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**THE EFFECT AND POST EFFECT OF ORGANO-MINERAL FERTILIZERS AND GROWTH PROMOTERS ON QUANTITY AND QUALITY OF POTATO YIELD CULTIVATED IN POST-FOREST BROWN SOILS**

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**Abstract**

The article presents the results of the studies on the changes in the quantity and quality indicators of the potato crop under the effect and post-effect of the application of organo-mineral fertilizers and growth promoters in post-forest brown soils, in potato fields grown in drought conditions.

The results of field experiments and laboratory studies showed that equivalent doses of organomix and mineral fertilizers in potato fields had an equal effect on increasing potato yields. In the variants receiving organomix, each ton provided an additional yield of 18-20 c/ha per year of exposure and 3-3.5 c/ha per year of subsequent exposure, while equivalent doses of mineral fertilizers had no reverse effect compared to the tester.

Despite the one-time and fractional application of equivalent doses of organic mixes and mineral fertilizers, as well as in the exposure and post-exposure versions of biofluid, the nitrate content increased compared to the tester (31-114 mg/kg on average during exposure years, 3-15 mg/kg on average during research years). however, their quantities in the potato harvest are within the limits of the MAD (the marginal allowable density).

**Keywords:** organo-mineral fertilizers, growth promoter, potato, quantity and quality of harvest, effect, post effect.

**Introduction**

Currently, the intensification of agriculture is of particular importance in solving key issues of the strategy, which can be achieved by the introduction and rooting of scientific achievements, new techniques and technologies, advanced experience. It is necessary to make the processes of product creation manageable in the agroecosystem, having a clear understanding of the natural animal biotic and non-living abiotic components that create the system, to correctly assess the features of their development and influence.

Both in Artsakh and in the Republic of Armenia, small and large collective farms and individual farms are developing at a high speed.

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After the collapse of the Soviet system and the privatization of lands in Artsakh and RA, the process of importing mineral fertilizers was severely reduced in those regions, as a result of which the yield level of agricultural crops also decreased.

In order to maintain the level of yield of agricultural crops, to increase it further, as well as to maintain the fertility of the soil, the use of alternative methods for growing agricultural crops, to develop and apply such a system of fertilization, which will result from the economic possibilities of these regions, becomes of primary importance.

Since 2011, the joint Armenian-Norwegian organization "Orwako" has been producing biohumus, organomix, supercompost and growth-stimulating bio-liquid to farms using the latest biotechnological methods, based on household and agricultural waste, using Californian red worms. That organization also had bases for the supply of organic fertilizers and growth promoters in Artsakh (Stepanakert and Askeran). Biohumus and organomix contain almost all easily assimilated macro and micronutrients for plant nutrition. They contain 40-60% dry organic mass, 10-12, even 18% humus, 20-30% total nitrogen, 2.1-3.2% phosphorus, 2.7-3.1% potassium. In addition to macroelements, the biofluid, which is the aqueous extract of vermicompost, also contains enzymes, hormones, auxins, heteroauxins, etc. [5,9]. A ton of vermicompost is equivalent in its nutritional value to 7-8 tons of manure for plants [5,9], a ton of organomix is equivalent to 5-6.5 tons of manure [4, 10,12].

Organomix is a biologically active, environmentally friendly organic fertilizer, rich in macro and microelements, a mixture of biohumus, peat and compost. It does not contain pathogenic microorganisms and weed seeds and is safe to use. Bio-liquid, which is obtained from biohumus and is its aqueous extract, is prepared by special fermentation, contains nutrients, humic acids, fulvic acids necessary for plants. Available nitrogen is 10.8 g/l, available phosphorus is 8.8, potassium is 1.7, magnesium is 9.0 [5, 11].

