УРОЖАЙНОСТЬ И КАЧЕСТВО КОРНЕПЛОДОВ ПРИ ПРИМЕНЕНИИ ОРГАНИЧЕСКОЙ ТЕХНОЛОГИИ

YIELD AND QUALITY OF ROOT CROPS USING ORGANIC TECHNOLOGY

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Аннотация

В статье приведены сведения об урожайности и товарных качествах столовой моркови и свеклы при возделывании по органической технологии в условиях Кемеровской области. Выявлено, что лучшим предшественником для возделывания корнеплодов является картофель. Высокую урожайность и товарные качества корнеплодов по изучаемому предшественнику сформировал сорт моркови Шантанэ 2461, получена урожайность 35,1 т/га, товарность и средняя масса корнеплодов – 73,2% и 187,2 г, соответственно. Также высокую урожайность и стандартные по форме и размеру корнеплоды сформировала свёкла Боро F1 и Детройт, имеющие урожайность от 31,4 до 34,3 т/га, товарность получена на уровне 77,4% и 83,1%, и средняя масса корнеплодов 218 и 245 г.

Abstract

This article provides information on the yield and commercial qualities of garden carrots and beets when grown using organic technology in the Kemerovo region. It was revealed that the best foregoing crops for the cultivation of root crops are potatoes. The high yield and commercial qualities of root crops according

to the studied precursor were formed by the carrot variety Shantane 2461, the yield was 35.1 t/ha, the marketability and average weight of root crops were 73.2% and 187.2 g, respectively. In addition, beets Boro F1 and Detroit, with a yield of 31.4 t/ha to 34.3 t/ha, formed a high yield and standard in shape and size root crops, marketability was obtained at the level of 77.4% and 83.1%, and the average weight of root crops was 218 g and 245 g.

Ключевые слова: предшественник, морковь столовая, свёкла столовая, урожайность, товарные качества, масса корнеплода.

Keywords: foregoing crop, garden carrot, garden beet, yield, commercial qualities, root crop weight.

Introduction

One of the primary conditions for stabilising the country's agro-industrial complex is to increase the efficiency of agricultural production. From the biological point of view, crop rotation contributes to the balance in the environment, has a beneficial effect on the phytosanitary state of the field, biological activity of the soil [1].

Biological crop rotations help to increase soil fertility and productivity of vegetable crops. Such crop rotations have a positive impact on the phytosanitary state of the fields, pest prevalence is reduced by 10-17%, pesticide load on plants and soil is reduced, environmentally friendly vegetable production is ensured, and vegetable yields are increased by 5-11% [2].

Carrots are a self-tolerant crop, which rules out their repeated cultivation on the same plot. Carrots are placed so that they are cultivated not earlier than the 2-3rd year after the application of fresh organic fertilizer [3]. The study of the effect of different predecessors on the yield of sown carrots on extensive (no fertilizers) background nutrition showed an increase in weight of carrots on green manure, it was 120 g for the precursor potato 102 g and clean steam 98.4 g. The yield of carrots placed on green manure was obtained at 1.8 t/ha, which is 0.5 t/ha higher than that of pure fallow [4].

When cultivating garden beet in an organic crop rotation, the characteristics of the crop should be taken into account. Table beetroot makes good use of the effects of organic fertilisers applied under the predecessor, so it is recommended to place its crops in the second and third fields of the rotation. On poorly cultivated soils, small doses of organic matter, not exceeding 40 t/ha, are allowed. Compared to other root crops, beetroot can form yields at high concentrations of nutrients [5].

In recent years, the sown area under carrots in the Kemerovo region farms is 653 ha, the average yield is 27.4 t/ha, under garden beet is about 400 ha, the average yield is at 26.3 t/ha. Studying the response of root crops to the choice of foregoing crop in the application of organic technology is an urgent task.

Goal , objects and methodology of the research

The goal of the research was to study the effect of different precursors when using organic technology on the yield and quality of carrots and table beetroot in the forest-steppe zone of the Kemerovo region.

The research objectives were to:

- to identify the optimal predecessor;

- to establish the effect of predecessors on the quality of root crops.

To solve the tasks in 2020, the experiment was laid on the fields of the farm "Bashmakov S.A." in Prokopyevskiy district. The soil of the plot is moderately humusy medium-loamy leached podzolic chernozem with the content of humus in the arable layer - 6.7%, exchangeable potassium 130 mg / kg, mobile phosphorus 147 mg / kg soil, pH - 6.2.

The experiment was set in four replications on two predecessors - potatoes and spring wheat, the area of the plot is 24 m^2, the accounting - 21 m^2. Carrots were sown on 3 May and beetroot on 15 May. Carrot and beet seeds were sown at the depth of 1-2 cm, and beet seeds were sown at the depth of 3-4 cm. The objects of the study were carrot varieties Shantane 2461 (standard) and Samson, table beet variety Detroit (standard) and hybrid Boro F1.

