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THE INFLUENCE OF ORGANIC AND BIOLOGICAL FERTILIZERS ON GROWTH PROCESSES, PRODUCTIVITY AND QUALITY OF MELON FRUITS IN THE SOUTH-EAST OF KAZAKHSTAN

Melon cultivation is an important feature of agriculture in Kazakhstan. According to Kazakh Academy of Nutrition, the rate of melon field consumption per 1 inhabitant per year is 26 kg.

In 2019, the cucurbits in the country were cultivated on an area of 102.1 thousand hectares, the gross harvest amounted to 2382.1 thousand tons, i.e. 132.3 kg per inhabitant per year. These data show the high export potential of the melon industry in Kazakhstan.

As we know, 95-97% of melons are consumed fresh. In this aspect, there is a need to produce natural, high-quality melons of particular relevance. The organic melon products can be grown in the climate of maximum biologization of agricultural technologies.

In Kazakhstan, the production of organic melon products is at the beginning of development. The most open and regulated elements of biological melon cultivation in the production environment include the use of organic fertilizers and biological products instead of chemical ones. The data received in the process of scientific research showed that the use of organic and biological fertilizers helped to raise fresh plants and process acceleration of fruit ripening by an average of 3-5 days. The productivity of melon grew to 37.32% with biologized fertilizer systems. So, the quality of melon fruits has increased for the non-fertilized control. Providing the low cost and high payback of organic fertilizers, the positive influence on the productivity and ecological purity of the cultivated products, we can do a conclusion about the potential transition of the melon industry of the country from traditional ways of cultivation to alternative ones.

Key words: melon, phenology, biometrics, organic and biological fertilizers, variety research, biochemical composition, productivity, quality.

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Қазақстанның оңтүстік-шығысы жағдайында органикалық және биологиялық тыңайтқыштардың қауын дақылының өсу үрдістеріне, өнімділігі мен сапасына әсері

Бақша шаруашылығы – Қазақстан ауыл шаруашылығының маңызды саласы. Қазақ тағам академиясы мәліметтері бойынша 1 тұрғынға келетін бақша тұтыну мөлшері жылына – 26 кг.

2019 жылы елімізде бақша дақылдары 102,1 мың гектар жерде өндіріліп, жалпы жиын-терін көлемі 2382,1 мың т, яғни әр жергілікті тұрғынға шаққанда 132,2 кг құрады. Бұл мәліметтер Қазақстандағы бақша саласының жоғары экспорттық потенциалын растайды.

Бақша өнімдерінің 95-97% балғын күйде тұтынылатыны белгілі. Осы орайда, табиғи, жоғары сапалы бақша өнімдерін өндіру өзекті болып табылады. Экологиялық таза бақша өнімдерін агротехнологиялық шараларды барынша биологизациялау арқылы өндіруге болады.

Қазақстанда экологиялық таза бақша өндірісі дамудың бастапқы сатысында тұр. Өндіріс жағдайында химиялық бақша шаруашылығын биологиялық бағытқа бұрудың ең қолжетімді және реттелмелі тәсілдеріне органикалық тыңайтқыштар мен биологиялық препараттарды қолдану жатады.

Ғылыми-зерттеулер барысында алынған мәліметтер органикалық және биологиялық тыңайтқыштарды қолдану, өсімдіктердің жасыл массасының ұлғаюына және жемістердің орташа есеппен 3-5 тәулікке ерте пісіп-жетілуіне ықпал етті. Биологиялық тыңайту жүйесінде қауын өнімділігі 37,32%-ға артты. Тыңайтылмаған бақылау нұсқасымен салыстырғанда қауын жемістерінің барлық сапалық көрсеткіштері жақсарды.

Жоғарыда айтылғандарды тұжырымдай отырып, органикалық тыңайтқыштардың төмен өзіндік құны мен жоғары өтімділігін және өндірілетін өнім өнімділігі мен экологиялық тазалығына оң әсерін ескерсек, еліміздің дәстүрлі бақша шаруашылығын альтернативті өндіріс бағытына бұру мүмкіндігі туралы қорытынды жасауға болады.

Түйін сөздер: қауын, фенология, биометрия, органикалық және биологиялық тыңайтқыштар, биохимиялық құрам, өнімділік, сапа.

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Влияние органических и биологических удобрений на ростовые процессы, продуктивность и качество плодов дыни на юго-востоке Казахстана

Бахчеводство – важная отрасль сельского хозяйства Казахстана. По данным Казахской академии питания, норма потребления бахчи на 1 жителя в год составляет 26 кг.

В 2019 году бахчевые культуры в стране возделывались на площади 102,1 тыс. га, валовые сборы составили 2382,1 тыс. т., т.е. 132,3 кг на каждого жителя в год. Эти данные свидетельствуют о высоком экспортном потенциале бахчевой отрасли Казахстана.

