6,6	37,8	5,9	44,0	12
The number of microorganisms in the soil under potatoes					
CONTROL	0,45	4,3	1,2	60,0	8
Endophyte	0,5	5,2	1,6	54,0	12
Gumysol	0,9	4,8	1,8	61,0	12

Vitalist 20 l / ha affects the activity of microbial cenosis of the root zone of soybean plants. Significantly increases the content of the total microbial mass and cellulose-irritating activity. In addition, the drug stimulates germination of the seeds and tends to reduce the toxicity of the soil. In a dose of 40 l / ha Vitalist only affects the reduction of soil phytotoxicity under soy.

On corn, on the contrary, Vitalist at a dose of 20 l / ha does not affect the microbial price of its root zone and soil. However, a dose of 40 liters per hectare increases the content of total microbial mass, respiration and cellulose-reducing activity.

Oasis in a dose of 40 liters per hectare increases the content of the total microbial mass in soybean and corn root soils. Cultivating activity in the soil is also increasing during the processing of corn by Oasis in a dose of 20 l / ha. Both concentrations tend to reduce phytotoxicity and stimulate the increase of similarity of the seeds.

Goodness does not affect the biological activity of the soil root zone and the microbiological parameters, but somewhat increases its phytotoxicity by 7.6 and 16.3% respectively, with corn and soybean.

Emistim at a dose of 10 ml / ha slightly increases all the parameters of soil bioactivity in soybean crops, namely: the intensity of respiration and destruction of cellulose, the content of the total microbial mass, and reduces the toxicity of the soil.

Significantly more effective the drug acts on the soil biota in corn crops, as the intensity of respiration and destruction of cellulose and the content of the total microbial mass in the soil of the corn root zone is significantly increased. This indicates the high stimulus properties of Emistim.

Endofit 10 ml / ha slightly increases the intensity of cellulose degradation and reduces phytotoxicity of the soil to 0. But in maize crops, Endophyte significantly increases the intensity of respiration and the content of the total microbial mass, slightly increases the intensity of cellulose destruction. Ecostim 25 l / ha positively affects the properties of the soil, because it acquires the ability to stimulate the germination of seeds of cereal test culture. Also, it increases the integral index of biological activity of rhizospheric soybean soil - the intensity of respiration, but in the soil root zone corn doubles the content of the total microbial mass.

At 25 ml / ha, doubling the amount of microbial mass in the root zone of corn doubles, but does not affect other indicators of biological activity. This can be influenced by the stimulation of plant growth and activation of root exudation or the stimulation of the development of protists and mushroom microflora. It is possible that the substance that is part of the drug is a substrate for feeding microorganisms.

All PPP tend to inhibit the development of streptomyces and the release of carbon dioxide from the ground, that is, to reduce the excessively rapid decomposition of the organic matter of the soil (for plants it can be positive and contribute to the increase in yield), all PPPs contribute to reducing the toxicity of soils under soybeans (can the pH increase?)

The endophyte significantly inhibits the process of carbon dioxide release and the accumulation of a common microbial mass.

Vitalist significantly reduces the content of the total microbial mass in the soil, mainly due to the inhibition of the development of streptomyces (in certain conditions it can be positive for plants, since they are often toxin generators) Oasis - suppresses the development of streptomyces - by 62%, Azotobacter by 39%, stimulates the development of oligotrophs, the number of which grows almost 5 times.

Vitalist, Oasis - reduce the variety of ammonifiers - protein minerals (if the phytopathogens are positive);

Endophyte reduces the number of ammonifiers by 42%, streptominates by 72%. Azotobacter - by 48%;

Vitalist - inhibits the development of streptomycetes by 75%, Azotobacter - by 69%, stimulates the development of the microflora of scattering - by 170%.

The intensity of soil respiration in the control variant of the bulla is the lowest - 31.9 mg CO2 / kg of soil. The highest intensity of "breathing" of the soil in the control variant is 42.7 mg CO2 / kg of soil.

With the use of OMD Vitalist, the intensity of soil respiration increased by 4.54 mg CO_2 / kg of soil for control, and Oasis - by 4.23 mg CO2 / kg of soil. Increasing the "intensity of respiration" of the soil as an integral indicator indicates an increase in activity (life, functioning) of the soil biocenosis as a whole.

Under all these, the growth regulators tend to inhibit the development of streptomyces and the release of carbon dioxide from the ground, that is, to reduce the excessively rapid decomposition of the organic matter of the soil (for plants it can be positive and contribute to the increase in yield) and also all the growth regulators of the plants that we have studied contribute to the reduction of toxicity soil under soya.

Azotobacter is a well-known test organism for such unfavorable endeavors as low pH, lack of mobile phosphorus compounds and low humidity. The soil of the experimental field of the Institute has a very low pH value, which inhibits the development of Azotobacter, therefore, under corn, which in addition exhaust the soil and moisture, Azotobacter was not detected in any way.