Potatoes are very demanding, especially to organic fertilizers, which, along with providing plants with nutrients, simultaneously improve the agrophysical properties of the soil, creating favorable conditions for plant growth and development not only in the year of application, but also the following year with a subsequent effect [6]. Therefore, a systematic and unified solution to these problems is extremely important and relevant and derives from the requirements of the strategy for the development of agriculture, and is considered one of the priorities of ensuring food security.

### **Conflict Setting**

The aim of the work is to study and find out for the first time the effect and post-effect of the equivalent amounts and application dates of the organomix organic fertilizer, growth-promoting bio-liquid and organo-mineral fertilizers obtained by the Armenian-Norwegian joint enterprise (Orwako) from household and agricultural waste and peat with the latest biotechnological methods in the arid conditions of the foothill zone. on the growth, development, transition of phenological stages and yield of potatoes and compare them with the results of the influence of the ratio of mineral fertilizers used in the region and make recommendations for agricultural production to maintain the level of soil fertility in the region and obtain ecologically safe food through the gradual development of organic agriculture.

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The studies on the effects of the mentioned fertilizers and growth promoters were carried out in 2021-2023, and concerning the post-effect - in 2022-2023. The field experiments were carried out in post-forest brown soils, which are characteristic for the region also in the sense that the predominant part of the potato fields (86.2%) is cultivated in this soil type.

The environmental reaction of the soils of the experimental field: the humus content is 3.3-3.4%, the pH ranged from 6.9 to 7.1, available nitrogen (N) is weakly (3.4-3.6 mg) provided, with mobile phosphorus- medium (P<sub>2</sub>O<sub>5</sub> is 5.1-5.3 mg), exchangeable potassium is good (K<sub>2</sub>O in 100 g of soil: 34.0-36 mg).

Field experiments were set up with 3 replications, with the following options:

1. Checker (without fertilization)
2. Organomix 8t/ha one time, in sowing
3. Organomix 10t/ha one time, in sowing
4. Organomix 5t/ha one time, (in sowing)+N<sub>30</sub>P<sub>40</sub>K<sub>40</sub> (in sowing)+ N<sub>30</sub> with nutrition
5. Organomix 5t/ha in sowing+ Organomix 3t/ha (with nutrition)+ bio-liquid 14l/ha (nutrition)
6. Bio-liquid 14l/ha soaking the planting material + organomix 5t/ha (in sowing)+organomix 3t/ha (nutrition)
7. N<sub>80</sub>P<sub>80</sub>K<sub>80</sub> (in sowing)+ N<sub>40</sub> (nutrition)

Studies were carried out both in the impact and post-impact years on the Impala variety of potatoes, the planting rate of which was 32.8 c/ha, further processing and harvesting were carried out according to the agro-rules adopted in the region.

The amounts of organo-mix and NPK were given in such a way that the content of nutrients in them provides the equivalent amount of application of these fertilizers. Agrochemical and quality indicators of soils, plants and tubers were determined by universal methods [9], nitrates with the help of "Soex" nitrate meter. The yield data were subjected to mathematical analysis, dispersion analysis method, determination of Sx,% and AET 0.95 c, experimental error and the most significant difference [7,8].

### **Research Results**

According to the average data of the three-year repetitions of the field experiments, the equivalent doses and application periods of organo-mineral fertilizers, as well as different methods of applying the growth-promoting bio-liquid had a significant effect on the yield of potatoes grown in drought conditions. It is noteworthy that the effect and after-effect patterns of the application of the mentioned fertilizers and growth promoters have been preserved everywhere, but the harvest level of 2022 and 2023 is higher than that of 2021. Thus, if in 2022 and 2023 the yield of potatoes without fertilization was 150.0 and 156.0, respectively, then in 2021 it was 142.4 c/ha or about 8-14 centners less (Table 1). This circumstance is explained by the fact that both in 2022 and 2023, the amount of atmospheric precipitation (562 mm and 584 mm, respectively) and the number of sunny days during tuber accumulation (38 and 39) were more favorable for potato growth and development than in 2021 with relatively little precipitation (476mm) and sunny days (25 days). From the data in Table 1, it can be seen that, on an average of 3 years, the equivalent doses of organo-mineral fertilizers

