

EXPERIENCE IN APPLICATION OF BIOMINERAL FERTILIZERS

The present day plants use only a part of nutrient substances which get into the soil with mineral fertilizers. A utilization coefficient of nitrogen by plants from overall introduced amount is 30-50%, phosphorus – 20-30%, potassium – 30-40% [1]. The most part of nutrient substances of fertilizers is washed into underground water, escapes into the atmosphere (nitrogenous fertilizers) or changes into unreachable form for plants (phosphorus fertilizers). In accordance with the data of American research workers, power consumption for producing and applying of mineral fertilizers is a half of overall power consumption in the agricultural industry. An increase in the fixing efficiency of solely nitrogenous fertilizers and only by 10% on scale of the world agricultural industry is equivalent to saving of 25 billion USD. That is why the issue of the increase in the efficiency of the mineral fertilizers utilization is very much of interest at this time.

One of possible solutions of this issue is a biological modification of pellets of mineral fertilizers, and deriving of so called biomineral fertilizers which efficiency is by 15-40% higher in comparison with traditional forms [4]. The gist of modification is to apply a biological preparation on the basis of the bacterial strains *Bacillus subtilis* Ch-13 – «BisolbiFit» on the pellet of mineral fertilizers. The economic efficiency of the biological modification utilization is from 3 to 15 rubles on 1 ruble expenditures depending on the fertilizer type, crop and soil and climatic conditions.

First researches of the utilization efficiency of biomineral fertilizers were carried out from 2003 till 2005 in All-Russian Research and Development Establishment of agricultural chemistry n.a. D.N. Pryanishnikov. Existing reports of Russian Agricultural Academy and publications in the *Agrochimiya* magazine [2] and in *Vestnik of Russian Academy of Agricultural Sciences* [3] confirm the high utilization efficiency of «BisolbiFit», modifier of mineral fertilizers.

Industrial approbation of modified mineral fertilizers was carried out in 2009 in households of the Amur Region, Far Eastern Federal District [5]. Approbation results are presented in Table 1 and Table 2.

Table 1 – Influence of the modified ammophos on the yield value of the soya bean in Baykal OJSC, Amur Region

Variants of the production experience	Yield value, c/ha
Control (without fertilizers)	16,3
Ammophos (traditional), 25 kg/ha	18,0
Ammophos (modified), 25 kg/ha	20,8

In the first household modification of mineral fertilizers by the preparation «BisolbiFit» resulted in the increase in the soya bean yield value relating to traditional ammophos - 2,8 c/ha. In the second household Dimskoye LLC the increase in the yield value due to the ammophos modification by the preparation «BisolbiFit» was 2,9 c/ha.

Table 2 – Influence of the modified ammophos on the yield value of the soya bean in Dimskoye LLC, Amur Region

Variants of the production experience	Yield value, c/ha
Ammophos (traditional), 50 kg/ha	13,3
Ammophos (modified), 50 kg/ha	16,2

In 2010 in the farm (peasant) household Niva, Ussuriysk urban district, specialists of the Primorye branch, Federal State Institution Rosselchozcentr carried out scientific and production experiment. The crop is soya bean, the sort is P-69. Total area is 10 ha. Accounting area is 6 ha. The soil of the experimental area is meadow-brown, and it was characterized with the following agrochemical parameters: humus - 3,75, P₂O - 1,6 mg/100 g, K₂O, -13,5 mg/100 g, P_{H_KCL} -4,5, H_Γ - 4,95 mg-equiv./100 g, S - 21,8 mg-equiv./100 g.

Mineral fertilizers diamphoska (10:26:26) were treated with the modifier «BisolbiFit» in the ratio 5:1000 kg as applicable. Fertilizers were applied locally when planting soya beans. Experimental design:

- 1) Control (without fertilizers);
- 2) Foil N₁₀ P₂₆ K₂₆;
- 3) Foil N₁₀ P₂₆ K₂₆ + «BisolbiFit»

Planting method is belt, in three stripes. Herbicides of Harmony (7 g/ha) + Centurion (0,25 l/ha) + Amigo (0,75 l/ha) were applied at vegetation development, and two inter-row cultivations were conducted. Plant population previous to the harvesting is 222 thousand of plants/ha. Measurement of productivity elements was conducted manually by the way of selecting sheaves in the field (16.10.10), at the same time the plant height, haulm thickness, quantity of beans and seeds on the plant were measured. After threshing seeds were weighted, productivity and biological crop yield of soya bean were estimated. Soya beans were harvested by the combine John Deer.