Известно, что 95-97% бахчи употребляется в пищу в свежем виде. В этом аспекте необходимость производства натуральной, высококачественной бахчи приобретает особую актуальность. Экологически чистую бахчевую продукцию можно вырастить в условиях максимальной биологизации агротехнологий.

В Казахстане производство экологически чистой бахчевой продукции стоит на начальном этапе развития. К наиболее доступным и регулируемым в условиях производства элементам биологического бахчеводства относится использование органических удобрений и биопрепаратов взамен химическим.

Полученные в ходе научных исследований данные показали, что внесение органических и биологических удобрений способствовало увеличению зеленой массы растений и ускорению процессов созревания плодов в среднем на 3-5 суток. На биологизированных системах удобрений продуктивность дыни возросла на 37,32%. Улучшились все качественные показатели плодов дыни к неудобренному контролю. Исходя из вышеизложенного, учитывая невысокую стоимость и большую окупаемость органических удобрений, положительное влияние на продуктивность и экологическую чистоту возделываемой продукции, можно сделать вывод о возможности перехода бахчевой отрасли страны от традиционных способов возделывания на альтернативные.

Ключевые слова: дыня, фенология, биометрия, органические и биологические удобрения, биохимический состав, продуктивность, качество.

Abbreviations

N – nitrogen, P – phosphorus, K – potassium, t – ton, ha – hectare, t/ha – ton per hectare, kg – kilogram, g – gram, mg – milligram, m^2 – square meter, mg% – milligram/percent, % – percent, MPC – maximum permissible concentration.

Introduction

Biological or alternative agriculture is given particular emphasis and huge financial resources are allocated around the world. All the world's major economies are developing organic farming more focused and balanced than ever before. And the reason for this one is the comprehensive factors, such as the health of the nation and the agricultural state of the environment [1-3].

The rapid growth of the world's population and, as a result, the urbanization of small towns into megalopolises leads to a global demand of food products followed by the forced expansion of agricultural land [4].

There has been a sharp rise in the use of mineral fertilizers and chemical plant protection products over the past 50-60 years due to the increase in planting acreage, as well as to increase the yield of agricultural crops [5]. There is also an active anthropogenic influence on the soil cover by raising the number of mechanical processing operations.

The annual growth of crops drives up the volume and frequency of agrochemicals application. Every year, 10 to 15 types of chemical protection products are synthesized in the world. Hundreds of thousands of different types of pesticides are used on crops in volumes of more than 2-2. 5 million tons per year [6].

The negative effects of agricultural chemicalization are making scientists and consumers of agricultural products more and more wary. There are calls for a partial and even total rejection of chemical agents. However, except for the nutritional value of the cultivated products, in recent decades, the more frequent use of synthetic fertilizers, pesticides, hormones, etc. in traditional production in some cases leads to a lower quality and safety of products and a violation of natural relations in ecosystems [7].

In 2017, UN experts reported 200,000 fatal pesticide poisonings per year, and that fixed contact with pesticides is related to cancer, Alzheimer and Parkinson's diseases, endocrine diseases, developmental disabilities, and sterility [8-9].

A series of events in 2020 related to the coronavirus pandemic shows that the main well-being of all countries lies in the health of the people.

The organic farming system is widely considered to be a more sustainable and safe agricultural system, as it aims to produce healthy food while preserving the soil. The stability of such agrocenoses is guaranteed by minimizing the negative influence on the agricultural ecosystem (avoiding the use of pesticides and other plant protection products, chemical fertilizers, GMOs, ionizing radiation) and introducing an environmentally sound farming system with obligatory monitoring of the state of the entire agrobiocenosis in the system of ecological-meliorative and agroecological monitoring [10-12].

The organic farming is conducted in almost all countries of the world. The share of farms that supply natural agricultural products is under constant growth in the total land area and in the structure of agricultural enterprises. The market for these products is also rapidly expanding, not only in Europe, North America and Japan, where the largest markets are located, but also in developing countries [13].

According to the Research Institute of Organic Agriculture (FiBL) and the International Federation of Organic Agriculture Movements (IFOAM), the area with organic farming has increased 6-fold over the past 20 years, reaching 1% of the world's agricultural land area or 71.5 million hectares of cultivated land [14-16].

Australia has the largest area of organic agriculture in the world – 35.7 million hectares. In Europe, organic products are cultivated on an area of 15.6 million hectares. It is followed by Latin America (8 million ha), Argentina (3.6 million ha) and China (3.1 million ha). Switzerland, Denmark and Sweden are the world leaders in terms of organic food consumption per person [17-18].

And Kazakhstan is no exception among the countries that practice organic agriculture. However, the production and market of organic products are still at an early stage of development, despite the adopted law of the country "On the production of organic products", introducing the "Rules for the production and turnover of organic products", the approval of the list of permitted products, as well as the certification of organic products under ST RK 1618-2007, adopted in the country in 2015. All organic products are imported to Kazakhstan mostly from Europe, which leads to high prices for them.