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(Organomix 8t/ha (one-time) and N<sub>80</sub>P<sub>80</sub>K<sub>80</sub>+ N<sub>40</sub>) had an almost equal effect on the increase in potato yield compared to the version without fertilization (the yield increase was 150.8 t/ha, respectively) ha (100.9%) 147.2 c/ha (98.5%), but when the potato planting material was moistened with a bioliquid solution in the version of fractional application of organic mix, the average of 3 years compared to the version without fertilization was the highest: 215.2 c /ha or 144.0%, even compared to the version where the same rate of bio-liquid was given as foliar nutrition (at the stage of cocooning), the yield increase was 169.2 c/ha (113.2%), or by changing the method of applying bioliquid to tubers up to the difference in crop yield was 46.0 c/ha or 30.8% compared to planting by wetting, foliar feeding method.

The advantage of using bioliquid, the method of soaking the planting material before planting, compared with foliar nutrition is due to the fact that the bioliquid promoted the germination of dormant buds at the base of the potato planting material, which resulted in the formation of more above-ground (stems) and underground (stolons) organs, which led to an increase in potato yields.

**Table 1**

**The effect of organomineral fertilizers and growth promoter on the amount of potato harvest according to post- effect years (2021-2023)**

N / N	Variants	2021			2022			2023			2021-2023		
		The average yield, c/ha	The extra crop		The average yield, c/ha	The extra crop		The average yield, c/ha	The extra crop		The average yield of three years, c/ha	The extra crop	
			c/ha	%		c/ha	%		c/ha	%		c/ha	%
1	Checker (without fertilization)	142,4	-	-	150,0	-	-	156,0	-	-	149,5	-	-
2	Organomix 8t/ha one-time, in sowing	290,0	147,6	103,7	301,0	151,0	100,7	310,0	154,0	98,7	300,3	150,8	100,9
3	Organomix 10t/ha one-time, in sowing	296,0	153,6	107,9	315,0	165,0	110,0	312,0	156,0	100,0	307,8	158,3	105,9
4	Organomix 5t/ha, in sowing N <sub>30</sub> P <sub>40</sub> K <sub>40</sub> (in sowing)+ N <sub>30</sub> with nutrition	300,0	157,6	110,7	307,0	157,0	104,7	316,0	160,0	102,6	307,7	158,2	105,8
5	Organomix 5t/ha, in sowing + Organomix 3t/ha, with nutrition +bio-liquid 14l/ha (nutrition)	307,0	164,6	115,6	322,0	172,0	114,7	327,0	171,0	109,6	318,7	169,2	113,2
6	Bio-liquid14l/ha by soaking the planting material +organomix 5t/ha (in sowing)+organomix 3t/ha (nutrition)	342,0	199,6	140,2	372,0	220,0	148,0	380,0	224,0	143,6	364,7	215,2	144,0
7	N <sub>80</sub> P <sub>80</sub> K <sub>80</sub> (in sowing)+ N <sub>40</sub> (nutrition)	285,0	142,6	100,1	300,0	150,0	100,0	305,0	149,0	95,5	296,7	147,2	98,5
	S <sub>x</sub> ,%	1,5			1,3			1,9					
	MSD 0,95 c	5,4			4,8			6,8					

