

Effect of Humus-Like Organic Substances and Beneficial Bacteria on Soil Agrochemical Parameters in Reducing the Amount of Heavy Metals in the Soil

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Received: 2024, 15, Aug
Accepted: 2024, 21, Aug
Published: 2024, 06, Sep

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Annotation: The article presents data on the positive effect of the new generation bacterial fertilizer of complex action Teria-S, organic fertilizer K-Gumat, biopreparation Serhosil and mineral fertilizer (NP) on the agrochemical parameters of soils contaminated with heavy metals at the Almalyk Mining and Metallurgical Plant when growing wheat plants.

Keywords: soils of the Almalyk Mining and Metallurgical Plant, heavy metals, winter wheat, K-Gumat, Teria-S, Serhosil.

Introduction

With the increase of man-made pollution of the environment, the self-cleaning ability of the soil decreases due to the change in the structure of the microbiocenosis. At the same time, species and groups of organisms that produce toxic substances appear, which means that the soil itself becomes a source of poisoning. In this case, obtaining environmentally friendly products becomes problematic [1,2].

Since heavy metals added to soil from anthropogenic sources are generally more mobile, they are easily transferred to plant products. This leads to an increase in the consumption of plant products by humans and animals [3,4].

Organic matter in the soil is an important natural accumulator and energy source of the earth, and determines the development of the soil and the formation of its totality. The amount of humus in the soil serves as a reserve source of nutrients for plants in many ways, together with water, it provides information about the agrophysical, physicochemical, and agrochemical properties of the soil [5].

It can also reduce Cd concentration in wheat by moderating the soil pH environment and immobilizing Cd in the soil [6]. For this, it is advisable to use organic products of humus nature. Humus is able to absorb toxic substances and heavy metals that enter the soil, preventing them from entering groundwater and plants[7].

RESEARCH MATERIALS AND METHODS

Experiments were carried out with winter wheat variety "Tanya" in the cultivated fields of the farm belonging to the Almalyk mining and metallurgical combine located in Ohangaron district of Tashkent region.

The selection of soil samples was carried out at the end of the growing season in accordance with GOST 17.4.4.02-84. Agrochemical analyzes of soils were carried out according to methods accepted in agrochemistry [8,9].

In order to reduce the amount of toxic effects of heavy metals in the soil and improve the growth and development of wheat plants, the effect of K-Gumat organic fertilizer, Teria-S bacterial fertilizer and Serhosil biopreparations on the change of agrochemical properties of soils contaminated with heavy metals was studied.

In the experimental options, before planting winter wheat, the soil was treated with mineral fertilizer (N₁₅₀P₂₅₀K₆₅ kg/ha), K-Gumat (200 l/ha), the seeds were treated with Teria-S bacterial fertilizer (1.5l/ha) and planted before planting. It was fed through the leaves with Serhosil biopreparation during the growing season (20 l/ha). In the control options, only mineral fertilizer was applied to the soil (N₁₅₀P₂₅₀ K₆₅ kg/ha) and seeds were planted.

RESULTS AND DISCUSSION

According to the results of the conducted experiments, it was observed that the germination of winter wheat seeds increased to 95% when treated with K-Gumat+Teria-S +Serhosil complex of organic and biological fertilizers, while in the control it was 90%.

Table 1. The effect of organic and biological fertilizers on changes in agrochemical properties of soils during the cultivation of winter wheat in soils contaminated with heavy metals (May, 2022)

№	Experience options	EC 1:5 dS/m	EC _e , dS/m	pH	Humus %	Humus carbon, (C _r , %)
1	Control, NPK	0,15	0,60	8,8	1,22	0,71
2	NPK + K-Gumat	0,13	0,52	8,7	1,37	0,91
3	NPK +Teria-S	0,12	0,48	8,6	1,75	0,80
4	NPK +K-Gumat+Teria-S+Serhosil	0,11	0,44	8,6	1,56	1,02
	The norm:			6,3-7,6	0,91-1,35	

The effect of organic (K-Gumat) and biological (Teria-S bacterial fertilizer and Serhosil biopreparation) fertilizers on the agrochemical properties of the soil during the cultivation of winter wheat on soils contaminated with heavy metals was studied. Analyzes of soils showed improvement of agrochemical properties under the influence of organic and bio fertilizers in wheat cultivation (Tables 1, 2).

The content of humus carbon in soil layers was 0.71% in the control options treated only with mineral fertilizers before planting, this indicator increased to 28.2% in the experimental options treated with mineral and K-Gumat organic fertilizers before planting wheat. was 91%.

It was found that the humus carbon content increased by 12.6% compared to the control options, and the humus index increased by 43.44% compared to the control options.

The amount of humus carbon increased by 43.6% and made 1.02% in the soils where mineral fertilizer and K-Gumat+Teria-S+Serhosil organic and biofertilizers were applied together. The humus index in these options increased by 27.86% compared to the control options.

The level of salinity (ES and ESe) was found to be reduced by 26.6% compared to the control options in the soils with the combined application of mineral, organic fertilizers and biofertilizers.

Variations in the amounts of total and mobile forms of nitrogen (N), phosphorus (P) and potassium (K) from the macroelements important for plants in the soil were studied in the experimental options (Table 2).