There is also a drop in the area occupied for organic farming by almost 2 times in comparison with 2016 (303.4 thousand hectares). Today, the land with organic production in Kazakhstan is about 192 thousand hectares [19].

Melon cultivation is one of the main agricultural sectors in Kazakhstan that is largely come into play to organic farming. It should be noted there is no organic melon cultivation in the country at all even if the traditional production is quite high.

The edaphoclimatic conditions of Kazakhstan make it possible to produce high volumes of vegetable and melon crops, thus providing the national market with a full range of agricultural products [20-21]. Our country has a great export potential for cucurbits. According to the statistics of 2019, in Kazakhstan, the cucurbits were cultivated on an area of 102.1 thousand hectares, the gross harvest was 2382.1 thousand tons. Based on the above data, Kazakhstan may well turn into a producer and supplier of organic melon products in the global society.

The transition of the melon industry in Kazakhstan to purely organic production becomes complicated by the lack of scientific research in this direction, which provides for a complete rejection to use agrochemicals and GMOs. In this aspect, research on the biologization of the main agrotechnological elements of melon cultivation, as well as the study and selection of tolerant varieties of melon to harmful objects are most important.

So, taking the above mentioned into consideration, under the grant project of the Ministry of Education and Science of the Republic of Kazakhstan for young scientists "Production technology of organic melon products (watermelon, melon) in the south-east of Kazakhstan" for 2020-2022, URN project AP 08052493, we conducted field and laboratory research to study the influence of various types of organic and biological fertilizers on biometric indicators, quality and productivity of melon fruits, as well as the selection and study of new adaptive and green varieties of melon and melon with the best economically valuable characteristics for organic melon cultivation.

Materials and Methods

The experiments were conducted at the Experimental Clinic of the Laboratory "Selection of vegetable and melon crops" and in the laboratory "Biosafety and Biocontrol of vegetable and melon crops" of Regional Branch "Kainar" of the LLP "Kazakh Research Institute of Fruit and Vegetable Growing" which is located in the foothill zone of the south-east of Kazakhstan (43°09'32.8"N 76°26'57.3"E) North Slope of Zailiyskiy Alatau Mountains (Altitude : 1000-1050 m) during the growing season 2020 with a view to finding out the melon expo as well as determining the different organic fertilizers such as biohumus, manure, poultry manure, grain straw, biohumus and recommended chemical NPK fertilizers. The locations of the evaluations were characterized by the continental climate (large daily and annual fluctuations in air temperature, characterized by cold winters and long hot summers), the air temperature reaches minimum values in January (-32 -35^{0}C), and maximum values in July (37-43^{0}C). The warm period lasts 240-275 days, the frost-free period is 140-170 days and an annual amount of precipitation is 350-600 mm.

The soil belongs to the general soil type of dark chestnut. The land was medium high with loamy. Before conducting the experiment, the soil sample was analyzed from Kazakh Research Institute of Soil Science and Agricultural Chemistry named after U.Uspanov. The soil was characteristically slightly alkaline (pH 7.3-7.4), soil organic matter 2.9-3.0% (moderate), total N 0.18-0.20% (high), available P_2O_5 35-40 mg kg^{-1} (moderate), available K_2O 360-390 mg kg^{-1} (low), cation exchange capacity 20-21 me 100g^{-1} soil, bulk density 1.1-1.2 gr cm^3, field capacity 26.6%.

The sources of chemical fertilizers utilized were: ammonium nitrate 34.5% N, double superphosphate 46%P_2O_5 and potassium chloride 60% K_2O. The source of the organic fertilizer utilized was biohumus, manure, poultry manure, grain straw, biohumus, whose contents of organic matter, nitrogen, phosphorus and potassium are presented in Table 1.

Table 1 – Composition of organic wastes, measured variables

Organic materials	Organic matter, %	C:N	N, %	P_2O_5, %	K_2O, %
Manure	21		0,5	0,25	0,6
Poultry manure	40-56		1,6	1,5	0,8
Grain Straw	35-40		0,5	0,25	0,8
Biohumus	40-60		2,2	1,8	1,6

Treatments and Experimental Design

The experiment was performed using a completely randomized block design with four replications. The soil was ploughed, harrowed, and flat seedbeds measuring 28 m^2 (2,8 m x10 m). were made. Each plot was separated from the other by a one-metre alley. Fertilizer was applied using grain drill. The design of the experiment was a randomized complete block replicated thrice. Treatments comprised control, biohumus, manure, poultry manure, grain straw, biohumus and recommended chemical NPK fertilizers. The experimental field was prepared in accordance with a standard practice used by RB Kainar of LLP Kazakh Research Institute of Fruit and Vegetable Growing. Other agronomic practices and data collection were conducted based on the recommendations ($N_{120}P_{120}K_{150}$) of Kazakh Research Institute of Fruit and Vegetable Growing. The experiment was performed with the following 8 treatments.

