Medicon Agriculture & Environmental Sciences
Volume 6 Issue 3 March 2024
Article Type: Research Article
ISSN: 2972-2691

The Effect of Biostimulants on Biochemical Changes in Pumpkin and Cucumber in the Conditions of the Andijan Region (Uzbekistan)

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Received: December 07, 2023; **Published:** March 07, 2024

DOI: 10.55162/MCAES.06.154

Abstract

The effect of biostimulants Uchkun, Uchkun plus, Gossipren, and Verva on pumpkin plants was studied in the conditions of the Andijan region (Uzbekistan). It was established that pre-sowing treatment with biostimulants facilitated seed germination and growth processes. The most effective growth stimulator on cucumber was Uchkun Plus.

Keywords: biostimulants; Uchkun; Uchkun plus; Gossipren; Verva; parthenocarpic plant

Introduction

In our republic, there is a problem of using natural bio-stimulants and creating new biologically active substances to introduce them into production, improve medicinal properties, and increase the productivity of pumpkin crops. Studying the effect of bio-stimulants and improving the quality of the product, enriching its biochemical composition and determining the medicinal properties of pumpkin crops is relevant in solving this problem.

Decrees of the President of the Republic of Uzbekistan dated April 10, 2020 No. UP-4670 "On measures to protect wild medicinal plants, cultivation, processing, and rational use of available resources", and No. UP 4901 dated November 26, 2020 "On measures to expand the scope of scientific research on cultivation and processing of medicinal plants, development of their seed production" are important strategic decisions identified as one of the major tasks [1, 2].

Analysis of chlorophyll and β-carotene content in pumpkin leaves

The effect of various bio-stimulants on the amount of chlorophyll and β-carotene in pumpkin and cucumber was experimentally determined under field conditions.

Plants were studied using different bio-stimulants in three different ways: after seed germination, after emergence of 2-3 leaves during the growing season, and before flowering [3].

Change in the amount of chlorophyll in pumpkin leaves

As a result of the research, the application of 4 types of bio-stimulants (Gossipren, Uchkun, Verva, and Uchkun plus) on pumpkin plants was studied and, as a reference option, the soaking in clean water was considered. To determine the content of green pigments,

pumpkin seeds were soaked in bio-stimulants for 18 hours and the sprouts were determined after 10-12 days. The second method was the spraying of plants with bio-stimulants when the third and fourth leaves emerged and determining the amount of chlorophyll before flowering. In the experiment, the third method (the mixed one) was used to determine the amount of chlorophyll in the indicated two periods (see Table 1).

Options	***Pumpkin***			
	Chlorophyll mg/g		***Amount of total chlorophyll, mg***	***Amount of b-carotine, mg/%***
	α	***b***		
Mixed method				
Reference (soaking in water)	1.54	0.40	1.94/100.0	0.71/100
Gossipren -1.0%	1.67	0.48	2.15/110.8	0.71 / 100
Uchkun - 0.01%	2.17	0.62	2.89/149.0	0.73/102.8
Uchkun plus -0.01%	2.29	0.65	2.94/151.5	0.74/104.2
Verva -5.0%	1.69	0.48	2.17/111.8	0.72/101.4

Table 1: The effect of biostimulants on the amount of chlorophylls in pumpkin leaves (2018-2020).

The reference amount of chlorophyll *α* and *b* in pumpkin plants using the mixed method was 1.54-0.40 mg/g, the total amount of chlorophyll was 1.94 mg/g, and the amount of β-carotene was 0.71%. The largest amount of chlorophyll according to these indicators was 2.29-0.65 mg/g when using 0.01% of the Uchkun plus bio-stimulator, the total amount of chlorophyll was 2.94 mg/g, i.e. 51.5% and β-carotene content was 0.74%, i.e. 4.2% higher.

Change in the amount of chlorophyll in cucumber leaves

The amount of chlorophyll α and b in cucumber plants using the mixed method in the reference option was 1.01-0.31 mg/g, the amount of total chlorophyll was 1.32 mg/g, the highest indicator was found in the Uchkun plus option - 1.25-0, 56 mg/g, the content of total chlorophyll was1.81 mg/g, i.e., 37.1% higher (see Table 2)

Options	***Chlorophyll mg/g***		***Amount of total chlorophyll, mg***
	α	***b***	
Mixed method			
Reference (soaking in water)	1.01	0.31	1.32/100
Gossipren -1.0%	1.12	0.38	1.50/113.6
Uchkun - 0.01%	1.22	0.53	1.75/132.6
Uchkun plus -0.01%	1.25	0.56	1.81/137.1
Verva -5.0%	1.15	0.41	1.56/118.2

Table 2: The effect of bio-stimulants on the amount of chlorophylls in cucumber leaves (2018-2020).