The total nitrogen content in the soils of the control options treated only with mineral fertilizer before planting is 0.085% in the upper layer control, which is lower than the norm (0.09-0.12%), before planting wheat with mineral and K-Gumat in experimental options treated with organic fertilizers, this indicator increased by 12.9% and corresponds to the standard amount. It was found that the mobile form of nitrogen in the soils increased by 28.2% in these options compared to the control options.

It was determined that the amount of total nitrogen increased by 36.47%, and the amount of mobile form of nitrogen increased by 73.63% compared to the control options.

Table 2. Effects of organic and biological fertilizers on N, P and K content of soils during the cultivation of winter wheat in soils contaminated with heavy metals (May, 2022)

№	Experience options	N		P		K	
		Total, %	Mobile N-NO ₃ , mg/kg	Total, %	Mobile, P ₂ O ₅ , mg/kg	Total, %	Mobile, K ₂ O, mg/kg
1	Control, NPK	0,085	11,0	0,145	9,6	0,90	301
2	NPK + K-Gumat	0,096	14,1	0,150	8,8	0,93	301
3	NPK +Teria-S	0,116	19,1	0,160	14,0	1,02	397
4	NPK +K-Gumat+Teria-S+Serhosil	0,109	14,1	0,165	15,7	0,96	385
	The norm	0,09-0,12	30-50	0,21-0,26	46-60	1,8-2,4	301-400

The amount of total nitrogen (N) in the soils where mineral fertilizer and K-Gumat+Teria-S+Serhosil organic fertilizer and biofertilizer complex was applied was 0.109% and increased by 28.25% compared to the control options. Also, the mobile form of nitrogen (N-NO₃) assimilated by plants was 11.0 mg/kg in the control, compared to the control options in the soils where mineral fertilizer and K-Gumat+Teria-S+Serhosil organic fertilizer and biofertilizer complex were applied. It was found that it increased by 2%.

The total phosphorus (P) content in the soil of the control options treated with only mineral fertilizer before planting was 0.145% in the upper layers, which is lower than the norm (0.21-0.26), mineral and K-Gumat organic fertilizers were applied to the soil before planting wheat. It was found that in the experimental options treated with this indicator increased by 3.44% compared to the control options, the amount of the mobile form of phosphorus (P₂O₅) decreased by 9.4%.

The total phosphorus (P) content increased by 10.34% compared to the control options, and the amount of the mobile form of phosphorus (P₂O₅) absorbed by plants increased by 45.83%. was found to have increased.

It was found that the amount of total phosphorus (P) increased by 13.5% in the soils where mineral fertilizer and K-Gumat+Teria-S+Serhosil organic fertilizer and biofertilizer complex were applied compared to the control options. Also, the mobile (P₂O₅) form of phosphorus absorbed by plants was 9.6 mg/kg in the control, and 63.5% compared to the control options in the soils where mineral fertilizer and K-Gumat+Teria-S+Serhosil organic fertilizer and biofertilizer complex were applied. was found to have increased to

The total amount of potassium (K) in the soil of the control options treated with mineral fertilizers before planting wheat plants was 0.90% in the upper layers, which is less than the norm (1.8-2.4). Before planting wheat, mineral and K- It was found that this indicator increased by 3.33% in experimental options treated with Gumate organic fertilizers, the amount of the mobile form of potassium (K_2O) did not change.

The amount of total potassium (K) increased by 13% compared to the control options, and the kinetic form of potassium assimilated by the plants (K_2O) increased by 31.9% compared to the control options. was found to have increased.

It was found that the amount of total potassium (K) increased by 6.7% in soils where NPK+K-Gumat+Teria-S+Serhosil mineral, organic and biofertilizers were applied. Also, the mobile form of potassium (K_2O) absorbed by plants was 301 mg/kg in the control, and 21.8% compared to the control options in the soils where mineral fertilizer and K-Gumat+Teria-S+Serhosil organic fertilizer and biofertilizer complex were applied.

The results of the experiment show that the application of mineral fertilizer, K-Gumat from organic substances of humus nature to the soil and the treatment of wheat seeds with Teria-S biopreparation before planting led to the improvement of the agrochemical properties of the soil and the decrease of the salinity level. Salt-resistant multi-characteristic soil bacteria contained in the Teria-S complex-acting bacterial fertilizer have the ability to improve the agrochemical properties of soils and reduce the level of salinity. This, in turn, confirmed that the level of salinity of the soil decreased sharply in the options where the NPK+K-Gumat+Teria-S+Serhosil complex was used.

Conclusion.

1. The agrochemical analyzes conducted in soil conditions under the harmful effects of toxic substances revealed that the use of the N150P250kg/ha+K-Gumat+Teria-S+ Serhosil organic and biological fertilizer complex in the soil-plant system has a positive effect on the agrochemical parameters of the soil.
2. The amount of humus carbon in the soils with the combined application of mineral, organic and biofertilizers increased by 43.6% and made 1.02% compared to the control options. The humus index in these options increased by 27.86% compared to the control options. It was found that the salinity level (ES and ESe), mineral, organic fertilizers and biofertilizers were reduced by 26.6% compared to the control options.
3. When NPK+K-Gumat+Teria-S+Serhosil mineral, organic fertilizer and biofertilizer complex is used, the agrochemical parameters of the soil increased by 3 mg/kg of mobile nitrogen, 6.1 mg/kg of mobile phosphorus and 84 mg/kg of mobile potassium compared to the control was determined.

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