

The Use of Complex Fertilizers in the Cultivation of Shallot

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Abstract—The results of research on improving the elements of shallot technology are presented. The research was carried out in 2016-2017 in Italmas village of Zavyalovsky district of the Udmurt Republic. Purpose of research: comparative assessment of the productivity of shallot depending on the planting material and fertilizing with complex mineral fertilizers. The tasks of the research were to study the effect of complex fertilizers and planting material of shallot on yield and its structure; to determine the quality indicators of turnips. To study the effect of complex fertilizers on the performance of shallot biochemical studies of bulbs were conducted (dry matter content, nitrates, vitamin C and water-soluble sugars), taking into account the yield and its structure. The highest yield of 32.9 t/ha was obtained by planting shallots with a whole onion and with fertilizing with the complex solution "Rastvorin". When planting shallots with a whole onion, the yield of marketable products was 91.8 %. The bulbs accumulated vitamin C in the range of 5.6-6.8 mg/100 g. The conducted researches have scientific and practical significance.

Keywords—shallots, complex fertilizers, planting material, yield.

I. INTRODUCTION

The Udmurt Republic is located in the zone of moderate continental climate with long cold snowy winters and short warm summers. The Republic is characterized by the predominance of continental air masses of temperate latitudes, with large daily, monthly, seasonal and annual amplitudes of air temperature. By the character of moisture it refers to the zone with unstable moisture. In general, climatic and soil conditions of the Udmurt Republic allow to grow many vegetable crops. Studies are being conducted in the republic to study new varieties and hybrids [1], to improve the technology of cultivation of cucumber, tomato [2, 3, 4], cabbage, pepper, carrots, beets [5,6], onions, garlic [7-13] and etc. Special attention is paid to new vegetable crops. Thus, in the Udmurt Republic, onion is the most common type of onion, but shallots are found in homestead lands. Shallots bulbs and leaves have nutritional value. Shallots, as a rule, has sweet and slightly sharp taste, has delicate juicy scales and is well suited for consumption in fresh form, in salads, etc. [14-19]. A necessary condition for the promotion of human health is the presence of vegetables in their diet. However, the range of vegetable crops in Udmurtia is not sufficient. One of the promising crops that can increase the range of vegetables grown is shallots. In this regard, the

study of the elements of the technology of growing shallots in the Udmurt Republic is relevant.

II. RESEARCH METHODOLOGY

The research was carried out in 2016-2017 in Italmas village of Zavyalovsky district of the Udmurt Republic on soddy-mid-podzolic mid-loamy soil. Agrochemical analysis of the soil was carried out in the agrochemical laboratory of the FSBEU HE Izhevsk State Agricultural Academy in accordance with generally accepted State standards (GOST). According to the humus content, the soil is medium humic. The acidity of the soil is close to neutral. The availability of mobile forms of phosphorus is very high and the exchange of potassium is increased. According to agrochemical indicators, the soil is suitable for growing shallots.

Two-factor experience was laid down and conducted for the research: factor A (fertilizing with complex mineral fertilizers): Zdraven, Rastvorin, Krepysh, water (control); factor B (planting material): whole bulb, weight 10-15 g (control), half a large bulb, weight 20-30 g. Fertilizing twice (during the period of leaf growth and at the beginning of bulb formation) in doses recommended by manufacturers. The total area of the plot by factor A - 4 m², factor B - 2.0 m². The accounting area of the plot by factor A is 2.8 m², by factor B - 1.4 m². Planting scheme – 30×20 cm. Placement of variants by the method of split plots, in four-fold repetition.

In the experiment, the yield and its structure, biochemical studies of the bulbs (dry matter, nitrates, vitamin C and water-soluble sugars) were recorded.

Laying and conducting experiments, records and observations, study of biochemical composition of the bulbs was carried out in accordance with the requirements for conducting experiments in vegetable growing [20, 21]. The data obtained as a result of the research are subject to statistical processing by the B.A. Dospekhov dispersion method using a computer program Microsoft Excel.