- T1: Control (non-fertilization)
- T2: Control No. 2 (fertilized -$N_{120}P_{120}K_{150}$)
- T3: Biohumus (10 t ha^{-1})
- T4: Biohumus (15 t ha^{-1})
- T5: Manure (40 t ha^{-1})
- T6: Poultry manure (5 t ha^{-1})
- T7: Poultry manure (10 t ha^{-1})
- T8: Grain Straw (3 t ha^{-1}) + Recommended fertilizer dose ($N_{90}P_{60}K_{60}$)

The trial was implemented on April-May and and the harvest began in the first decade of August and Trial was well protected against insects and weeds during the season.

Melon expo was planted on 22 May 2020. The size of each elemental plot was 28 m^2 and included seven planting rows 1.5 m apart with eight plants per row, with a distance of 1.5 m between plants. The irrigation system, which was similar to that used by farmers in the area, consisted of one drip line per crop row and emitters of 2 l/h – 1, 0.5 m apart.

Melons were harvested by hand when the fruit matured. Melons were picked by experienced persons and in general fruit were considered mature when the tendril nearest to fruit start to dry, and color of fruit on the bottom side changed from creamy white to yellowish. Fruits were measured and weighed during harvest and total yield and phenological observations were determined. In addition, the total sugar content was determined using the Bertrand method vitamin C determined according to Murri, nitrate content was determined potentiometrically with ion-selective electrodes.

The following classical methodologies were used in the research: Methodology of Field Experience (B.I.Dospekhov, 1985) [22]; Methodology of Experimental Work in Vegetable Growing and Melon Cultivation (V.F.Belik, 1992) [23]; Methodology of Watermelon and Melon Breeding (Moscow, 1998) [24].

Results and Discussion

The further yield of cucurbits is defined by the degree of vegetative biomass development of plants. A decrease in the assimilation surface of melon leaves at the intensive development and formation of vegetative organs can have a negative effect on the productivity level. The low volume of the leaf area leads to a decrease in photosynthesis, in the process of which the plants are suppressed and the size of the fruit is reduced. The leaves of cucurbits are the main conductor of nutrients to the fruits [25-27]. Therefore, the longer and greener the leaves, the larger and tastier the fruits.

So, taking the above mentioned into consideration, we have studied the influence of organic and biological methods of fertilization on the beginning of the main phenological phases of development and biometric parameters of melon plants. As a comparison, 2 control options were set: control No. 1 – without fertilizing; control No. 2 – with fertilizing ($N_{120}P_{120}K_{150}$).

The results of phenological observations at the experimental plots showed that according to the possible experiments, where different types of organic and biological fertilizers were applied to the melon, the main phases of plant development occurred a few days earlier than in control No. 1, where fertilizers were not used at all.

The process acceleration of plant growth and development is explained by the positive influence of biological fertilizers on the dynamics of the root system development and the underground mass of plants as a whole. The periods of the beginning and finishing of a certain phenological phase on melon passed faster in the variants where manure was introduced under the culture – at the rate of 40 t/ha, biohumus – 15 t/ha and poultry manure – 10 t/ha. There was also an improvement in growth processes in the second control variant, where the plants were fertilized with the full rate of mineral fertilizers ($N_{120}P_{120}K_{150}$). As to nonfertilized control, all the processes of watermelon plant development were delayed and occurred on average 3-5 days later than the samples (Figure 1 – Phenological observations in experiments with melon culture, 2020).

To identify the intensity of growth and development of melon plants, the formation of its biomass and food organs, biometric studies were conducted at all experimental plots in the phases: wattle formation – the beginning of flowering and mass flowering – the formation of fruits. According to the results of the research, it was found that the biometric indicators of plants in the variants with different combinations of organic and biological fertilizers exceeded the first (non-fertilized) control in all parameters. During the period of wattle formation, the most intensive growth in the development of the green mass of melon was recorded in the variants where manure was applied at the rate of 40 t/ha, biohumus – 15 t/ha and poultry manure – 10 t/ha (Table 2).

In order to more objectively assess the influence of the studied fertilizer systems, the second biometric measurements were made in the phases of development-mass flowering – fruit formation. When using biofertilizers, melon plants showed the lengthening and thickening of the main stem on the melon culture – from 84,10 cm in control No. 1 to 89,15-110,51 cm and from 2,44 cm to 2,70-2,96 cm, an increase in the quantity of side shoots – from 5,65 pcs. to 6,05 pcs., the length of internodes – from 6.30 to 6.53-8.60 cm and Leafstick length – from 5.81 cm to 6.05-10,42 cm, leaf apparatus – from 7.66 to 8.54-10.42 cm in width and from 6.88 to 7.30-8.68 in length. There was an increase in the quantity of ovaries – from 13.35 pcs. to 16.7 pcs.

