

## Section 1. Biotechnologies

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### WAYS OF OBTAINING ORGANIC PRODUCTS FROM SEVERAL BREAD CROPS (BARLEY, EMMER AND WHEAT)

**Abstract.** With the aim of effective cultivation of cereal crops and obtaining organic products, the effect of ecologically safe preparations on the quantity and quality of the yield of several bread crops was studied. Our results showed that investigated preparations can be recommended as a new effective and safe agrochemical for crop cultivation.

**Keywords:** Organic preparation, seed disinfectant, Complex-Co, Bactophyte, Quicelium, Triamin 10.2%, growth stimulant, barley, emmer, triticale.

#### **Introduction**

To solve the food problem, meet the growing needs of the population for food and provide livestock feed, it is extremely important to obtain new, highly productive varieties of agricultural crops that can best withstand the stressful situations observed as a result of global climate change [1, 111; 2, 328; 3, 203–209]. In this way, it is no less important and

very responsible process to develop a complex of scientifically based agrotechnical measures for newly obtained and high-efficiency varieties, under which conditions the variety can demonstrate its potential possibilities of efficiency. Here, in particular, great attention should be paid to the definition of the exact fertilization system, choosing the optimal combination of fertilizers, on which both the quantity and

quality of the expected harvest largely depend [4, 114–119; 5].

In modern conditions, it is becoming very relevant to obtain an environmentally pure product, which is free from unwanted compounds harmful to human health and residual nitrogen. In this regard, bread crops are extremely important, the products obtained from which are a daily component of the human diet [6]. It is equally important to pay similar attention to the quality indicators of grain feed used in the ration of farm animals, because in order to obtain high-quality livestock products, it is necessary to feed animals with quality feed without extraneous additives [7; 8]. The solution to this global problem should start from the very initial stage of crop cultivation, seed disinfection, continuing it throughout the vegetation and excluding the use of any mineral fertilizers in the form of nutrients. For this purpose, we used “Complex – Co” preparation of organic origin as a seed disinfectant, which is a highly effective means of combating bread crops against fungal diseases [9, 285–290]. At the same time, it also has the best properties of a plant growth promoter, significantly increasing the degree of effective plant tillering in bread crops. The above mentioned valuable properties of “Complex – Co” organic preparation were presented in our previous report [10].

### **Material and method**

This time, the order and sequence of organic fertilizers used during the subsequent stages of the cultivation of several spiked bread crops (barley, emmer, wheat) obtained by us are presented, as well as the effect of fertilizers on the chemical composition of the grain and the main provisions for obtaining an ecologically clean product [11; 12, 413; 13, 175].

At the early stage of plant growth and development (stemming and spring regrowth) on the background of “Complex-Co” preparation, Triamin 10.2% organic fertilizer given in the form of extra-root nutrition had a significant effect. It is a liquid fertilizer containing amino acids and microelements, which is applied to a number of agricultural crops, particu-

larly bread crops. The preparation is developed specifically for the stimulation of plant growth and the formation of new tissues, significantly contributes to the improvement of the plant’s immune system, increasing resistance to diseases. At the same time, it provides the plant with microelements necessary for growth [14, 72–79; 15, 702–707].

In the later stages of the growth and development of bread crops, the fight against fungal diseases (downy mildew and leaf rust) was carried out with Bactophyt biological fungicide preparation, at the beginning of the tube setting stage. It is a biological fungicide and bactericide preparation for grain, fruit and vegetable crops to combat fungal and bacterial diseases. At the same time, the preparation provides a good result in the fight against root rot, powdery mildew, rust and fusarium.

The application of organic fertilizer Quiselium, which is applied in the form of extra-root nutrition at the end of the flowering of bread crops, as soon as grain formation begins, provides a noticeable increase in the grain yield of bread crops. It is a liquid fertilizer containing microelements derived from valuable plant extracts. The preparation stimulates the division of cells, the process of plant growth, which in the end noticeably increases the yield and increases the sugar content.

Each of the selected preparations has its own specific mechanism of action and period of application, which determines the level of effectiveness of the given preparation. For this reason, when conducting scientific experiments, a very stable schedule for the use of organic preparations was defined, because each of them can provide its maximum result in a very specific period of time and at the planned stage of growth and development [16, 71–75; 17, 422].

All three preparations used during the vegetation has organic origin, as a result of their after-effect, obtaining an ecologically pure product is fully guaranteed. Here it is also worth mentioning the fact that the soils of the test field, where the scientific experiments were carried out, are certified by the “Ecoglobe” organization operating in RA, where no pesticides and mineral fertilizers have been used

for more than ten years [18,112]. At the end of the three-year studies, average samples were separated from the product (grain mass) for laboratory examination and determination of the amount of undesirable compounds and residual nitrogen in them. It was carried out in the “FDI” laboratory located in the Abovyan region of the Kotayk marz of RA and having state certification, the results of which are attached to the article in the form of an appendix.

