Increasing the quality and productivity of tomato fruits under the impact of a growth regulators

Rano Alimova[1,*], *Mirkosim* Sagdiev[1] and *Alisher* Omonlikov[1]

[1]Tashkent State Agrarian University, 2, University street, Tashkent, 100140, Uzbekistan

Abstract. Evaluating the impact of growth regulators is a simple, inexpensive method that is considered an environmentally safe method to improve plant yield and quality, increase growth and productivity.The obtained results of the research on the influence of the Humosteem preparation on the productivity and quality of tomato plants have been presented herein.In foreign countries, 50-80% of tomato crops are treated with such preparations. Their number has been increasing in recent years.Due to the high biological activity of this preparation, it was noted, during the research, that it had a positive effect on local and hybrid varieties of tomatoes during the entire growing season, showed high efficiency in the absorption of nutrients, growth, development and productivity of the plant. It was observed that the content of nitrites and nitrates in plant products did not exceed the state standard requirement. It was determined that the amount of nitrites and nitrates increased by 17.07% in the Yablochniy variety, by 16.5% in the Lojain F1 hybrid, and by 13.3% in the TMK-22 variety under the impact of the Humosteem preparation. Thus, it was observed that the amount of nitrates was low in tomato variety TMK-22.

Keywords. Productivity, growth regulator, “Humosteem” preparation, seed treatment, tomato quality.

1 Introduction

Cultivation of vegetable crops in the soil-climate conditions of Tashkent region consists of timely implementation of agricultural-technical measures and enhancement of economic technologies, application of highly effective methods of irrigation, fertilizing, plant protection and mechanization of technological processes.

The focus is hereby mainly on creating environmentally friendly agrotechnologies, growing products without polluting the environment and without toxic substances, applying new generation drugs to agricultural production, solving problems [1 ,2].

Evaluating the effect of growth stimulants is a simple, inexpensive method that is considered an environmentally safe method to improve plant yield and quality, increase growth and productivity. In foreign countries, 50-80% of tomato crops are treated with such preparations. Their number has been increasing in recent years [3-5].

* Corresponding author: r.alimova@tdau.uz

The advantage of growth regulators is that even if they are used in small amounts, they have a sufficient influence on the physiological and biochemical processes in plants and enable them to be controlled [5-9]. Tomato is the most consumed vegetable in the world, and its varieties are distinguished according to yield and nutritional value. Tomato fruit contains carbohydrates, organic acids, mineral salts, aromatic substances and many vitamins [10, 11].

Among the growth regulators, the biostimulant preparation "Humosteem" has successfully passed approval in practice and is widely used in agriculture [12, 13]. The composition of this preparation embodies the feature of high biological activity, affects plants throughout the growing season, increases plant growth and productivity due to better absorption of nutrients [14]. The purpose of the research was to determine the efficacy of the Humosteem stimulant in the cultivation of tomatoes in the soil-climatic conditions of the "Bur ota" farm of Kibray district of Tashkent region.

The object of the research wastomato varieties “Yablochniy” (as standard), “TMK-22” and tomato hybrid “Lojain F1”. Experiments were triplicated.Experiment’s layout was systematic. Drip-irrigation was used. Planting schemewas 0,90 x 0,5 m. 1 kg seed was used per ha (35 00 seedlings perha). A 1% solution of potassium permanganate (1 g of crystals per 100 ml of water) was placed into gauze bags with a label according to tomato varieties for a few minutes, and then washed in distilled water for 20-30 minutes.The working solution prepared with the growth regulator "Humosteem" at 2 g/kg was soaked for 30-40 minutes before planting the seeds. Then the seeds were dried and planted. Planting was carried out using 1.4 sections. Except the roots, other plant partsweretreated with solutionof 15 kg of Humosteem with 300 g of water per hectare during the entire vegetation period (spraying at the beginning of growth, spraying at the beginning of budding and flowering) [15]. Irrigation was in a differentiated mode, the average soil moisture was 70-75%. The average amount of water absorbed during the year was 6800-7500 m^3/ha.

2 Materials and methods

The research was conducted during 2020-2022 in the cultivated fields of the “Bur ota” farm in Kibray district of Tashkent region. The climate of this place is strongly continental, but due to irrigation and strong insolation - light and sunlight, the vegetation and development of vegetable crops is activated. For example, 2020 was characterized by drought (GTK - 0.69), 2021 was dry (GTK - 0.38) and 2022 was very dry (GTK - 0.55).