Changes in the amount of phytohormones in the root and stem of pumpkins

The amount of phytohormones in a plant changes during the growth period. During the period of seed germination, the amount of some of them increases, and after the formation of the upper part of the plant, their amount decreases. The reason for this is that some hormones have inhibitory properties [4].

According to the results of the study, it was noted that the activity of phytohormones increased when seeds were heated before sowing with the Uchkun Plus bio-stimulant at the beginning of plant ontogenesis. The amount of indoleacetic acid (IAA), which stops the development of plant growth, in the seeds of the reference option was initially 0.002 mg/ml, and subsequently, its amount increased to 0.011 mg/ml on the surface of the plants. Under the effect of the Uchkun plus bio-stimulator, the amount of kinetin in the aerial part was 0.074 mg/ml, and in the root part - 0.136 mg/ml. The amount of indole fatty acid (IFA), obtained in the form of a standard solution, in the stem with the application of the Uchkun plus was 0.011 mg/ml, however, its amount in the root was not determined (Table 3).

Options	***aerial part***			***Roots***		
	Kinetin	***IAA***	***IFA***	***Kinetin***	***IAA***	***IFA***
Reference (soaking in water)	0.074	0.011	0.005	0.037	0.002	0.0
Gossipren -1.0%	0.085	0.0051	0.006	0.038	0.001	0.0
Uchkun - 0.01%	0.091	0.010	0.004	0.039	0.001	0.0
Uchkun plus -0.01%	0.123	0.010	0.011	0.041	0.001	0.0
Verva -5.0%	0.087	0.0051	0.007	0.038	0.002	0.0

Standard phytohormones: Kinetin 0.030; IAA 0.030; IFA 0.030.

Table 3: The amount of phytohormones in the roots and aerial parts of pumpkins.

The use of growth regulators in growing plants, including bio-stimulants, radically changes the growth and development of plants, and helps to increase yield and plant productivity. When applied, the resistance of plants to unfavorable conditions (drought, salinity, and other soil and climatic conditions), pests, and diseases increases.

Change in the amount of pectin in pumpkin fruits

The purpose of our experiments is to determine the amount of pectin in pumpkin fruits, to see a change in the amount of pectin in pumpkin fruits grown using bio-stimulants, and to provide scientific recommendations to consumers and enterprises processing agricultural products [5]. When comparing the results obtained in the experiment, the Uchkun plus bio-stimulator gave a better result compared to the reference option (by 31.2%), Gossipren (by 12.6%), Uchkun (by 25.0%), and Verva (by 15.8%) (Table 4).

S No.	***Options***	***Pectin, g / %***
1	Reference (soaking in water)	6.41/ 100.0
2	Gossipren -1,0%	7.22/ 112.6
3	Uchkun - 0,01%	8.01/ 125.0
4	Uchkun plus -0,01%	8.41/ 131.2
5	Verva -5,0%	7.42/ 115.8

Table 4: Change in the amount of pectin in pumpkin fruits.

When pumpkin varieties were treated with the Uchkun Plus bio-stimulant, the amount of pectin increased significantly, which showed a better effect than the one obtained by applying other bio-stimulants used in the experiment.

When comparing the results of the effect of bio-stimulants on the amount of pectin contained in the pumpkin fruits during the experiment, 6.41 grams were recorded in the reference option, and the best result was seen with the 0.01% of Uchkun plus; the amount of pectin was 8.41 grams, i.e., 31.2% higher than in the reference option.

The influence of bio-stimulants on the content of β-carotene and nitrates

According to WHO, the daily intake of nitrates for an adult is 5 mg/kg body weight. The amount of nitrates in pumpkins ranges from 50 to 630 mg/kg, depending on growing conditions. β-carotene is a yellow-orange plant pigment, one of 600 naturally occurring carotenoids. β-carotene serves as the main raw material for vitamin A (retinol) and is a powerful antioxidant.

The amount of beta-carotene in the reference option was 3.69 mg, and the amount of nitrate was 55.0 mg. These figures were 3.76 mg and 49.1 mg for Gossipren, 4.06 mg and 49.4 mg for Verva, and 4.13 mg and 48.0 mg for the Uchkun option. The best result was obtained for the "Uchkun Plus" option, the amount of β-carotene was 4.15 mg, which is 12.5% higher than the reference option, and the amount of nitrates was 45.3 mg, which is 17.6% less than the reference option [5].

S No.	*Options*	*β -carotene, mg/%*	*Nitrate, mg/kg*
1	Reference (soaking in water)	3.69/100.0	55.0/100.0
2	Gossipren -1.0%	3.76/101.9	49.1/89.3
3	Uchkun - 0.01%	4.13/111.9	48.0/87.3
4	Uchkun plus -0.01%	4.15/112.5	45.3/82.4
5	Verva -5.0%	4.06/110.0	49.4/89.8

Table 5: The influence of bio-stimulants on the content of β-carotene and nitrates.