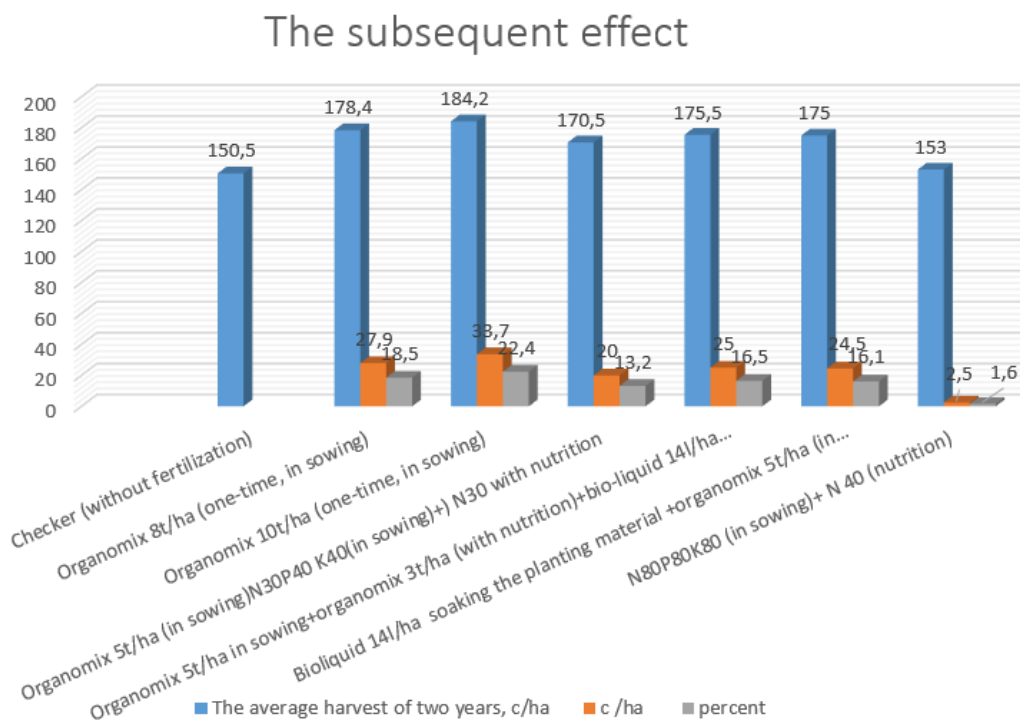
At the same time, it can be seen from the data in Table 1 that the fractional application of organomix and mineral fertilizers and their joint equivalent doses compared to one-time applications had a more beneficial effect on increasing the number of crops and compared to the option without fertilization, if in the case of one-time application of organo-mineral fertilizers (variants 2 and 7 ) crop addition was 100.9 and 98.5% then their equivalent joint doses were 105.8%.

According to the results of the studies, the amounts of mineral and organic fertilizers given during the previous year had some reverse effect on the increase of the potato harvest.

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As it can be seen from the data in Table 2, in the versions that received organomix, on average for 2022-2023, each ton given in the previous year provided an additional yield of about 3-3.5 c/ha in the following year, while mineral fertilizers provided a crop additive in very small quantities, compared to the tester, 2.5 c/ha (1.6%), which is within experimental error and is not significant.[Fig.1]



**Fig.1 The subsequent effect**

This is probably explained by the fact that the organic matter in the organomix does not manage to fully decompose and turn into mineral nutrients in the first year of application and becomes more available to plants in the following year of application. Along with an increase in potato yield, as well as the structure of the crop, it is very important what effect or subsequent effect this fertilizer or a combination of fertilizers has on the quality indicators of the most important food product, the potato.

Studies conducted by us in the period from 2021 to 2023 concerning the effects of fertilizers and growth stimulants, in the period from 2022 to 2023 concerning the subsequent effects, showed that if a single and fractional application of organomix and growth-stimulating bio-liquid positively affected the increase in starch and vitamin C (ascorbic acid) in potato tubers, mineral fertilizers, on the contrary, reduced or caused almost no change compared to the control variant (Tab. 3). According to the average data of three years, if the content of dry matter and starch in the test version was 20.8 and 15.2%, the output was 31.1 and 22.7 c/ha, then organomix 8t/ha and bioliquid 14l/ha by soaking the planting material+ the content of these indicators in the options of organomix 5t/ha (in sowing) + organomix 3t/ha (nutrition) was 24.0; 19.0%, output: 72.1; 57.1 c/ha and 24.0; 19.2%, output: 87.5; 70.0 c/ha, then in the variant that received only mineral fertilizers (variant 7), the content of dry matter and starch was 22.9, respectively; 15.9% and 67.9%; 47.2 c/ha.