The soil includes to light brown soil subgroup, and its granulometric composition is similar to the medium and heavy clay variety,soil contains of 1.5 – 2.0% humus, 3.8 – 8.9 mg per 100 g soil hydrolyzable nitrogen, 2.7 – 3.5 mgphosphorus, 300 – 450 mg/kg exchangeable potassium, the soil solution is weakly alkaline, the amount of absorption corresponded to 26-30 mg/100 g of soil. Experimental research was carried out on the basis of "Experimental methods in vegetable growing and policing" [8] and "Methods of field experiments" [3].

Humosteem preparation is a dark brown solution with a special smell. It dissolves well in water. The exchange acidity is around pH 7–9, the total percentage of humic acids is 2.4–2.7%, it has a 4th class hazard (low hazard substance), so it is used in the cultivation of environmentally friendly vegetables.Application rate of working solution is 0,001% humic acid, for spraying to plantsat the rate 1.5 – 5 l/kg, consumption rate of Humosteem (1% humic concentration) 1.5 – 2.0 ml/kg, for spraying to plants 0.15 – 0.3 l/mg.

The phenological observations of tomato growth and development were carried out in specially designated areas by generally accepted methods. Using these methods, the beginning periods of phenological phases, the main phenological phases of growth and

development were studied. The initial phase of growth included 10% of plants, total phase included 75% of plant growth.

Biometric indicators of tomato were periodically determined on the 1st day of every month. From each variant certain plants were taken to measurethe number, height, plant mass (weight), fruit diameter, size and weight. Irrigation was performed by drip irrigation method. It was in the mode of differential soil moisture in the active layer at an optimal humidity of 70-80-75% (Table 1).

Table 1. Total water absorption of tomato (average as in 2020-2022).

Atmospheric rainfall		**Irrigation rate**		**Moisture consumption from soil reserves**		**Total water absorption m^3/ha**
m^3/ha	%	m^3/ha	%	m^3/ha	%	6900.0
1390	11.3	4900	81.8	429	6.9	

It is obvious from the table that the moisture in the tomato field was 81.8% due to irrigation, and the moisture in the soil during the tomato planting period was 45 mm, which was only 6.9% of the water balance. Productivity was calculated by hand-picking, then into marketable and non-marketable product parts, and the yield structure was studied in each experimental variant during the harvesting period.

As a result of the use of Humosteem growth regulator during the vegetation period, the yield of tomatoes increased to 10.25 kg/m^2. This indicator was observed in all variants. The application of the preparation led to accumulation of sugar and dry matter from essential compounds in tomato fruits. A large amount of vitamin C was synthesized in all tomato varieties and hybrids, and their nutritional value was improved. The lowest amount of nitrate accumulation was observed in TMK-22 variety. Thus, the application of the growth regulator had a positive effect on the yield and quality of tomato.

3 Results and discussion

The effect of growth stimulant was studied when tomato was treated with it before sowing the seeds. The effectiveness of the growth regulator began to manifest in the 1st stage of the experiment of tomato ontogeny. Changes in biochemical processes and improvement of seed germination quality were observed (Table 2).

Table 2. Effect of Humosteem growth regulator on seed germination.

#	**Experimental options**	**Nuber of germinated seeds (pcs)**	**Germinability**	**Number of days from sowing to mass shoots**	**Root height, mm**	**Plant height, mm**
Yablochny						
1	Control (soaked in water)	72	72.78	18	3.8	5.3
2	Seeds soaked in “Humosteem” preparation 1 ml/kg	82	83.8	15	4.9	5.8
Lojain F_1						
1	Control	74	75.2	18	4.3	6.2

	(soaked in water)					
2	Seeds soaked in "Humosteem" preparation 1 ml/kg	85	85.6	13	5.4	6.8
TMK-22						
1	Control (soaked in water)	79	78.3	18	4.9	6.2
2	Seeds soaked in "Humosteem" preparation 1 ml/kg	94	94.5	12	5.6	6.9

The obtained results showed that the germination of tomato seeds in laboratory conditions was higher than those treated with water. Long primary branches and shoots were well formed in variants of application of growth regulators. Tomato productivity as a result of the application of growth regulators is presented in the accompanying table (Table 3).

Table 3. Effect of "humosteem" preparation on the productivity of tomato (in 2020-2022).