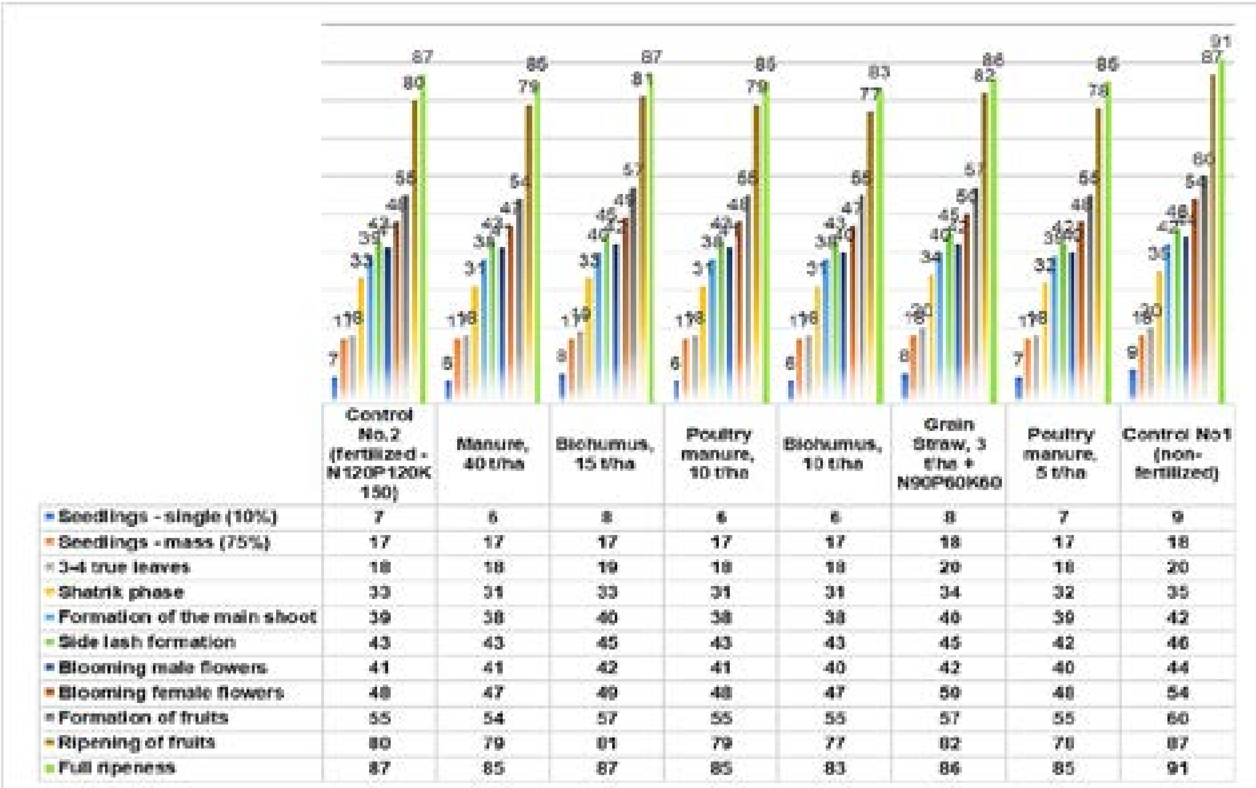

Figure 1 – Phenological observations in experiments with melon culture, 2020.

Table 2 – The influence of various types and combinations of organic and biological fertilizers on the formation of melon plant biomass (wattle formation – the beginning of flowering), 2020.

Experience options	Length of the main shoot, cm	Quantity of stems, pcs.	Base thickness, cm	Internode length, cm	Male flowers, pcs	Female flowers, pcs	Ovaries, pcs	Middle mass of plants, g
Control No. 1 (non-fertilized)	56,30	5,65	1,40	5,40	5,35	0,82	0,42	193,3
Control No. 2 (fertilized -$N_{120}P_{120}K_{150}$)	69,80	6,92	1,76	6,31	7,77	1,35	0,95	235,4
Biohumus, 10 t/ha	61,92	5,82	1,49	5,82	6,67	1,0	0,7	224,2
Biohumus, 15 t/ha	66,32	5,95	1,59	5,94	6,97	1,25	0,80	229,4
Manure, 40 t/ha	70,65	6,25	1,69	6,28	6,95	1,22	0,85	238,6
Poultry manure, 5 t/ha	60,50	5,67	1,48	5,43	6,47	0,9	0,62	230,8
Poultry manure, 10 t/ha	66,30	5,90	1,59	5,91	6,85	1,05	0,75	238,5
Grain Straw, 3 t/ha + $N_{90}P_{60}K_{60}$	60,37	5,42	1,40	5,74	5,97	0,85	0,50	210,5

The average weight of melon was equal to 286,5 g on the non-fertilized control variant, and 530,6 g on the variant fertilized with full mineral fertilizer, and 382,5-510,25 g on the variants with organic fertilizers and biohumus. The largest fruit mass was formed in the variants where “Manure, 40 t/ha – 510,25 g”, “Grain Straw, 3 t/ha + $N_{90}P_{60}K_{60}$” – 458,90 g and “Biohumus, 15 t/ha” – 413,95 g were added for cucurbits (Table 3).

