ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Biopreparations In the Spring Wheat Fertilization System.

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ABSTRACT

High efficiency of biopreparations: rizoagrin, flavobacterin, azorin, agrophil, mizorin and extrasol for pre-sowing seed treatment has been proved in the technology of cultivating spring wheat with their application both in a pure form and in contrast to mineral fertilizers. The grain yield gain without the use of any fertilizers was 0,1 – 0,49 t/ha (4 – 18 %), in contrast to $N_{30}P_{30}K_{30}$ – 0,59 – 0,81 t/ha (21 – 29 %).

Keywords: biopreparations, mineral fertilizers, spring wheat, yield.

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ISSN: 0975-8585

INTRODUCTION

Soil is a unique polydisperse and multicomponent system in its physical and chemical properties that represents an ideal environment for the existence of a great number of microorganisms which are various in their needs. In any clod of the soil there are aerobic, anaerobic, thermophilic and psychrophiles , acidophile and alkalophilic bacteria, autotrophic and heterotrophic, eubacteria, prokaryotes and eukaryotes.

Contemporary natural science recognizes a special role of the bacteria living in the soil in supporting stability both of ground ecosystems and biosphere on the whole. The activity of a person contributes to the intensification of biogeochemical functions causing by this a shift of homeostasis existing in nature. That is why it is not accidental that in the last years an interest to new non-traditional components of farming has been growing quickly the vital element of which is a widespread use of biopreparations directed towards the regulation of activity of some functional bacteria groups, first of all, nitrogen-fixing ones. The circulation of nitrogen in nature is carried out by bacteria and microorganisms only and microbiologic fixation of nitrogen played an important role in creation of the nitrogen status of biosphere and maintaining it for several billions of years. [1]

In this connection it is worth reminding that until recent times the capability of fixing molecular nitrogen has been ascribed to a small number of highly specialized bacteria (bulb bacteria, azotobacter, some species of bacilli). By present time the nitrogen-fixing activity has been found practically in species of all bacteria groups: autotrophic and heterotrophic, spore and non-spore, in eubacteria and archaeons. [1]

The management of microbiological processes of atmospheric nitrogen fixation for the purpose of preserving the soil fertility became one of the most important theoretical and practical objectives of soil science, agrochemistry and farming. In this connection the most important technique is the introduction of definite useful microorganisms in agrocenoses. [2, 3, 4, 5, 6, 7] It is believed that biological nitrogen comes into the soil by means of pre-sowing seed treatment with diazotrophic preparations in the amount of 20 – 107 kg/ha depending on the identification method, region, soil and climatic conditions, type of agrocenosis and others. [8, 9]

Soil microorganisms(first of all, microscopic fungi and bacteria) are the main agents converting poorly soluble phosphorus compounds into available forms. That is why the use of phosphate-mobilizing bacteria in the composition of bacterial fertilizers to improve plant nutrition is an effective technique. The effect exerted by phosphate mobilizing microflora on the plant is determined both by the increase of phosphorus available for plants and forming physiologically active substances by it. [10]

The analysis of contemporary scientific literature on the study of biopreparations in sown crops shows a great prospect and predetermines the necessity of applying each of them in definite soil and climatic conditions since they identify to a greater extent the efficiency of any techniques of raising the crop yield. The above mentioned ascertained the purpose of our studies – to investigate the efficiency of biopreparations offered to agricultural producers at present for the use in the system of fertilization of one of the main food crops of the Volga region – spring wheat.

Objects, conditions and methods of research

The objects of the study were: biopreparations - rizoagrin, flavobacterin, azorin, agrophyl, mizorin and extrasol; mineral fertilizers – ammonium saltpeter, double granulated superphosphate and chloric potassium; a crop – spring wheat of the variety “Zemlyachka”; the soil of the experimental plot – black soil slightly leached hard clayloam with a humus content in the arable layer of 5,65 %, total nitrogen 0,26 %, mobile compounds of phosphorus and potassium 215 and 103 mg/kg of the soil respectively, pH_{KCl} 6,6 units.

The experimental design: 1 variant – control, 2. Rizoagrin, 3. Flavobacterin, 4. Azorin, 5.Agrophyl, 6. Mizorin, 7. Extrasol, 8. $N_{30}P_{30}K_{30}$ (NPK), 9. NPK + rizoagrin, 10. NPK + flavobacterin, 11. NPK + azorin, 12. NPK + agrophyl, 13. NPK + mizorin, 14. NPK + extrasol. Mineral fertilizers in the form $N_{аа}$, $P_{сд}$ и $K_{х}$ were applied for pre-sowing seedbed cultivation , seeds were treated with biopreparations before sowing in doses of 600 gr for 1 tonne of seeds with the use of adhesives.

ISSN: 0975-8585

The sowing area of the plot was 59,4 м^2 (1,65*36), registration plot was 49,5 (1,65*30), the location was randomized. Field and lab studies were conducted in conformity with methodological requirements and state standards. In the years of doing experiments the weather conditions of vegetation periods on the whole were favorable for plant development and yield formation.

Investigation results

The yield values of spring wheat have been given in table 1 depending on the application of biopreparations in the technology of its cultivation both in a pure form and in contrast to mineral fertilizers.