#	Experimental options	Productivity kg/m^2	Addition to control kg/m^2	Number of fruits kg/m^2	Average mass of fruits kg/m^2
Yablochny					
1	Control (soaked in water)	87.55	-	11.2	80
2	Seeds soaked in "Humosteem" preparation 1 ml/kg	8.58	1.07	11.9	82
3	1st spray in growth phase	9.37	1.85	12.3	84
4	2nd spray in budding and flowering phases	10.15	2.65	13.3	86
Lojain F_1					
1	Control (soaked in water)	9.4	-	14.5	65
2	Seeds soaked in "Humosteem" preparation 1 ml/kg	10.11	0.82	15.4	68
3	1st spray in growth phase	10.94	1.52	16.1	72
4	2nd spray in budding and flowering phases	11.56	2.15	16.8	78
TMK-22					
1	Control (soaked in water)	9.8	-	13.3	85
2	Seeds soaked in "Humosteem" preparation 1 ml/kg	10.44	0.75	14.1	88
3	1st spray in growth phase	11.62	1.86	14.8	90
4	2nd spray in budding and flowering phases	12.65	2.82	15.4	93

The application of growth regulator preparation "Humosteem" had a positive effect on the quality indicators of tomato fruits (Table 4).

Table 4. Effect of "Humosteem" preparationon the quality of tomato fruits.

#	Experimental options	Dry matter, %	Amount of vitamin Cmg/kg	Total sugar content, %	Acidity, %	Nitrate content, mg/kg
Yablochny						
1	Control (soaked in water)	3.7	15.8	2.5	0.55	90.4
2	Seeds soaked in "Humosteem" preparation 1 ml/kg	4.5	15.9	2.7	0.57	95.5
3	1st spray in growth phase	5.1	16.2	2.8	0.58	98.3
4	2nd spray in budding and flowering phases	5.9	16.5	2.9	0.59	105.3
Lojain F_1						
1	Control (soaked in water)	4.5	16.0	2.8	0.53	91.3
2	Seeds soaked in "Humosteem" preparation 1 ml/kg	5.1	16.2	3.0	0.55	96.1
3	1st spray in growth phase	5.7	16.3	3.1	0.56	97.2
4	2nd spray in budding and flowering phases	6.1	16.4	3.2	0.57	106.2
TMK-22						
1	Control (soaked in water)	4.2	15.5	2.4	0.53	91.7
2	Seeds soaked in "Humosteem" preparation 1 ml/kg	4.6	15.6	2.7	0.54	94.2
3	1st spray in growth phase	5.2	15.8	2.9	0.55	98.6
4	2nd spray in budding and flowering phases	5.8	16.1	3.1	0.55	103.8

The following were taken as morphological indicators: plant height, stem thickness, number of flowers and buds. These parameters were determined in budding and flowering phases. During the application of preparation, the height of the plants increased. In all variants, compared to the control, it was observed that the increase in plant height was in Yablochny - 33.75%, in Lojain F1 hybrid - 51.68%, in TMK-22 variety - 64.16%.

The productivity of tomato was observed from 7.5 kg/m^{2}to 9.8 kg/m^{2}in the control by variants. In all variants, an increase in productivity was observed when the preparation Humosteem was used. When Humosteem growth regulator was used during at the vegetation period, the indicator ranged from 10.15 kg/m^2 to 12.65 kg/m^2 in all options.

As a result of the use of this preparation, the main compounds – sugars dry matter - accumulated in tomato fruits. In all experimental variants, the content of vitamin C in tomato fruits increased and their nutritional value improved.

It was stated that the content of nitrites and nitrates in plant products did not exceed the state standard requirements. According to this standard, the content of nitrites and vanitrates in tomato fruits should not exceed 150 mg/kg. It was determined that the amount of nitrites and nitrates increased by 17.07% in the Yablochny variety, by 16.5% in the

Lojain F1 hybrid, and by 13.3% in the TMK-22 variety under the impact of the Humosteem preparation. It was also observed that the amount of nitrates was low in tomato variety TMK-22.

As a result of the application of the growth regulator Humosteem, the taste and quality of tomato fruits improved, and it provided an opportunity to obtain high-quality raw materials for the product processing sector.

4 Conclusions

The study delved into the practical application of a growth regulator, specifically focusing on the effects of the "Humosteem" preparation. This investigation unveiled that the utilization of this growth regulator has a positive impact on the productivity and quality of tomato products cultivated in an ecologically clean manner.

Through rigorous research, the study generated valuable insights and developed recommendations that enable the efficient utilization of cultivated areas. As a result of these findings, strategies were formulated to enhance both the productivity and quality of tomatoes in the Kibray district of the Tashkent region.

This research has important implications for agricultural practices, as it offers a tangible approach to improving tomato yields and their overall quality, while also considering ecological considerations. By harnessing the positive effects of the "Humosteem" growth regulator, the study contributes to the optimization of tomato production processes in the specific geographic context of the Kibray district of Uzbekistan.