Table 3 – The influence of various types and combinations of organic and biological fertilizers on the formation of melon plant biomass (mass flowering – fruit formation), 2020.

Experience options	Length of the main shoot, cm	Quantity of side shoots of stems, pcs.	Base thickness, cm	Internode length, cm	Leafstick length, cm	Leaf width, cm	Leaf length, cm	Quantity of inflorescences, pcs.	Quan tity of fruits, pcs.	Fruit diameter, cm	Ave-rage weight of the 1st fruit, g
Control No. 1 (non-fertilized)	84,10	5,65	2,44	6,30	5,81	7,66	6,88	13,35	1,4	8,37	286,50
Control No. 2 (fertilized -$N_{120}P_{120}K_{150}$)	110,78	6,25	3,14	8,81	7,75	10,28	8,79	20,00	2,25	10,66	530,60
Biohumus, 10 t/ha	89,15	5,80	2,71	6,53	6,05	8,54	7,30	13,65	1,55	9,20	382,50
Biohumus, 15 t/ha	95,90	5,90	2,88	6,67	6,36	9,03	7,59	14,05	1,7	9,41	413,95
Manure, 40 t/ha	110,51	6,05	2,96	8,60	7,66	10,42	8,68	16,70	2,0	10,36	510,25
Poultry manure, 5 t/ha	91,35	5,65	2,74	6,65	6,11	8,78	7,33	12,88	1,55	9,14	384,95
Poultry manure, 10 t/ha	93,35	5,65	2,77	6,73	6,22	8,87	7,32	13,10	1,65	9,27	392,15
Grain Straw, 3 t/ha + $N_{90}P_{60}K_{60}$	100,40	5,75	2,70	7,97	7,12	9,93	8,06	13,75	1,9	9,63	458,90

The biochemical composition of fruits is closely related to the plant nutrition conditions.

The optimal nutrition greatly improves the quality of the grown products, and excessive fertilizer rates, on the contrary, degrade the quality of the grown products.

To assess the influence of various types and combinations of organic and biological fertilizers on the quality indicators of melon, we conducted biochemical analyses of the fruits in the laboratory.

The results of analytical research showed that the content of dry substances in rmelon fruits varied in the range of 9.74-14.96%. At the same time, higher rates were registered in the variants where poultry manure, 5 t/ha (14.96%), poultry manure, 10 t/ha (13.02%) and manure, 40 t/ha (10.17%) were applied for crops.

The use of biological fertilizers contributed to an increase in total sugar and ascorbic acid in the fruit. In the variants where biohumus, manure and poultry manure were added to the melon, the fruits were the sweetest – 16.82-17.28%. The highest content of vitamin C was recorded in experiments with mineral fertilizers (Control No. 2) – 21.1 mg %, manure (40 t/ha) – 25.0% mg and poultry manure (10 t/ha) – 25.0 mg % (Table 4).

Table 4 – The influence of various types and combinations of organic and biological fertilizers on the quality indicators of rmelon fruits, 2020.

Experience options	Dry substance, %	Total sugar, %	Vitamin C, mg%	Nitrates, mg/kg (MPC-90)
Control No. 1 (non-fertilized)	11,18	15,23	18,4	24,2
Control No. 2 (fertilized -$N_{120}P_{120}K_{150}$)	15,08	20,66	21,1	130,4
Biohumus, 10 t/ha	7,39	16,82	18,4	54,8
Biohumus, 15 t/ha	9,78	17,28	17,1	74,2
Manure, 40 t/ha	10,17	17,44	25,0	87,2
Poultry manure, 5 t/ha	14,96	17,04	18,4	60,8
Poultry manure, 10 t/ha	13,02	17,22	25,0	85,6
Grain Straw, 3 t/ha + $N_{90}P_{60}K_{60}$	9,74	16,12	18,4	99,4

The research results showed that the content of nitrates in melon products was much lower than the maximum permissible concentration (MPC for melon – 90 mg/kg of raw mass) on variants where organic and biological fertilizers were applied to the crop – 54.8-87.2 mg/kg. In experiments where mineral fertilizers were used, the excess of nitrates is more than 1.5 times the maximum permissible concentration.

According to the conclusion of the Test Center of Phytosanitary Laboratory Analysis of the Kazakh Research Institute of Plant Protection and Quarantine named after Zh.Zhiembayev LLP, the Protocol of toxicological tests of soil samples showed that the content of the residual amount of pesticides was not detected in the soils of the experimental plots (Protocol No. 112-05 dated September 03, 2020).