The results of the agrochemical analysis of the soil showed that after applying fertilizers, treated with modifier «BisolbiFit», the level of the moving form of phosphorus in the soil increased by 10%. Meanwhile the quantity of general phosphorus in the soil was 0,014% less than by foil of mineral fertilizers. It is evidence that the utilization of the biopreparation furthered more intensive fixation of phosphorus by soya plants from the soil.

It is commonly known that changing of the feeding schedule affects the habitus of plants. Meanwhile improving the nutrition causes intensive growth of soya beans. Applying the preparation «BisolbiFit» to mineral fertilizers truly increased the plants height almost by 13% in comparison with traditional forms of mineral fertilizers. «BisolbiFit» also furthered the increase in the quantity of seeds on the plant almost by 11% in comparison with traditional forms of mineral fertilizers. As the final result modification of pellets of mineral fertilizers with the preparation «BisolbiFit» essentially raised the yield value of soya beans (Fig.1).

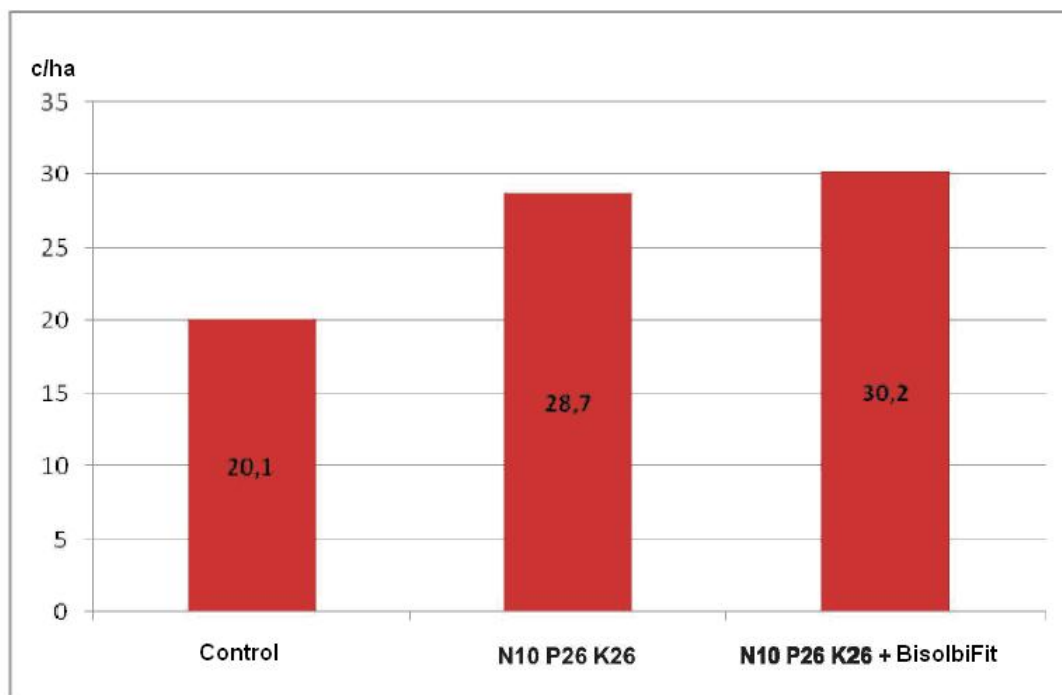


Fig.1. Influence of the mineral fertilizers modifier «BisolbiFit» on the yield value of soya beans, 2010.

In Fig.1 we can see that maximum yield value of soya beans (30,2 c/ha) was achieved in the variant «NPK+ BisolbiFit». Modification of mineral fertilizers by the preparation «BisolbiFit» resulted in 1,5 c raise of the soya beans yield value in comparison with traditional mineral fertilizers.

Calculation of economic efficiency of the mineral fertilizers utilization, represented in Table 4, evidences the high profitability of utilization of the biomodified mineral fertilizers.

The price of 1 t of diammophoska as the result of modification increased by 9% in comparison with usual diammophoska. This lead to the increase in expenditures for mineral fertilizers in the calculation on 1 ha in absolute terms by 110,5 rub.: from 1211,25 to 1321,75 rub. If the price of soya beans was 800 rub./c, net profit from the utilization of biomineral fertilizers in the calculation on 1 ha would be 6758 rub. It is 1089 rub. more than when using traditional diammophoska. As the final result the cost-effectiveness of the modified diammophoska utilization for soya beans turned out to be by 43% higher than the cost-effectiveness of the usual diammophoska utilization.