III. PURPOSE AND TASKS OF RESEARCH

Purpose of research: comparative assessment of the productivity of shallots depending on the planting material and compound fertilizing. Tasks: to assess the impact of complex fertilizers and planting material of shallots on yield and its structure; to determine the quality indicators of shallots.

IV. RESULTS

The studies revealed that the total yield of shallots varied from 15.8 to 32.9 t/ha (table 1).

TABLE I. INFLUENCE OF PLANTING MATERIAL AND FERTILIZING WITH COMPLEX MINERAL FERTILIZERS ON YIELD AND ITS STRUCTURE (AVERAGE 2016-2017)

Planting material - bulb (B)	Fertilizing (A)	Total yield, t/ha	Commercial yield, t/ha	Quantity of commercial bulbs in seedbed, pcs.	Weight of commercial bulb, g
Whole (k)	Water (k)	25.5	23.4	3.9	37.1
	Zdraven	31.4	29.1	4.0	44.5
	Krepysh	27.6	25.0	3.8	40.4
	Rastvorin	32.9	30.5	4.0	45.9
Half	Water (k)	15.8	14.0	2.1	44.2
	Zdraven	16.4	14.0	2.1	44.4
	Krepysh	17.2	14.6	2.1	44.3
	Rastvorin	18.7	16.2	2.1	51.5
LSD ₀₅ of particular differences A		2.4	2.4	0.3	3.8
LSD ₀₅ of particular differences B		3.3	3.6	0.3	6.1
LSD ₀₅ of main effects A		1.6	1.7	0.2	2.7
LSD ₀₅ of main effects B		1.6	1.8	0.2	3.0

Planting material had a significant impact on this indicator. Thus, planting a whole bulb (k) led to a significant increase in the total yield of onions in comparison with planting a half bulb by 12.4 t/ha, with LSD₀₅ of main effects by factor B=1.6 t/ha. All the studied compound fertilizers had a significant positive impact on the overall yield of shallots. The use of fertilizer "Rastvorin" contributed to a significant increase in this indicator by 5.1 t/ha, "Zdraven" by 3.2 t/ha and "Krepysh" by 1.7 t/ha with LSD₀₅ of main effects by factor A=1.6 t/ha. The highest yield - 32.9 t/ha was obtained when planting onions with a whole bulb and fertilizing with complex fertilizer "Rastvorin", the difference with the control variant was 7.4 t/ha with LSD₀₅ of particular differences by factor A = 2.4 t/ha.

Analysis of the commercial yield of shallots showed the same trends. On average, when planting half a bulb, there was a significant decrease in yield by 12.3 t/ha with LSD₀₅ of main effects by factor B=1.8 t/ha. Fertilizing with complex fertilizers "Zdraven" and "Rastvorin" led to a significant increase in commercial yield by 2.9 and 4.7 t/ha, respectively, with LSD₀₅ of main effects by factor A=1.7 t/ha. The highest commercial yield of 30.5 t/ha was obtained by planting shallots with a whole onion and with "Rastvorin" fertilizing. In comparison with the control, the increase was 7.1 t/ha with LSD₀₅ of particular differences by factor A=2.4 t/ha.

Selection of planting material had an impact on the quantity of commercial bulbs in the seedbed. The quantity of commercial bulbs in the shallot seedbed varied from 2.1 to 4.0 pcs. The use of onion halves when planting onions led to a significant decrease in the quantity of commercial bulbs in the seedbed compared to the control version by an average of 1.8 pcs with LSD₀₅ of main effects by factor B=0.2 pcs. Fertilizing with compound fertilizers did not have a significant impact on this indicator.

Both factors had an impact on the mass of the commercial shallot bulb. Planting with half of the bulb led to a significant increase in the mass of the commercial bulb by 4.1 g compared

to the control. Fertilizing of shallots with Rastvorin and Zdraven contributed to an increase in this indicator by 8.1 and 3.9 g, respectively, in comparison with the control at LSD₀₅ of main effects by factor A=2.7 g. The weight of the commercial bulb with the use of fertilizer "Krepysh" was at the level of control.