The agricultural yield is the main efficiency indicator of agricultural technologies. Allowing for this, we defined the productivity of melons, along with other important indicators, in our research during the development of biological fertilizer systems, depending on the conditions of its nutrition in the south-east of Kazakhstan.

According to the research, the lowest yield of melon fruits was recorded at the non-fertilized control (Control No. 1) – 17.31 t/ha. As to the mineral background, where a full mineral fertilizer was applied to the melon in the norm $N_{120}P_{120}K_{150}$, 23.96 t/ha of fruit was produced. All experience options with biological fertilizer systems exceeded the standard fruit yield of the non-fertilized control. The highest increase in yield – 23.77 t/ha was registered in the variant where manure was applied to cucurbits at a rate of 40 t/ha. As to all other variants, the increase to the control varied from 5.45 to 6.65 t/ha (Table 5).

Table 5 – The influence of various types and combinations of organic and biological fertilizer systems on melon yield, 2020.

Experience options	Fruit harvesting, t/ha			Yield, t/ha	Increase in fruit yield	
	1st	2nd	3rd		t/ha	%
Control No. 1 (non-fertilized)	5,25	5,89	6,17	17,31	-	-
Control No. 2 (fertilized -$N_{120}P_{120}K_{150}$)	6,61	8,42	8,93	23,96	6,65	38,42
Biohumus, 10 t/ha	6,67	8,22	8,14	23,03	5,72	33,04
Biohumus, 15 t/ha	6,24	8,56	8,49	23,29	5,98	34,55
Manure, 40 t/ha	6,70	8,73	8,34	23,77	6,46	37,32
Poultry manure, 5 t/ha	6,13	9,0	7,73	22,86	5,55	32,06
Poultry manure, 10 t/ha	6,04	8,71	8,22	22,97	5,66	32,70
Grain Straw, 3 t/ha + $N_{90}P_{60}K_{60}$	6,50	7,37	8,89	22,76	5,45	31,48
P, % 3,95 НСР $_{095}$, т/га 0,92						

Conclusion

Following the results of our research, we can conclude:

- The application of organic and biological fertilizers improves the phenological and biometric indicators of melon during the intensive growth and development of crops. It was found that all the growth parameters of melon plants occurred on average 3-5 days earlier in comparison with the non-fertilized control (No. 1) and were slightly lower than the fertilized control (No. 2). The most influential biomass of melon plants in the system of bio-organic fertilizers was formed on the variants with manure (40 t/ha), biohumus (15 t/ha) and poultry manure (10 t/ha).

- The biochemical analysis showed a positive influence of various combinations of organic and biological fertilizers on the quality indicators of melon fruits. An increase in the content of dry substances, total sugar and ascorbic acid in the products for non-fertilized control was defined.

- The soil analysis for the content of the residual amount of pesticides showed the lack of toxicological residues (Protocol No. 112-05 dated September 03, 2020) in the experimental plots. Laboratory studies melon fruits showed that NO_3 content did not exceed the maximum permissible concentration in all variants with bio-organic fertilizers.

- It was found that the application of bio-organic fertilizers substantially increased the productivity of cucurbits. The highest yields of melon are formed on variants with manure (40 t/ha) and biohumus (15 t/ha). Thus, the increase to the yield was 31,48-37,32% to the non-fertilized control (No. 1).

Conflict of interest

All authors have read and are familiar with the content of the article and have no conflict of interest.

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References

1 Chychkalo-Kondrats'ka I.B., Novyts'ka I.V. World experience of development of organic production. Agrosvit. No. 17-18. (2020): 23-27. DOI: 10.32702/2306-6792.2020.17-18.23.

2 Viniukova O.B., Chuhrij H.A. Organic products market in Ukraine: problems and prospects of its development. Prychornomors'ki economichni studii. T. 26/1. (2018): 42-47. doi.org/10.21511/im.14(2).2018.02.

3 Tiutiunnyk H. Basis of the develop& ment of organic farming national market in Ukraine. Halyts'kyj ekonomichnyj visnyk. T.3. № 46. (2014): 46-52.

4 Tilman D., Socolow R., Foley J.A., Hill J., Larson E., Lynd L., Pacala S., Reilly J., Searchinger T., Somerville C. & Williams R. Beneficial biofuels-the food, energy, and environment trilemma. Science. No. 325. (2009): 270-271. doi.org/10.1126/science.1177970.

5 Dovban K.I. Development of scientific foundations and technologies of ecological agriculture based on the use of green fertilizers and environmentally friendly use of soil resources. Natural resources and the environment: collection of scientific materials. Minsk: Belarusian Science. (2016): 126-129.

6 Omarova Z.M. The effect of pesticides on human health. Russian Bulletin of Perinatology and Pediatrics. No. 1. (2010): 59-60.