References

1. Alimova R. A. et al. Plant growth stimulants and the effect of foliar feeding on the yield of some vegetable crops //Eurasian Research Bulletin. – 2022. – T. 9. – C. 30-38.
2. Allayarov, Abdurakhman & Zuparov, Mirakbar & Khakimov, Albert & Omonlikov, Alisher. (2021). Application of the biopreparation ‘Orgamika F’ against fusarium disease of cabbage and other cole vegetables. E3S Web of Conferences. 284. 03011. 10.1051/e3sconf/202128403011.
3. Khakimov, Albert & Omonlikov, Alisher & Utaganov, Samad. (2020). Current status and prospects of the use of biofungicides against plant diseases. 13. 119-126. 10.30574/gscbps.2020.13.3.0403.
4. Khakimov, Albert & Salakhutdinov, I & Omonlikov, Alisher & Utaganov, Samad. (2022). Traditional and current-prospective methods of agricultural plant diseases detection: A review. IOP Conference Series: Earth and Environmental Science. 951. 012002. 10.1088/1755-1315/951/1/012002.
5. Sagdiev M. T., Amanova M. M., Omonlikov A. U. The influence of growth regulators on tomato productivity in the conditions of the Tashkent region //ISJ Theoretical & Applied Science, 11 (79). – 2019. – C. 241-244.
6. Sagdiev M. T., Amanova M. M., Omonlikov A. U. The influence of plant growth stimulators on tomato productivity in the conditions of Tashkent region. World Journal of Pharmaceutical and Life Sciences,(WJPLS //India. – 2020. – T. 6. – №. 8. – C. 04.
7. Sagdiev M., Omonlikov A. Influence of plant growth stimulants on tomato productivity in the conditions of the tashkent oasis //Journal of Agriculture & Horticulture. – 2023. – T. 3. – №. 4. – C. 58-63.
8. Tayjanov, K., Khojimatov, O., Gafforov, Y., Makhkamov, T., Normakhamatov, N., & Bussmann, R. W. (2021). Plants and fungi in the ethnomedicine of the medieval East-a

review. Ethnobotany Research and Applications, 22, 1-20. DOI:0.32859/ERA.22.46.1-20

9. Jabeen, S., Zafar, M., Ahmad, M., Althobaiti, A. T., Ozdemir, F. A., Kutlu, M. A., ... & Majeed, S. (2023). Ultra-sculpturing of seed morphotypes in selected species of genus Salvia L. and their taxonomic significance. Plant Biology, 25(1), 96-106. DOI:10.1111/plb.13473
10. Majeed, S., Ahmad, M., Ozdemir, F. A., Demirpolat, A., Şahan, Z., Makhkamov, T., ... & Nabila. (2023). Micromorphological characterization of seeds of dicot angiosperms from the Thal desert (Pakistan). Plant Biosystems-An International Journal Dealing with all Aspects of Plant Biology, 157(2), 392-418. DOI:10.1080/11263504.2023.2165553
11. Majeed, S., Ahmad, M., Ali, A., Althobaiti, A. T., Ramadan, M. F., Kilic, O., ... & Sultana, S. (2023). Pollen micromorphology among amaranthaceous species from desert rangeland: Exine stratification and their taxonomic significance. BioMed Research International, 2023, 4967771. DOI:10.1155/2023/4967771
12. Makhkamov, T., Sotiboldiyeva, D., Mamarakhimov, O., Yuldashov, Y., & Botirova, L. (2022, May). Morphogenesis and Seasonal Developmental Rhythm Under the Conditions of Introduction of Curcuma Longa L. In International Scientific Conference on Agricultural Machinery Industry “Interagromash"” (pp. 1460-1469). Cham: Springer International Publishing. DOI:10.1007/978-3-031-21432-5_155
13. Boboev, S., Makhkamov, T., Bussmann, R. W., Zafar, M., & Yuldashev, A. (2023). Anatomical and phytochemical studies and ethnomedicinal uses of Colchicum autumnale L. Ethnobotany Research and Applications, 25, 1-9. DOI:10.32859/era.25.6.1-9
14. TKh, M., Brundu, G., Jabborov, A. M., & Gaziev, A. D. (2023). Predicting the potential distribution of Ranunculus sardous (Ranunculaceae), a new alien species in the flora of Uzbekistan and Central Asia. BioInvasions Records, 12(1), 63-77. DOI:10.3391/bir.2023.12.1.05
15. Ameen, M., Zafar, M., Ahmad, M., Ramadan, M. F., Eid, H. F., Makhkamov, T., ... & Majeed, S. (2023). Assessing the Bioenergy Potential of Novel Non-Edible Biomass Resources via Ultrastructural Analysis of Seed Sculpturing Using Microscopic Imaging Visualization. Agronomy, 13(3), 735. DOI:10.3390/agronomy13030735