However, the number of Azotobacter is high in soybean root soils and 100% of investigated lumps of the soil of the control variant overgrown with its colony. Favorable conditions for the development of Azotobacter are provided by alkaline root extractants, soy exudates, which is substantiated by a significantly lower amount of fungi propagated than in maize ground. Soils with a neutral or slightly alkaline reaction are favorable for the development of most types of bacteria, which in such conditions successfully compete with mushrooms. In acid soils, where competition from bacteria is weakened, mushrooms that are adapted to such conditions are better developed.

In the application of OMD and PPP, the activity and orientation of biological processes in the root zone of plants changed, the activity of aboriginal microflora of the soil was optimized, which positively affects the productivity of plants. It was established that when spraying crops of OMD and PPP, the content of total microbial mass in the soil of the root zone of plants increased by 13.3 μg of soil.

Humic acids in the OMD have a positive effect on the biological activity of the soil. This is due to an increase in the amount of organic substrate in the form of brown extracts and root precipitates, which, in turn, indicates high stimulating properties, OMD and in doses of 40 l / ha.

Phytotoxicity is one of the main indicators of the ecological state of the soil. The spraying of crops of OCM and PPP positively influenced the reduction of phytotoxicity of the soil. So, when using OMD Vitalist phytotoxicity of the soil decreased by 1,55%, and at ODD Oasis - by 0,53%. The highest phytotoxicity of the soil was obtained in the control variant of 4.17%, which resulted in an increase in the number of trace elements.

The introduction of ODD and PPP reduces phytotoxicity of the soil by 2.5 and 3.6%, respectively, reducing the number of microorganisms-ammonifiers. The intensity of soil respiration under corn rises by OMD at 1.31-4.47 and after PPP - by 0.72-7.86 μg C / g soil; on soybean crops after OMD at 4.23-10.87 and after PPP at 3.11-9.77 mg CO_2 kg of soil. Negative changes in the composition of the microbial group were not detected. The use of OMD and PPD due to fungicidal properties significantly affects the immune status of plants, reduces the spread and development of diseases in wheat, maize and soybeans. This makes it possible to reduce the use of agrocentoses in the dose of pesticides by 25-30%.

Application of PPP in appropriate concentrations for legume plants of bean-periosobial symbiosis increases the activity of nitrogen fixation, plant productivity and nitrogen content in products. Treating PPP plants indirectly affects the activity of associational nitrogen fixation process through macrosymbiont. In this case, the process of photosynthesis activates, which contributes to the intensification of binding of atmospheric nitrogen due to an increase in the flow of ascible vegetable carbon into the tubers.

Stimulants of growth also activate the synthesis of nitrogen-bearing plant enzymes, which can also identify the synthesis of nitrogenase due to depletion of the substrate into nitrogen. In addition, as a general (due to the increase of the root system) and specific (due to the additional inflow of carbon), the number of typical nitrogen fixators for plants, which provides effective mixed autobacterization increases.

It is proved that the use of new domestic organo-mineral, microbiological fertilizers and plant growth regulators meets ecological requirements and ensures the protection of the environment, confirms the efficiency of energy-saving agrotechnologies, and also promotes the creation of suitable conditions for the growth and development of agricultural crops.

The long-term agro-ecological research has proven the expediency and safety of the wide use of new fertilizers and plant growth regulators in the cultivation of non-polluting environmental crops, while the products obtained are safe for human consumption and animal health. Application of the specified fertilizers and preparations increases productivity and improves the quality of products, does not reduce soil fertility.

Conclusions

1. In the application of mineral fertilizers (ammophos-34, ammophos-52 and NPK) under wheat crops the number of phosphate-motilizing agents increased by 4.0-5.9 and the sulfate-reducing microorganisms by 7.3-17.6 thousand CFUs per 1 g soil, the content of Azotobacter increased in 2,0-3,6 times, pedotrophic in 1,5-5,0 times.

2. The use of new organo-mineral fertilizers and growth regulators of plants stimulated the development of nitrogen-fixing microorganisms, enriching the soil available to plants by nitrogen compounds. OMD reduces the amount of fungi in the rhizosphere and the threat of phytopathogenesis.

3. It was established that pedotrophic and organotrophic microorganisms most often developed in the soil for the optimal amount of NPK. The number of microorganisms capable of dissolving tricalcium phosphates, increased in 2,3 - 2,9 times.

4. It was established that OMD and PPP reduces the phytotoxicity of the soil by 2.5 and 3.6%, respectively, reducing the number of microorganisms-ammonifiers. The intensity of soil respiration under corn rises by OMD at 1.31-4.47 and after PPP - by 0.72-7.86 μg C / g soil; on soybeans after OMD at 4.23-10.87 and after PPP at 3.11-9.77 mg CO_2 kg of soil. Negative changes in the composition of the microbial group were not detected. The use of ODD and PPP, due to fungicidal properties, significantly affects the immune status of plants, reduce the spread and development of diseases in wheat, maize and soybeans. This makes it possible to reduce the application in agrocenoses of 25-30% of pesticide doses.

Application of new OMF and PGR stimulates the development of nitrogen-fixing microorganisms, enriching the soil with plants available nitrogen compounds.

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