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**Table 2**

**The subsequent effect of organomineral fertilizers and growth promoter on the amount of potato harvest by year (2022-2023)**

N/ N	Variants	2022			2023			2022-2023		
		The average yield, c/ha	The extra crop		The average yield, c/ha	The extra crop		The average yield of two years, c/ha	The extra crop	
			c/ha	%		c/ha	%		c/ha	%
1	Checker (without fertilization)	149,0	-	-	152,0	-	-	<b>150,5</b>	-	-
2	Organomix 8t/ha one-time, in sowing	176,6	27,6	18,5	180,2	28,2	18,6	178,4	27,9	18,5
3	Organomix 10t/ha one-time, in sowing	183,4	34,4	23,1	185,0	33,0	21,7	184,2	33,7	22,4
4	Organomix 5t/ha, in sowing N <sub>30</sub> P <sub>40</sub> K <sub>40</sub> (in sowing)+) N <sub>30</sub> with nutrition	170,0	21,0	14,1	171,0	19,0	12,5	170,5	20,0	13,2
5	Organomix 5t/ha, in sowing + Organomix 3t/ha, with nutrition +bio-liquid 14l/ha (nutrition)	174,0	25,0	16,8	176,9	24,9	16,4	175,5	25,0	16,5
6	Bio-liquid14l/ha by soaking the planting material +organomix 5t/ha (in sowing)+organomix 3t/ha (nutrition)	174,8	25,8	17,3	175,2	23,2	15,3	175,0	24,5	16,1
7	N <sub>80</sub> P <sub>80</sub> K <sub>80</sub> (in sowing)+ N <sub>40</sub> (nutrition)	152,0	3,0	2,0	154,0	2,0	1,3	153,0	2,5	1,6
	<b>Sx%</b>	1,8			1,6					
	MSD 0,95 c	6,4			5,4					

**Table 3**

**Effects and post-effects of organomineral fertilizers and growth promoters on dry matter, starch content and output, vitamin C and nitrate content in potato tubers**

N/ N	Variants	Effect of fertilizers and growth promoters (2021-2023 average)						Aftereffect of fertilizers and growth promoter (2022-2023 average)					
		Dry matter,%	starch%	vitamin C, mg %	Output c/ha		content of nitrates mg/kg	Dry matter,%	starch, %	vitamin C, mg %	Output c/ha		Nitrate content mg/kg
					Dry matter	starch					Dry matter	starch	
1	Checker (without fertilization)	20,8	15,2	10,0	31,1	22,7	78,0	20,6	14,9	9,9	31,0	22,4	75,0
2	Organomix 8t/ha one-time, in sowing	24,0	19,0	10,8	72,1	57,1	109,0	21,2	15,6	10,0	37,6	27,8	78,0
3	Organomix 10t/ha one-time, in sowing	24,6	19,1	10,9	75,7	58,8	139,0	21,4	15,6	10,2	39,4	28,7	80,0
4	Organomix 5t (in sowing) N <sub>30</sub> P <sub>40</sub> K <sub>40</sub> (in sowing)+) with N <sub>30</sub> nutrition	23,2	18,5	11,0	71,4	56,9	150,0	21,0	15,2	10,2	35,8	25,9	76,0
5	Organomix 5t/ha in sowing + organomix 3t/ha (with nutrition) + bio-liquid 14l/ha (nutrition)	23,9	19,2	11,2	76,2	61,2	135,0	21,6	15,8	10,4	37,9	27,7	76,0
6	Bio-liquid 14 l/ha by soaking the planting material + organomix 5 t/ha (in sowing) + organomix 3 t/ha (nutrition)	24,0	19,2	11,1	87,5	70,0	140,0	22,0	16,0	10,4	38,5	28,0	76,0
7	N <sub>80</sub> P <sub>80</sub> K <sub>80</sub> (in sowing)+ N <sub>40</sub> (nutrition)	22,9	15,9	9,9	67,9	47,2	192,0	20,8	15,0	9,9	31,8	23,0	75,0