7 Zdravkovska M., Agic R., Popsimonova G., Bogevska Z., & Davitkovska M. Morphological characteristics and yield of carrot (Daucus Carota L.) Grown with application of microbiological fertilizers. J. of Agricultural, Food and Environmental Sciences, JAFES. T.68. (2016): 63-67. Online ISSN 2545-4315.

8 Philip J. Landrigan, Charles Benbrook. GMO-s, Herbicides, and Public Health. The new England journal of Medicine. No. 373. (2015): 693-695. DOI: 10.1056/NEJMp1505660.

9 Charles M. Benbrook. Trends in glyphosate herbicide use in the United States and globally. Environmental Sciences Europe. T. 28. No. 1. (2016): 2-8. ISSN 2190-4715. – doi:10.1186/s12302-016-0070-0.

10 Kussainov T.A. Estimating yield trends in agriculture: accounting for the changes in technologies and weather conditions. Science Review. № 1(11). (2013): 15-17.

11 Otutumi A.T., Oliveira T.S., Mendonça E.S. and Lima P.J. Qualidade do Solo em Sistemas de Cultivo Agroecológicos no Município de Tauá – CE. In: Oliveira T. S. (coord.) Solo e Água: aspectos de uso e manejo com ênfase no semi-árido nordestino. Fortaleza, Departamento de Ciências do Solo, UFC. (2004): 1-30.

12 Gabriel D., Sait S. M., Kunin W.E. and Benton T.G. Food production vs. biodiversity: comparing organic and conventional agriculture. J. Apple Ecol. No. 50. (2013): 355-364. doi.org/10.1111/1365-2664.12035.

13 Babadzhanov D.D., Shokirov R.S., Abdulloeva M.G., Khasanov M.M. Trends in the development of the organic sector of agriculture in the world economy. Bulletin of the Tajik State University of Law, Business and Politics. Humanities Series. No. 3. (2009): 67-73.

14 Kaminska A. World experience of development of organic production. Agrosvit. No. 17-18. (2020): 23.

15 Wilier H., Lernoud J. The World of Organic Agriculture. Statistics and Emerging Trends. Research Institute of Organic Agriculture (FiBL), Frick, and IFOAM – Organics International, Bonn. (2016): 38-40.

16 Matthew H., Anne M. The World of Organic Agriculture. Statistics and Emerging Trends. FiBL-IFOAM Report. IFOAM. and FiBl. Frick. (2012): 277-282.

17 National Organic Union Media Review. Organics. (2018): 10.

18 Grigoruk V.V., Klimov E.V. Development of organic agriculture in the world and Kazakhstan. Food and Agriculture Organization of the United Nations. Ankara. (2016): 3.

19 Internet link: The market for organic products has exceeded 106 billion US dollars and beaten the arms market, while in Kazakhstan, on the contrary, the acreage for organic products is decreasing (-25%). 11.11.2020. URL: www.energyprom.kz/ru/a/monitoring/rynok-organicheskoj-produkcii-prevysil-106-milliardov-dollarov-ssha-i-obognal-rynok-vooruzheniya (11.11.2020).

20 Internet link: Certification as a tool to boost organic food development in Kazakhstan. 17.06.2020. URL: www.undp.org/kazakhstan/news/certification-tool-boost-organic-food-development-kazakhstan (17.06.2020).

21 Aitbayev T.E., Mamyrbekov Zh.Zh., Aitbayeva A.T., Turegeldiyev B.A., Rakhymzhanov, B.S. The influence of biorganic fertilizers on productivity and quality of vegetables in the system of «green» vegetable farming in the conditions of the south-east of Kazakhstan. OnLine Journal of Biological Sciences. No. 18(3). (2018): 277-284. DOI: 10.3844/ojbsci.2018.277.284.

22 Dospekhov BA Method of field experiment (with the basics of statistical processing of research results). Moscow, Kolos. (1985): 418.

23 Methodology of experimentation in vegetable growing and melon cultivation (edited by V.F. Belik). Moscow. (1992): 320.

24 Gutsalyuk T.G. Method for breeding watermelon and melon. Kainar. (1998): 4-29.

25 Koleboshina T.G., Belov S.I. New agricultural practices of watermelon cultivation and its influence on the yield and quality of watermelon fruits in Volgograd Zavolzhye. Proceedings of the Nizhnevolzhsk Agricultural University Complex: Science and higher professional education. No. 3 (39). (2015): 60-64.

26 Agafonova E.V., Barykina V.S., Guzhvina S.A. and Chernova A.Ya. The efficacy of combined application of mineral and bacterial fertilizers for watermelon. Bulletin of Agrarian Science of the Don. No. 1. (2010): 76-85.

27 Medvedev G.A., Tarassova E.M. The effects of biologically active substances in the cultivation of cucurbits. Proceedings of the Nizhnevolzhsk Agricultural University Complex: No.1 (17). (2010): 2-8.