While analyzing the data of the table first of all it makes itself conspicuous that a number of biopreparations in cultivating spring wheat on typical black soil of the Middle Volga region make it possible to form the grain yield comparable with the yield of the use of medium doses of mineral fertilizers. For example, rizoagrin and flavobacterin in efficiency exceed the variant with soil application of $N_{30}P_{30}K_{30}$, and the yield gain from the use of extrasol for pre-sowing seed treatment at the level of the mineral fertilization degree. The latter, without any doubt, owes its marked nitrogen fixation capability of these biopreparations, and in relation to rizoagrin – much wider range of bacteria strains present in it *(Arthrobacter mysorens 7, Bacillus subtilis, Agrobacterium radiobacter 204, Azomonas agilis 12, Agrobacterium radiobacter 10, Azospirillum lipoferum137).*

Table 1: Efficiency of biopreparation application and fertilizers for spring wheat (on average for 3 years)

№	Variant	Grain yield, t/ha	Yield gain		Cost-repayment of 1 kg NPK зерном, кг/кг	Straw weight, t/ha	Economic coefficient
			t/ha	%			
1	Control	2,75	-	-	-	3,68	0,43
2	Rizoagrin	3,24	0,49	18	-	4,10	0,44
3	Flavobacterin	3,11	0,36	13	-	3,95	0,44
4	Azorizin	2,85	0,10	4	-	3,68	0,44
5	Agrophil	2,96	0,21	8	-	4,02	0,42
6	Mizorin	2,98	0,23	8	-	3,96	0,43
7	Extrasol	3,08	0,33	12	-	4,12	0,43
8	$N_{30}P_{30}K_{30}$	3,07	0,32/-	12/-	3,6	4,15	0,43
9	NPK + Rizoagrin	3,43	*0,68/0,36	25/12	7,6	4,28	0,44
10	NPK + Flavobacterin	3,45	0,70/0,38	25/12	7,8	4,33	0,44
11	NPK + Azorin	3,51	0,76/0,44	28/14	8,4	4,34	0,45
12	NPK + Agrophil	3,56	0,81/0,49	29/16	7,4	4,41	0,45
13	NPK + Mizorin	3,34	0,59/0,27	21/9	6,6	4,22	0,44
14	NPK + Extrasol	3,46	0,71/0,39	26/13	7,9	4,33	0,44

* – numerator in relation to control, denominator – to NPK

$LSD_{0,5}$ of grain: variant – 0,16; biopreparation – 0,06; fertilizer – 0,11; interaction – 0,16 t/ha; P_1% – 1,73.

Azorin, agrophyl and mizorin are less efficient in this relation. However the use of them in the background of mineral fertilizers sharply increases their efficiency: the grain yield gain in all the variants practically doubles. The inoculation of seeds with various biopreparations correspondingly increases the cost-repayment of mineral fertilizers with the grain yield gain from 3,6 to 6,6 – 8,4 kg/kg.

Consequently, despite the opinion of a number of authors [11, 12] that the molecular nitrogen assimilation is inhibited in the presence of certain amounts of nitrogen and seed inoculation efficiency due to

this decreases. Small starting doses of easily available nitrogen seem to be required for the formation of a powerful photosynthetic potential in plants and stimulation of the nitrogen-fixing bacteria development.

Along with the rise of the main produce yield the application of mineral fertilizers and biopreparations contributed to an increase of the straw harvest the weight of which in the background of applying NPK on average in all variants was 3,93 t/ha, and with application of $N_{30}P_{30}K_{30}$ and biopreparation's use it rose up to 4,29 t/ha, or by 1,1 times. According to the action efficiency on the straw weight on both fertilization patterns the tested biopreparations were practically equal. Biopreparations did not have any substantial effect on the value of economic coefficient that shows a grain share in the total biological yield (grain + straw), which was 0,42 – 0,45 on both patterns.

A sudden increase of the spring wheat yield when using biopreparations in contrast to mineral fertilizers(by 0,59 – 0,81 t/ha in relation to absolute control) is probably associated with a considerable rise of coefficients of nutritional elements used from them and the data of table 2 testify to it.

With application of $N_{30}P_{30}K_{30}$ the coefficient of using nitrogen was 31 %, phosphorus and potassium – 23 %. With application of rizoagrin, flavobacterin and azorizin the coefficient of using nitrogen increased up to 41 – 51 %. While calculating the coefficients of the nutrition elements' use from fertilizers inrelation to the variant without their application the value of coefficients rose reaching 70 – 75 % in nitrogen, 25 – 36 % in phosphorus and 30 – 39 % in potassium.

Table 2: Coefficients of the nutrition elements' use by spring wheat from fertilizers when using biopreparations, % (average for three years)

№	Biopreparation	To control (without a biopreparation)			To the fertilization with a biopreparation		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O
1	Control	-	-	-	31	23	23
2	Rizoagrin	75	36	39	50	21	24
3	Flavobacterin	70	36	35	41	14	12
4	Azorizin	66	25	30	51	23	15
5	Agrophil	50	39	36	26	28	26
6	Mizorin	75	23	36	32	6	28
7	Extrasol	52	28	38	15	6	15

Thus, the application of biopreparations for inoculating spring wheat seeds makes it possible to increase considerably coefficients of using nitrogen, phosphorus and potassium from mineral fertilizers. It is more significant that the rise of coefficients in nitrogen takes place from rizoagrin, flavobcterin, mizorin and azorizin; in phosphorus from rizoagrin, flavobacterin and agrophil.

CONCLUSIONS

Thus the use of biopreparations: rizoagrin, flavobacterin, and extrasol for pre-sowing seed treatment of spring winter makes it possible to form the yielding capacity of grain comparable with the application of average doses of nitrogenous, phosphorus and potassium fertilizers ($N_{30}P_{30}K_{30}$). The efficiency of all the studied preparations increases sharply when they are used in contrast to mineral fertilizers. In view of this the grain yield in relation to the control group increases by 21-29%, to mineral fertilizers by 9 – 16 %; cost – repayment of 1 kg of fertilizers with grain rises from 3,6 kg to 8,4 kg/kg.

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