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A similar pattern was observed in ascorbic acid content. The content of vitamin C in the tubers was 9.9 mg% in the version of the full ratio of mineral fertilizers, and 10.8-11.2 mg% in the versions that received organomix and growth promoter or only organomix.

From the results of the analysis of the content and output of dry matter, starch and vitamin C in potato tubers obtained as a result of the effects of applied organomineral fertilizers and a growth stimulant, shown in Table 3, it is clear what effect organomineral fertilizers individually or in combination and their equivalent dosages had on potato yield. This pattern manifested itself in qualitative indicators, as well as in the amount due to the harvest.

According to the two-year post-impact data, under the influence of one-time and fractional application of organomix compared to the control version, the content of dry matter and starch increased by only 0.6-1.4% and 0.7-1.1%, the output was 6.6-7.5 and 5.4-6.3 c, while no significant changes in vitamin C content were observed in post-exposure years. Therefore, it can be stated that the application of organomix, regardless of the form of application, had a more positive effect and post-effect on the quality indicators of potatoes (dry matter, starch, vitamin C, nitrates) than the equivalent doses of mineral fertilizers.

### **Conclusion**

In post-forest brown soils, in potato fields grown in arid conditions, the one-time application of equivalent amounts of organic and mineral fertilizers almost equally affected the amount of potato harvest, while the fractional or joint application of these fertilizers had a more beneficial effect on the mentioned indicators than their one-time application.

Bio-liquid, as a growth stimulator, significantly contributes to the rapid germination of potato seedlings, the increase of above-ground and underground organs, and as a result, soaking the tubers with the same amount of bio-liquid before planting, increases the amount of potato harvest compared to the method of foliar nutrition (three-year average: 46.0 c/ha. or 30.8%), increases output of dry matter and starch content while providing environmentally safe high-quality potatoes.

Despite the one-time and fractional application of equivalent doses of organomix and mineral fertilizers in the impact and post-effect options, compared to the variant without fertilization, the nitrate content increased (in the case of exposure by 31-114 mg/kg, in the case of after-effect by 3-15 mg/kg), but their amounts in the potato crop is within the limits of the MAD (the MAD for nitrate content in the open field is 250 mg/kg).

Due to the limitations and high cost of mineral fertilizers, in case of their absence, crop fields must be fertilized with an organomix norm of 8 t/ha, 60% of which is in sowing, 40%, in the case of potatoes, the planting material must also be treated with a bio-liquid solution of 14 l/ha, as a result, in arid conditions 350-365 c/ha will be provided in the year of exposure, 175 c/ha (additional harvest of 25 c/ha) of potato crop - in the post-impact year, which was proposed to be invested in farms.

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**ՕՐԳԱՆԱՀԱՆՔԱՅԻՆ ՊԱՐԱՐՏԱՆՅՈՒԹԵՐԻ և ԱՃԻ ԽԹԱՆԻՉԻ ԱՂԴԵՑՈՒԹՅՈՒՆՆ ՈՒ ՀԵՏԱՆԱՍՈՒԹՅՈՒՆԸ ՀԵՏԱՆՏԱՌԱՅԻՆ ՇԱԳԱՆԱԿԱԳՈՒՅՆ ՀՈՂԵՐՈՒՄ ՄՇԱԿՎՈՂ ԿԱՐՏՈՖԻԼԻ ԲԵՐՔԻ ՔԱՆԱԿԻ ԵՎ ՈՐԱԿԻ ՎՐԱ**