Table 4. Relative economic efficiency of the biological modification of pellets of mineral fertilizers by the preparation «BisolbiFit»

Parameter	UOM	Unmodified mineral fertilizers (N ₁₀ P ₂₆ K ₂₆)	Modified mineral fertilizers (N ₁₀ P ₂₆ K ₂₆ +BisolbiFit)
Rate of fertilizer application	kg/ha	50	50
Price for 1 t of fertilizers VAT included	rub.	24 225,00	26 435,00

Expenditures for fertilizers in the calculation on 1 ha	rub.	1211,25	1321,75
Cost of 1 c of soya beans	rub.	800,0	
Raise of Yield value	c/ha	8,6	10,1
	rub./ha	6 880,00	8 080,00
Net profit from 1 ha	rub.	5 668,75	6 758,25
Cost-effectiveness of fertilizers	%	468%	511%

With additional expenditures for the modification of mineral fertilizers in the amount of 110,5 rub./ha, additional net profit due to the raise of yield value of soya beans was 1089 rub./ha. Recoupment of additional expenditures (on modifier and modification of mineral fertilizers) was 9,86 rub. It means that each 1 rub., invested in modification of mineral fertilizers by the preparation «BisolbiFit», results in 9,86 rub. of net profit when managing soya beans.

«BisolbiFit» is a bulk solid from light-grey to cream color. Active substance of «BisolbiFit» is a strain of riosphere bacteria *Bacillus subtilis* Ch-13 and their metabolites. The quantity of bioagent is not less than 100 mln colony-forming units in 1 g of preparation [6].

«BisolbiFit» is used for biological modification of all types of mineral fertilizers with the purpose to increase the plants utilization coefficient of: nitrogen — from 20 to 50%; phosphorus — from 20 to 60%; potassium — from 10 to 40% from mineral fertilizers.

Modifier is applied to the surface of pellets of mineral fertilizers during their production after the oil treatment by pulverizers. Modifier can also be applied to pellets of fertilizers in missing units at bulk blending plants.

Mineral fertilizers, modified by the preparation «BisolbiFit», are used without any restrictions for any types of agricultural crops, in any climatic conditions, both separately and with any mineral feedings, microelements, stimulators, pesticides and biopreparations.

The preparation for modification of pellets of mineral fertilizers «BisolbiFit» is developed in All-Union Research and Development Establishment of agricultural microbiology of Russian Academy of Agricultural Sciences (St. Petersburg-Pushkin). It is produced by TU 929172-001-53281571-2006 and holds a Certificate № 0680 on state registration of pesticide and (or) agrochemical».

MODE OF ACTION OF THE MODIFICATOR OF MINERAL FERTILIZERS

1) When treating pellets of mineral fertilizers their surface is artificially settled with beneficial microflora, which can activate nutrient substances contained in mineral fertilizers. Moreover bacteria mobilize and convert soil reserves of nitrogen, phosphorus and potassium into the reachable form for plants.

2) Amino acids, vitamins, hormones and organic acids produced by microorganisms of the preparation «BisolbiFit», stimulate and accelerate physiological processes passed in the plant cell, increase the intensity of photosynthesis and respiration, and also significantly build immune system of the plant, accelerate its growth.

3) During their vital activity microbions synthesize substances which block the development of phytopathogenic microorganisms such as: brown rust, powdery mildew, snow mold, late blight, fusariose, all possible bacteriosis, helminthosporiosis, root rots, etc.

As a result «BisolbiFit» by 5-15% increases the yield value of agricultural crops in comparison with traditional forms of mineral fertilizers.

APPLICATION METHOD OF MODIFICATOR

«BisolbiFit» is included in generally accepted technology of production of mineral fertilizers and mixed goods. Estimated amount of preparation is uniformly pulverized on pellets (after conditioning) or is fed into the mixer. Mixing time in the mixer is 2-4 min. After mixing is finished, pellets of mineral fertilizers should be fully covered with the preparation. Application rate of «BisolbiFit» is 4-5 kg on 1 t of mineral fertilizers.

Therefore, modification of pellets of mineral fertilizers by the preparation «BisolbiFit» at the present day is one of the most perspective and efficient methods for the efficiency increase of their utilization. This method increases the efficiency coefficient of mineral fertilizers by 10-50%. Moreover modification almost fully solves the issue of fertilizers caking when storing and transportation. Thus, domestic manufacturers may have significant competitive advantage at the world market of mineral fertilizers.