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THE APPLYING ADDITIONAL FEEDING OF PLANTS FOR GROWING TOMATOES IN SMALL-VOLUME HYDROPONICS

Abstract

In the article presents the results of studies on the effect of plant nutrition with potassium nitrate on the productivity and quality of tomato fruits when grown on low-volume hydroponics.

Key words: tomato, potassium nitrate, low-volume hydroponics, crop, profit.

Introduction

From a wide variety of vegetable crops, tomato, popularity, is one of the first places. The areas of the whole soil under the tomato culture stand in second place after the cabbage. Such popularity is due to the high biological fullness of the tomato fruit. They contain a set of vitamins, mineral salts, organic acids, carbohydrates, phytoncides [1]. From the fruits of tomato, juice, ketchup, and widely-used fruits are cooked. In addition to fresh consumption, a large amount goes to pickling.

In connection with the fact that the supply of fresh tomato fruit to the population from the open ground is possible only 2-3 months per year, it is widely used for growing it in greenhouses. Here the products are received all year round. Growing tomato in greenhouses on low-volume hydroponics in recent years has acquired a steady trend. Mineral fertilizers determine here the value of the crop. Therefore, the selection of doses of mineral fertilizers is very relevant when growing tomato on low-volume hydroponics.

Materials and methods

Research work of the tomato variety Zhalyn on the establishment of optimal doses of potassium nitrate was carried out in a winter greenhouse.

The substrate for the root system was perlite. The variant of Potassium nitrate doses: 30 kg / ha (control), 60 kg / ha, 90 kg / ha, 120 kg / ha, 150 kg / ha. Plant nutrition was carried out from the flowering phase with an interval of 3-4 days. Promissory notes on options for experience were made for 20 additional feedings.

Seed sowing for growing seedlings was conducted on January 14, 2017. Planting seedlings on a permanent place on February 17. Repeat in the experiment three times.

Phenological observation of seedlings was carried out according to the form adopted by the state variety testing [3]. From the moment of sowing to the beginning of harvesting, the timing of the onset and passage of the phenophase is noted-the phase of the emergence of single and mass shoots, budding, flowering, blanched ripeness, and fruiting. The power of development of tomato plants was determined - the height of the plant was measured, the number of leaves was counted and their area determined (according to N. Konyaev), the number of brushes and fruit tied to them was counted.

To analyze the biological usefulness of fruits obtained from plants at different dosages of additional feedings with potassium nitrate, mean samples were taken, the dry matter content (drying), ascorbic acid according to state educational standard 2456-89 [4], the micromodification sugar of the Bertrand method [5], the total acidity [6]. The determination of the nitrate content was carried out by the ionometric method [6].

Results and discussion

Carrying out phenological observations made it possible to establish differences in the timing of plant entry into the next phases of development. Feeding of potassium nitrate in a dose of 120 kg / ha allowed the plants to enter the phases of blanched ripeness and ripening of fruits 2 days earlier. In variants with a dose of top dressing 90 and 150 kg / ha the plants entered before the control in these phases for one day. In the remaining variants of the experiment, there was no difference in the time of plant entry into the next developmental phases (Table 1). The biometrics conducted before the first collection allowed to reveal the differences in the development of experimental plants (Table 2).

Table 2 – Biometrics of tomato plants of Zhalyn variety before the first collection at different doses of additional feeding with potassium nitrate, 2017

Variant	Plant height, cm	Leaf area, cm^2	Number of fastened fruits on a brush, pcs.		
			1-st	2-nd	3-d
30 kg / ha (control)	260,3	7376	7,6	8,7	8,1
60 kg / ha	265,7	7953	8,0	8,9	8,3
90 kg / ha	270,7	8504	8,2	8,1	8,5
120 kg / ha	273,3	8736	8,4	9,3	8,7
150 kg / ha	270,3	8411	8,4	9,2	8,6

The highest height was for plants when feeding them with a dose of 120 kg / ha - 273.3 cm. The increase in the dose of fertilizing did not increase the height of the plants. The more the leaf surface of plants, the better supply of nutrients generative organs. As the dose of fertilizing increases, the area of the leaves of the plant increases. The largest leaf area of the plant in the version with a dose of additional feeding potassium nitrate 120 kg / ha is 8736 cm2. The fertilizing dose of 150 kg / ha does not further increase the area of the leaves. With a dosage of 120 kg / ha additional fertilizing was noted on the first three brushes. The biological usefulness of tomato's food organs determines the content of dry matter, sugars, ascorbic acid, total acidity, nitrates in them. The higher content of dry matter in tomato fruits was when applying potassium nitrate 120 kg / ha. The content of sugars in fruits increased in variants with the introduction of potassium nitrate in doses of 90, 120, 150 kg / ha. The content of ascorbic acid in tomato fruits increases with increasing dosage of top dressing, reaching a maximum at a dose of 120 kg / ha - 19.36 mg%. Further increase in the dosage of top dressing to 150 kg / ha does not contribute to a further increase in the content of ascorbic acid (Table 3)

Table – 3. The content of dry matter, sugars, acids, nitrates in the food organs of the tomato variety Zhalyn at different doses of feeding with potassium nitrate, 2017

Variant	Dry matter, %	Sugar,% by wet matter	Ascorbic acid, mg%	Total acidity by malic acid,%	Nitrates, mg / kg
30 kg / ha (control)	5,58	2,00	11,44	0,30	143,2
60 kg / ha	5,82	2,00	12,32	0,40	146,4
90 kg / ha	5,64	2,10	18,48	0,44	145,3
120 kg / ha	6,32	2,10	19,36	0,32	145,5
150 kg / ha	5,06	2,10	15,84	0,27	145,7