**Միրզոյան Մ.Շ.**

*Շուշիի տեխնոլոգիական համալսարան*

Ներկայացված են հետախոսության շագանակագույն հողերում, բնական պայմաններում աճեցվող կարտոֆիլի դաշտերում օրգանահանքային պարարտանյութերի և աճի խթանիչի կիրառման ազդեցությամբ և հետազոտությամբ կարտոֆիլի բերքի քանակի և որակական ցուցանիշների կրած փոփոխությունների վերաբերյալ կատարված ուսումնասիրությունների արդյունքները: Դաշտային փորձերի և լաբորատոր հետազոտությունների արդյունքներով բացահայտվել է, որ կարտոֆիլի դաշտերում օրգանոմիքսի և հանքային պարարտանյութերի համարժեք չափաքանակները հավասարապես են ազդել կարտոֆիլի բերքի քանակի ավելացման վրա: Օրգանոմիքս ստացած տարբերակներում, յուրաքանչյուր տոննան ազդեցության տարում ապահովել է 18-20g/հա, իսկ հետազոտության տարում՝ 3-3,5g/հա հավելյալ բերք, մինչդեռ հանքային պարարտանյութերի համարժեք չափաքանակները ստուգիչի համեմատ հետազոտություն չեն ունեցել: Չնայած օրգանոմիքսի և հանքային պարարտանյութերի համարժեք չափաքանակների միանվագ և կոտորակային կիրառման, ինչպես նաև կենսահեղուկի ազդեցության և հետազոտության տարբերակներում, ստուգիչի

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համեմատությամբ նիտրատների պարունակությունը ավելացել է (ազդեցության տարիների միջինով 31-114 մգ/կգ, հետազոտության տարիների միջինով՝ 3-15մգ/կգ-ով), սակայն դրանց քանակությունները կարտոֆիլի բերքում գտնվում է ՍԹԽ-ի շրջանակներում:

**Բանալի բառեր:** օրգանահանքային պարարտանյութեր, ածի խթանիչ, կարտոֆիլ, բերքի քանակ և որակ, ազդեցություն, հետազոտություն

**ВОЗДЕЙСТВИЕ И ПОСЛЕДСТВИЕ ОРГАНО-МИНЕРАЛЬНЫХ УДОБРЕНИЙ И СТИМУЛЯТОРОВ РОСТА НА КОЛИЧЕСТВО И КАЧЕСТВО УРОЖАЙНОСТИ КАРТОФЕЛЯ, КУЛЬТИВИРУЕМОГО НА ЗАЛЕСНЫХ БУРОЗЕМАХ**

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Представлены результаты исследований по изменению количественных и качественных показателей урожая картофеля под влиянием применения органо-минеральных удобрений и стимуляторов роста на залесных буроземах, на полях картофеля, выращиваемого в условиях засухи. По результатам полевых опытов и лабораторных исследований выявлено, что эквивалентные дозы органических смесей и минеральных удобрений на картофельных полях одинаково повлияли на увеличение количества урожая картофеля. В вариантах полученного органомикса каждая тонна в год воздействия обеспечивала 18-20 ц/га, а в год последствия – 3-3,5 ц/га прибавочного урожая, тогда как эквивалентные дозы минеральных удобрений по сравнению с контролем не имели последствий. Несмотря на однократное и частичное применение эквивалентных доз органомикса и минеральных удобрений, также как в вариантах воздействия и последствия биологической жидкости по сравнению с контролем содержание нитратов увеличилось (в годы воздействия в среднем – 31-114мг/кг, в годы последствия в среднем 3-15 мг/кг), однако их количества в урожае картофеля находятся в рамках УДН (установленных дозванных нарушений).

**Ключевые слова:** органо-минеральные удобрения, стимулятор роста, картофель, количество и качество урожая, воздействие, последствие.

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