Agroecological efficiency of biomodified mineral fertilizers

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Abstract. To improve the elements of winter wheat cultivation technology in order to reduce the loss of nutrients from the soil, research was conducted. The results presented in the article show the effectiveness of the use of mineral fertilizers with the application of a biological preparation to the granules. The influence of the method of applying a biological preparation based on Bacillus subtilis H – 13 on urea granules was evaluated. The influence of bio mineral fertilizers on the dynamics of nitrogen accumulation by wheat plants is established. The results obtained are the scientific basis for the use of rhizospheric bacteria Bacillus subtilis H - 13 as an effective strain for expanding the range of mineral fertilizers by creating bio modified forms and subsequent use in agricultural technologies.

1 Introduction

Effective use of nutrients by plants from mineral fertilizers is very important for the ecological safety of the ecosystem and the economy [1]. Ecologization of agricultural production [2,3] is possible with the use of microbiological preparations that have a complex of properties both fungicidal and bactericidal and the fixation of molecular nitrogen [4,5,6,15].

In a number of countries of the European community, biologics serve as additional components of organic farming. Their application should ensure the production of environmentally safe products and the stabilization of a healthy state of the environment [7, 8, 9].

Bio modified fertilizers are obtained by applying special agronomically useful bacteria to the surface of granules with the inclusion of rhizospheric nitrogen-fixing spore bacteria Bacillus subtilis strain H-13, which also have a growth-stimulating effect. Due to the produced antibiotics, Bacillus subtilis is an antagonist of pathogenic and opportunistic microorganisms (Salmonella, Proteus, staphylococci, streptococci, yeast fungi) that produce enzymes that remove the products of putrefaction of tissues and the ability to acidify the environment [10, 11].

The "bio capsule" formed by these bacteria on the surface of the granule can simultaneously perform several functions: fertilizing, protective and stimulating. The use of these fertilizers in agricultural technologies is an additional method of increasing productivity, product quality, and improving the environmental situation of agrocenoses. The use of bio mineral fertilizers in some cases allows reducing the dose of fertilizers by 20-30% without loss of biological efficiency [12,13,14].

The purpose of the research was to scientifically substantiate the effectiveness of using biomineral fertilizers to reduce the loss of nutrients.

The microorganisms that make up the preparation increase the use of mineral fertilizers by plants and increase the availability of soil reserves of phosphorus and potassium [5]. The main objective of the research was to study the agro ecological effectiveness of urea and urea Bio.

The research was carried out on meadow black -soil heavy-duty low-humus heavy-loam soil (table. 1).

The experimental setup consisted of 4 variants: 1)

Table 1. Agrochemical characteristics of the soil of the experimental area.

pH_{H_2O}	$H_Г$	S	Content						
			$N\text{-}NO_3$	$N\text{-}NH_4$	P_2O_5	K_2O	humus	V	Clay fraction (<0,01 mm)
	mg-eqv/ 100 gr		mg/kv of soil				%		
6,5	2,04	35,7	15,0	12,7	68,0	198,1	2,8	94,6	67

Table 2. Dynamics of mineral nitrogen content in soil, mg / kg.

Variant		Vegetation phase					
		tillering		Getting into the tube		Full ripeness	
		$N-NO_3$	$N-NH_4$	$N-NO_3$	$N-NH_4$	$N-NO_3$	$N-NH_4$
Control		11,2	15,4	9,8	11,3	13,0	13,8
1st subfeeding N_{30}+2nd subfeeding N_{30}	Urea	15,9	21,8	11,2	15,4	14,9	15,7
	Urea Bio 1	17,2	22,5	11,5	16,8	15,9	16,7
	Urea Bio 2	17,0	22,3	11,3	16,6	15,6	16,8
HCP_{05}		0,7	0,7	0,6	0,7	0,8	0,8

Control; 2) Urea (1 feeding N30+ 2 feeding N30); 3) Urea BIO-1 (1-feeding N30 + 2 feeding N30); 4) Urea BIO-2 (1 feeding N30 + 2 feeding N30). Repeatability-4 times. The placement of options is randomized. Before sowing, nitroammophoska (16:16:16) was introduced at a dose of 200 kg / ha in physical weight, while sowing – ammophos 50 kg/ha. top Dressing was carried out with urea and urea Bio in two modifications (BIO-1 and BIO-2) according to the scheme of the experiment. BIO-1 is a method for spraying a microbiological preparation on a urea granule in the conditions of fertilizer plants, BIO-2 is a method for mixing a microbiological preparation with urea in the conditions of agrocentres and agro - entrepreneurs. All analytical work was performed in accordance with the General requirements for analysis (GOST 29269-91).

Analysis of the dynamics of the nitrogen regime of soils showed that in the tillering phase of plants after nitrogen fertilization,the content of nitrate and ammonium nitrogen in the soil increased by 42-53.5% and 41.6–46.1%, respectively, in comparison with the control. When using modified urea, the soil contained the largest amount of mineral nitrogen. Fertilizers modified by Bio 1 and Bio 2 did not differ significantly in their effect on the nitrogen regime of the soil during this period (table. 2). By the phase of plants entering the tube, differences in the content of mineral nitrogen of the soil with the options of fertilization and control are reduced. This was mostly observed in the case of nitrate nitrogen, which is most likely due to the large consumption of it by plants. Note that there are no significant differences between different forms of urea.

The content of ammonium nitrogen was influenced by urea forms to varying degrees. Most of it was contained in the soil when feeding with urea Bio 1 (48.7 % more than in the control), significantly less – when using urea Bio 2 (+47.0 % to the control). And when using standard ammonium nitrogen urea, the soil contained significantly less than when feeding with modified fertilizers.

At the end of the winter wheat growing season, the soil in the variants with top dressing contained more mineral nitrogen than in the control: nitrate by 14.6-22.3%, ammonium-13.8-21.7%. The largest number of them is noted on variants with the use of modified forms of urea.

Thus, the determination of the nitrogen content in the soil showed a better supply of plants with modified urea when feeding, both in comparison with the control and with traditional urea. There were no significant differences in the effectiveness of urea Bio 1 and urea Bio 2, although a stable trend of Bio 1 advantage was observed throughout the growing season.

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