### Results and discussions

During the cultivation of cereal crops, the use of preparations of organic origin began with the disinfection of seeds, and the effect of the Comlex-Co preparation as a disinfectant and growth promoter on seed germination capacity and duration was studied.

Organic fertilizer of Triamin 10.2% introduced in the form of foliar feeding had a significant effect on the background of Comlex-Co preparation in the early stage of plant growth and development (tillering and spring regrowth). This is evidenced by the indicators of productive tillering introduced in Table 1, which significantly exceed the results of the control variant.

The highest rate of productive tillering was observed in barley – 1.31, which exceeded the control option of the same crop by 0.21, while in emmer and triticale, these differences compared to the control one were 0.12 and 0.15, respectively.

Triamin 10.2% preparation applied in the form of foliar feeding during vegetation had a noticeable effect on the number of total stems, as well as stems

with spike, which is one of the primary and important prerequisites for the formation of high grain yield. The increase in the number of cereal crop total stems in the variants treated with the preparations can be attributed mainly to the aftereffect of the Complex-Co preparation, and later the intensive rate of their growth may be related to the Triamin 10.2% organic preparation. At the early growing stage Complex-Co promotes the intensive accumulation of nutrients in the tillering node, which in its turn leads to the formation of a large number of stems. It is especially well manifested in the case of triticale, increasing the number of stems with spike by 75.1 units compared to the control variant, and in the case of barley and emmer, it was 42.6 and 10.8 stems, respectively.

At the early stages of growth and development, the formation of healthy plants and their high level of preservation is provided by the Complex-Co preparation, and during the vegetation period, the application of Bactophyte organic preparation in the form of foliar feeding, which had a significant effect on the prevention of diseases characteristic to the cereal crops. This is evidenced by the phytopathological data presented in Table 2, which clearly state that in all the crops of the variants fertilized with organic fertilizers, the infection intensity with diseases was assessed with a of 5 ball. An exception was observed in case of emmer, where a few traces of leaf rust was recorded and due to that it was scored as 4.9 ball and this was during the summer season with high amount of precipitations.

Table 1.– Effect of organic fertilizers on stem extension capacity of spiked cereals

Crop	Variant	Number of stems per 1 m <sup>2</sup> , unit		Tillering		Plant height by stages, cm				The intensity of the infection of the plants with diseases, ball
		total	with spike	total	productive tillering	tillering	stem extension	heading	ripening	
1	2	3	4	5	6	7	8	9	10	11
Barley	Control	646.5	467.8	1.52	1.10	13.1	41.3	66.1	71.8	4.9
	Treated with preparations	878.6	510.4	1.91	1.31	16.8	53.4	80.0	88.5	5.0

1	2	3	4	5	6	7	8	9	10	11
Emmer	Control	571.1	412.7	1.55	1.12	12.1	44.7	59.8	65.0	4.5
	Treated with preparations	688.1	423.5	1.81	1.24	14.8	52.4	68.4	72.1	4.9
Triticale	Control	587.3	429.3	1.45	1.05	17.8	102.3	150.3	162.7	4.8
	Treated with preparations	790.3	504.4	1.88	1.20	20.2	114.7	189.78	197.8	5.0

The significant positive effect of bacteriophage is also testified by the fact that in the control variants of cereal crops, a relatively high level of infection was observed, reaching 4.5–4.9 ball, while it decreased sharply in the variants where preparations were applied.

In the grain formation and filling stages the foliar feeding of plants with Quicelium preparation had its considerable effect on the structural elements of the spike, on the mass of 1000 grains, as well as on the developed biological and actual yield quantity, the results of which are summed up in the Tables 2 and 3.

Table 2. – The effect of organic fertilizers on the biological yield of grain and its structural elements

Crop	Variant	The number of plants per 1 m <sup>2</sup> at the end of vegetation, unit	The number of the stems with spike per 1m <sup>2</sup> , unit	One spike			Weight of 1000 grains, g total	Grain yield from 1m <sup>2</sup> , g	Biological yield, t/ha		
				length, cm	the number of spike-lets, pcs	weight of grains, g			total	of which	
										grain	thatch
Barley	control	425.3	467.8	6.8	34.7	0.84	38.8	392.5	89.0	39.2	49.8
	treated with preparations	466.4	510.4	7.4	36.8	0.88	38.4	433.3	100.5	43.7	56.8
Emmer	control	368.5	412.7	7.0	30.7	0.71	34.8	294.7	68.5	29.8	38.7
	treated with preparations	380.2	423.5	7.9	34.8	0.76	35.1	317.4	72.1	31.3	40.8
Triticale	control	405.1	429.3	9.4	31.7	1.2	52.3	511.3	119.3	51.8	67.5
	treated with preparations	420.4	504.4	10.9	39.5	1.3	52.8	674.1	156.3	67.8	88.5