Table 1 – Phenological observations of the Zhalyn variety with different doses feeding of potassium nitrate, 2017

Variant	Date													
	seeding	young growth %		planting seedlings	butonization, %		flowering, %		blanche ripeness, %		Fruit ripening, %		Harvesting	
		10	75		10	75	10	75	10	75	10	75	10	75
30 kg / ha (control)	12.01	17.01	20.01	15.02	25.02	02.03	19.03	23.03	10.04	15.04	19.04	23.04	08.05	21.06
60 kg / ha	12.01	17.01	20.01	15.02	25.02	02.03	19.03	23.03	10.04	15.04	19.04	23.04	08.05	21.06
90 kg / ha	12.01	17.01	20.01	15.02	25.02	02.03	19.03	23.03	9.04	14.04	18.04	22.04	08.05	21.06
120 kg / ha	12.01	17.01	20.01	15.02	25.02	02.03	19.03	23.03	8.04	13.04	17.04	21.04	08.05	21.06
150 kg / ha	12.01	17.01	20.01	15.02	25.02	02.03	19.03	23.03	9.04	14.04	18.04	22.04	08.05	21.06

The content of total acidity was maximum in tomato fruits, the plants of which received a dose of 90 kg / ha. The permissible level of nitrate content, according to SanPiN - 42 - 23 - 4619 and SanPiN 4.01.71.03 [8] in the fruits of greenhouse tomato is 300 mg / kg. The feeding with potassium nitrate and a dose did not reveal a clear pattern in the content of nitrates in tomato fruits, depending on the dose. Despite this, even the maximum dose of nitrates in 146.4 mg /kg is 2 times lower than the maximum permissible concentration (MPC). In table 4 of the lesson and the average weight of the fruit at different doses feeding of tomato plants.

Table 4 – Yield and mass of tomato fruit of variety Zhalyn at different doses of feeding with potassium nitrate, 2017

Variant	Harvest with 1m^2				Increment of harvest, kg / m^2		Fruit weight, g	
	for 3 collections		for vegetation		early	for vegetation	in early training	for vegetation
	кг	%	кг	%				
30 kg / ha (control)	4,08	100	20,51	100	-	-	125	121
60 kg / ha	4,13	101,2	20,83	101,6	0,05	0,32	125	123
90 kg / ha	4,19	102,7	21,04	102,6	0,11	0,53	126	124
120 kg / ha	4,25	104,2	22,74	110,9	0,17	2,23	129	126
150 kg / ha	4,18	102,5	21,41	104,4	0,10	0,90	127	125
SSD 0,5	0,13		0,55					
Sx, %	3,2		2,7					

In the early harvest, a reliable yield increase was obtained at a feed dose of 120 kg / ha. The yield for vegetation was maximal in the variant with a dosage of potassium nitrate supplementation of 120 kg / ha - 22.74 kg / m2, increasing the dose of feeding to 150 kg / ha is not made until the yield of tomato is further increased. The weight of the fetus, both in early collections and during vegetation, was the highest with a dosage of 120 kg / ha.

The highest revenue was received in the variant with top dressing of tomato plants with potassium nitrate at a dose of 120 kg / ha and amounted to 7672 tg / m2. The smallest revenue was received at a dosage of 30 kg / ha - 6969 tg / m2 (see 5).

Table 5 – Economic efficiency of cultivation of Zhalyn tomato variety at different doses of feeding with potassium nitrate, 2017.

Variant	Harvest, kg /m^2	Revenue, tg / m^2	Expenses for cultivation, tg/m^2	Net income, tg / m^2	Cost of 1 kg, tg	Profita-bility,%
30 kg / ha (control)	20,51	6969	4388	2581	213,9	58,8
60 kg / ha	20,83	7075	4390	2685	210,8	61,2
90 kg / ha	21,04	7150	4392	2758	208,7	62,8
120 kg / ha	22,74	7672	4394	3278	193,2	74,6
150 kg / ha	21,41	7259	4396	2863	205,3	65,1

The highest yield was brought by the cultivation of tomato plants with a dose of additional potassium nitrate 120 kg / ha - 3278 tg / m2, increasing the dosage of top dressing to 150 kg / ha increases the prime cost of tomato production.

A small profitability was given by top dressing of tomato plants with potassium nitrate at a dose of 120 kg / ha (74.6%). Increasing the dose of fertilizing reduces the profitability of growing tomatoes.

Conclusions

1. It is established that additional feeding of tomato grown by the method of small-volume hydroponics, has a positive effect on tomato productivity.

2. To increase the productivity of the greenhouse tomato grown by the method of small-volume hydroponics, it is necessary to fertilize plants with potassium nitrate at a dose of 120 kg / ha.

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ИСПОЛЬЗОВАНИЕ ПОДКОРМКИ РАСТЕНИЙ ПРИ ВЫРАЩИВАНИИ ТОМАТА НА МАЛООБЪЕМНОЙ ГИДРОПОНИКЕ

Аннотация

В статье приведены результаты исследований по влиянию подкормки растений нитратом калия на продуктивность и качество плодов томата при выращивании на малообъемной гидропонике.

Ключевые слова: томат, нитрат калия, малообъемная гидропоника, урожай, прибыль.

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ҚЫЗАНАҚТЫ ҚОСЫМША АЗЫҚТАНДЫРУДЫҢ КІШІ КӨЛЕМДІ ГИДРОПОНИКАҒА ӘСЕРІ

Аңдатпа

Мақалада өсімдікті қосымша калий нитратымен азықтандырудың әсері және аз көлемде гидропоникада өсірудегі қызанақ жемісінің сапасы келтірілген.

Кілт сөздер: қызанақ, калий нитраты, аз көлемді гидропоника, түскен өнім, пайда.