The analysis showed that the difference in the amount of nitrates in pumpkin fruits was 49.0-56.0 mg/kg. This indicator confirmed that the content of nitrates in pumpkin fruits in all varieties was less than the permissible norm (MPC-150 mg/kg). It indicates that the quality of the product, which increases the medicinal properties of pumpkin, meets the requirements of the nitrate standard.

An analysis of the composition of macro- and microelements in pumpkin and cucumber [6]

Na, *K*, and *Mg* are elements that ensure cellular metabolism; in the experiment, the amount of macro-elements in pumpkins was Na-2.0 mg/l, K-164.0 mg/l, and Mg 10.0 mg/l in the reference option; in other options: Na-3.003-3.391 mg/l, K-177.2-188.2 mg/l, Mg 11.53-12.91 mg/l. When treated with the Uchkun plus bio-stimulant, an increase in the values was observed: Na-3.391 mg/l, K-144.01 mg/l, and Mg 9.02 mg/l.

Such positive indices were observed for calcium, phosphorus and sulfur elements in pumpkins: Ca-18.0 mg/l, P-17.01 mg/l, S-14.0 mg/l in the reference option: and Ca-20.58-22.55 mg/l, P-19.22- 21.26 mg/l, S-16.02-17.33 mg/l mg/l In other options. The values of Ca- 22.55 mg/l, P- 21.26 mg/l, S- 17.33 mg/l were obtained when treated with the Uchkun plus bio-stimulant (Table 6).

S No.	*Option*	*Mg*	*Na*	*K*	*Ca*	*P*	*S*
1	Reference	10.0±0.14	2.001±0.08	164.0±0.16	18.0±0.17	17.01±0.18	14.0±0.16
2	Gossipren -1.0%	11.53±0.16	3.032±0.12	177.2±0.09	20.64±0.18	19.22±0.17	16.02±0.14
3	Uchkun - 0.01%	12.79±0. 15	3.191±0.13	186.4±0. 24	21.37±0.28	20.51±0.12	16.93±0.18
4	Uchkun plus -0.01%	12.91±0.25	3.391±0.15	188.2±0.16	22.55±0.25	21.26±0.18	17.33±0.18
5	Verva -5.0%	11.87±0.17	3.043±0.12	184.2±0.17	20.58±0.28	21.16±0.12	16.77±0.17

Table 6: Pumpkin macro-nutrient composition (mg/l).

Although the number of plant cells and tissues is small, the number of trace elements considered important from the point of view of their function can be seen from the data given in Table 7 [8].

If we analyze the indices of microelements in pumpkin fruits, the most important elements are Fe-0.322 μg, Cu-0.140 μg, Zn-0.22 μg in the reference option, and Fe-0.362-0.466 μg, Cu-0.142-0.198 μg, Zn-0.233-0.259 μg in other options. The best result was recorded when treated with the Uchkun plus; the values of the elements were: Fe-0.466 μg, Cu-0.198 μg, and Zn-0.259 μg.

Trace elements such as boron, molybdenum, manganese, and chromium are also important for plant life. The amount of these microelements in pumpkin fruits is B-0.007 μg, Mo-0.003 μg, Mn-0.0035 μg, Kr-0.0015 μg in the reference option, and B-0.011-0.017 μg, Mo-0.004-0.0043 μg, Mn -0.0039-0.0041 μg, Cr - 0.0017-0.0023 μg in other options. The best result was recorded when treated with the Uchkun plus; the values of the elements were B-0.017-μg, Mo-0.0043 μg, Mn-0.0041 μg, and Cr-0.0023 μg (Table 7).

S No.	*Option*	*Fe*	*Cu*	*Zn*	*B*	*Mo*	*Mn*	*Cr*
1	Reference	0.322±0.13	0.140±0.16	0.22±0.19	0.007±0.28	0.003±0. 12	0.0035±0.18	0.0015±0.16
2	Gossipren -1.0%	0.362±0.14	0.142±0.17	0.233±0.009	0.011±0.14	0.004±0.14	0.0039±0.21	0.0017±0.18
3	Uchkun - 0.01%	0.465±0.15	0.194±0.16	0.253±0.16	0.016±0.16	0.0041±0.16	0.0040±0.16	0.0022±0.16
4	Uchkun plus -0.01%	0.466±0.16	0.198±0.16	0.259±0.16	0.017±0.16	0.0043±0.16	0.0041±0.16	0.0023±0.16
5	Verva -5.0%	0.462±0.14	0.193±0.16	0.249±0.16	0.011±0.16	0.004±0.16	0.0040±0.16	0.0019±0.16

Table 7: Pumpkin macro-nutrient composition (mkg/l).

Thus, when applying 0.01% of Uchkun Plus to pumpkins, their biochemical composition improved, the amount of nitrates decreased, the amount of macro- and microelements, vitamins, protein, moisture content, phytohormones, chlorophyll and β-carotene increased; all these lead to an increase in medicinal properties.

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