In 2016, when fertilizing shallots with complex fertilizers "Zdraven" and "Rastvorin" relative to water, a decrease in the dry matter content in the bulbs was noted by 1.9 and 2.1 %, respectively (control 18.2 %) at LSD₀₅=1.0 % (Table 2).

TABLE II. EFFECT OF FERTILIZING WITH COMPLEX FERTILIZERS ON THE QUALITY INDICATORS OF SHALLOTS FOR PLANTING MATERIAL (WHOLE ONION) (2016)

Options	Dry matter, %	Vitamin C, mg/100 g	Water soluble sugars, %	Nitrates, mg/kg
Water (k)	18.2	5.6	16.5	85
Zdraven	16.3	5.7	15.8	70
Rastvorin	16.1	6.3	15.1	69
Krepysh	18.1	6.8	14.5	61
LSD ₀₅	1.0	F _T <F ₀₅	0.1	7

The same regularity was observed in the content of water-soluble sugars in shallots. The use of fertilizers "Rastvorin" and "Krepysh" led to a significant decrease in this indicator by 1.4 and 2.0 %.

Vitamin C in harvested bulbs accumulated in the range of 5.6-6.8 mg/100 and the difference in the variants was within the error of the experiment. Complex fertilizers "Zdraven", "Rastvorin", "Krepysh" in comparison with the control reduced the level of nitrate content in the products of shallots by 15, 16 and 24 mg/kg, respectively, at LSD₀₅ =7 mg/kg.

In 2017, the dry matter in the bulb contained within 12.4-14.4 %, the use of fertilizers had a negative impact on this indicator (Table 3).

TABLE III. EFFECT OF PLANTING MATERIAL AND FERTILIZING WITH COMPLEX MINERAL FERTILIZERS ON THE DRY MATTER CONTENT IN SHALLOT PRODUCTS (2017)

Fertilizers (A)	Planting material - bulb (B)				Dev. by factor B	Average by factor A	
	whole		half			%	dev.
	%	dev.	%	dev.			
Water (k)	13.6	-	14.4	-	0.8	14.0	-
Zdraven	12.4	-1.2	14.1	-0.3	1.7	13.3	-0.7
Krepysh	12.6	-1.0	14.2	-0.2	1.6	13.4	-0.6

TABLE IV. EFFECT OF PLANTING MATERIAL AND FERTILIZING WITH COMPLEX MINERAL FERTILIZERS ON VITAMIN C CONTENT IN SHALLOT PRODUCTS (2017)

Fertilizers (A)	Planting material - bulb (B)				Dev. by factor B	Average by factor A	
	whole		half			mg/100 g	dev.
	mg/100 g	dev.	mg/100 g	dev.			
Water (k)	5.1	-	6.2	-	1.1	5.7	-
Zdraven	5.2	0.1	6.9	0.7	1.7	6.1	0.4
Krepysh	5.2	0.1	5.8	-0.4	0.6	5.5	-0.2
Rastvorin	6.0	0.9	6.7	0.5	0.7	6.4	0.7
Average B	5.4	-	6.4	-	1.0	-	-
LSD ₀₅	<i>of particular differences</i>				<i>of main effects</i>		
	A		B		A	B	
	F _t <F ₀₅		0.6		F _t <F ₀₅	0.3	

A significant increase in the content of water-soluble sugars in shallot products was noted when planting half an onion by 1.0 %, the studied fertilizers had a positive effect on this indicator, increasing it by 1.3–2.8 % with LSD₀₅ of main effects by factor A=0.7 % (Table 5).