The study of data in (Table 2), makes it clear that the applied agro-measures had their effect on the preservation level of the plants at the end of vegetation. From this point of view, particularly barley was distinguished, in case of which the number of preserved plants per unit area (1m<sup>2</sup>) exceeded the indices of control variant by 41.1, whereas in the emmer and triticale variants it was 11.7 and 15.3 plants, respectively.

The actual amount of grain and thatch yield obtained was determined by the yield amount obtained from the entire experimental bed, based on which the surplus of grain yield (in centner/ha and%) against the control variants was calculated. The highest surplus in actual grain yield was observed for triticale, making 12.7 centner/ha or 30.6%, and for barley and emmer it was 3.3 centner/ha or 10.4% and 3.5 centner/ha or 14.6%, respectively.

Table 3.– Effect of organic fertilizers on grain yield

Crop	Variant	Yield, centner/ha			Yield difference comparing with control	
		total	of which		centner/ha	%
			grain	thatch		
Barley	control	72.9	31.7	41.2	–	–
	treated with preparations	80.5	35.0	45.5	3.3	10.4
	LSD <sub>05</sub>	8.7	7.6	7.8	1.4	
Emmer	control	52.6	23.9	28.7	–	–
	treated with preparations	60.1	27.4	32.7	3.5	14.6
	LSD <sub>05</sub>	9.7	8.4	7.1	1.6	
Triticale	control	95.4	41.5	53.9	–	–
	treated with preparations	124.7	54.2	70.5	12.7	30.6
	LSD <sub>05</sub>	11.0	5.2	7.1	1.9	

As a result of the conducted comprehensive studies, it becomes clear that the grain yield of spiked cereal crops obtained by our research group in case of using preparations of organic origin is 2.1–3.4 centner/ha more than when fertilizing the same varieties with accepted doses of mineral fertilizers.

Here it is also necessary to mention the fact that though the quantity of grain yield is of primary importance, the quality of the obtained product is of no less importance, taking into account the amount of residual nitrogen present in its composition. Since the investigated cereals have food (emmer) and fodder (barley, triticale) significance, in both cases the acquisition of

ecologically clean product is of high priority. In the latter case the grain comes forth as one of the main components of the animal feed ration, which greatly promotes the manufacture of high quality and ecologically clean product. For this purpose, an average sample was isolated from the grain yield obtained as a result of scientific experiments and subjected to laboratory examination to find out the chemical composition of the grain, emphasizing the amount of harmful nitrogen (residual nitrates) present in it, the results of which are introduced in Table 4. The laboratory examinations were carried out in the “FDA” laboratory of Abovyan province of Kotayk marz.

Table 4.– The effect of organic fertilizers on the chemical composition of grain

Crop	Variant	Proteins,%	Carbohydrates,%	Nitrate residues, mg/kg
Barley	control	10.1	68.8	11.1
	treated with preparations	11.8	72.2	5.1
Emmer	control	10.2	71.8	12.4
	treated with preparations	11.7	79.4	4.1
Triticale	control	9.9	77.8	10.9
	treated with preparations	10.8	81.9	7.8

The energy value of food used for both food and feed purposes is first of all estimated based on the percentage content of proteins and carbohydrates present therein. In this regard, when using again organic fertilizers, according to the results of chemical analy-

sis, considerable increase in the amount of those substances was observed in the grain composition. Thus, the protein percentage in the grains of the fertilized variants of the tested cereal crops increased by 0.9–1.5%, and carbohydrates – by 3.4–4.1%, compared to

the control variants of the same crops. Here the issue related to the production of ecologically safe food and fodder is highly important, which is determined by the amount of their nitrate content. In this regard, it should be noted that a certain amount of residual nitrogen was observed in the grain yield obtained from the control variants cultivated in the traditional way, which significantly exceeded the same indicators of the variants cultivated with organic fertilizers. Thus, the amount of residual nitrates in the experimented

variants crossed the minimum limit, reaching 4.1–7.8 mg/kg, which was 4.6–6.8 mg/kg lower than the indicators of the control variants. Thus, the results of multi-year studies confirm that organic fertilizers not only greatly increase the amount of grain yield, but also significantly improve the yield quality, making it ecologically safe and harmless to human and animal health. That is why, currently the application of such systems is highly emphasized, which is very efficient and rather prospective in the coming future.

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