TABLE V. EFFECT OF PLANTING MATERIAL AND FERTILIZING WITH COMPLEX MINERAL FERTILIZERS ON THE CONTENT OF WATER-SOLUBLE SUGARS IN SHAL-LOT PRODUCTS (2017)

Fertilizers (A)	Planting material - bulb (B)				Dev. by factor B	Average by factor A	
	whole		half			%	dev.
	%	dev.	%	dev.			
Water (k)	12.5	-	12.9	-	0.4	12.7	-
Zdraven	15.2	2.7	15.8	2.9	0.6	15.5	2.8
Krepysh	13.8	1.3	15.0	2.1	1.2	14.4	1.7
Rastvorin	13.1	0.6	14.9	2.0	1.8	14.0	1.3
Average B	13.7	-	14.7	-	1.0	-	-
LSD ₀₅	<i>of particular differences</i>				<i>of main effects</i>		
	A		B		A	B	
	1.0		2.1		0.7	1.0	

At average, less nitrates accumulated in the bulb when planting a whole bulb – 65 mg/kg. Complex fertilizers Zdraven, Krepysh, Rastvorin in comparison with water reduced the accumulation of nitrates in shallot products when planting a whole bulb by 19-29 mg/kg (control 83 mg/kg) with LSD₀₅ of particular differences by factor A=19 mg/kg (Table 6).

TABLE VI. EFFECT OF PLANTING MATERIAL AND FERTILIZING WITH COMPLEX MINERAL FERTILIZERS ON NITRATES CONTENT IN SHALLOT PRODUCTS (2017)

Fertilizers (A)	Planting material - bulb (B)				Dev. by factor B	Average by factor A	
	whole		half			mg/kg	dev.
	mg/kg	dev.	mg/kg	dev.			
Water (k)	83	-	66	-	-17	75	-
Zdraven	54	-29	60	-6	6	57	-18
Krepysh	64	-19	88	22	24	76	1
Rastvorin	60	-23	87	21	27	73	-2
Average B	65	-	75	19	10	-	-
LSD ₀₅	<i>of particular differences</i>				<i>of main effects</i>		
	A		B		A	B	
	19		10		14	5	

Rastvorin	13.4	-0.2	14.3	-0.1	0.9	13.9	-0.1
Average B	12.9	-	14.3	-	1.4	-	-
LSD ₀₅	<i>of particular differences</i>				<i>of main effects</i>		
	A		B		A	B	
	0.4		0.8		0.3	0.4	

When planting half of the bulb, there was a significant increase in the content of vitamin C in the turnip by 1.0 mg/100 g. Fertilizers had no significant impact on this indicator (Table 4).

V. CONCLUSION

Studies performed have confirmed that shallots are a promising crop for growing in the Udmurt Republic. When growing it, both whole bulbs and bulbs cut in half can be used as a planting material. The total yield when planting with a whole bulb averaged 29.4 t/ha, half bulbs - 17.0 t/ha. All the studied compound fertilizers had a significant positive impact on the overall yield of shallots. The highest yield of 32.9 t/ha was obtained by planting shallots with a whole onion and with fertilizing with the complex solution "Rastvorin".

When planting shallots with a whole bulb yield of commercial products was 91.8 %, half bulbs - 86 %. Fertilizing with Rastvorin and Zdraven led to an increase in the yield of commercial bulbs to an average of 90.7 and 90.4 %, respectively.

The use of half a bulb during planting contributed to an increase in the mass of commercial bulb to 46.1 g, which is 4.1 g more than planting with a whole bulb. Complex fertilizers had a positive impact on this indicator. Thus, feeding shallots with Rastvorin and Zdraven led to an increase in the mass of commercial bulbs to 48.7 g and 44.5 g.

The studied factors had not an unambiguous impact on the quality indicators of shallot products. Content of vitamin C in bulbs varied by year and has been changing within the limit from 5.6 to 6.9 mg/100 g. The use of complex fertilizers had a positive impact on the quality of shallot products, there was a decrease in nitrate content by 19-29 mg/kg.

Result of studies have scientific and practical significance.

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