Land treatment was common in the area: after potatoes, ploughing to a depth of 23-25 cm was carried out in autumn. In spring - early-spring harrowing and pre-sowing cultivation before sowing of beets. After spring wheat in autumn, cultivation to a depth of 10-12 cm was carried out. In spring, early spring harrowing and pre-sowing cultivation before sowing of beets. In 2018, 35 t/ha of organic fertiliser was applied to the potatoes in autumn. Plant care included pre-planting and two post-row loosening and weeding.

Root crops were recorded separately by replications and sorted into marketable and non-marketable root crops. Marketable root crops were weighed for each variety and the average weight of one root crop was calculated [6]. Dry matter content was determined in roots according to GOST 31640-2012, mass fraction of raw ash according to GOST 26226-95, mass fraction of carotene according to GOST 8756.22-80, saccharinity according to GOST ISO 2173-2013. Mathematical processing of the research results was carried out by the method of analysis of variance [7].

Meteorological conditions in the year of the study were close to the mean annual values, there was a slight excess of moisture in July and the first half of August, precipitation was higher than normal by 15% and 30%, respectively (Fig. 1). Temperature was above the norm by 3.70°C in May and by 2.50°C in August, while the rest of the months were close to the long-term averages.

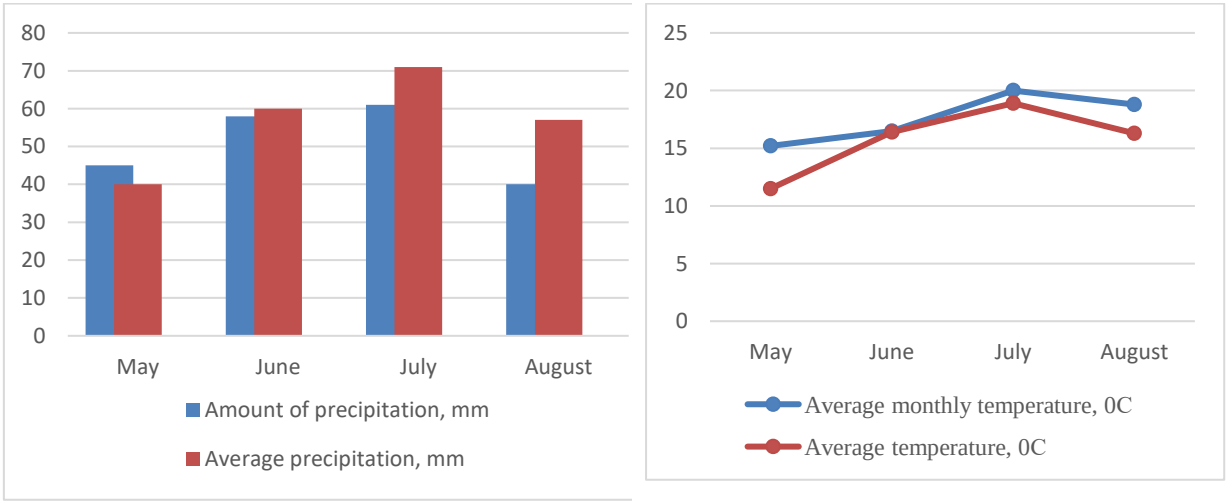

Figure 1 – Meteorological conditions of the growing season, 2020.

In general, moisture conditions during the growing season of 2020 were favourable for the growth and development of root crops, with a GTC of 1.2.

Results and discussions

In the crop rotation, crop productivity reflects the effectiveness of predecessors as a means of providing plants with the basic factors of life [8]. Our research has shown that the best precursor for root crops is potato (Table 1).

Root yield of carrots in the variety Shantane 2461 ranged from 14.3 t / ha (the precursor - spring wheat) to 35.1 t / ha (the precursor - potato). In the variety Samson yield ranged from 20.0 t/ha (the precursor - spring wheat) to 32.4 t/ha (the precursor - potato).

Table 1 - Yield and marketable quality of carrots

Variety	Yield, t/ha		Output of marketable products, %	Average root mass, g	Non-marketable root crops, %				
	general	commercial			small	epinastic	branched	cracked	pest damage
Foregoing crop - potato									
Shantane 2461	35,1	25,7	73,2	187,2	7,5	7,7	3,9	3,7	3,9
Samson	32,4	17,6	54,3	154,5	7,0	10,1	5,5	7,5	15,7
Foregoing crop – spring wheat									
Shantane 2461	14,3	10,0	69,9	117,5	14,5	7,0	4,5	2,0	2,0
Samson	20,0	17,1	85,5	122,8	1,7	2,3	6,5	1,7	2,3
HCP_{05}	1,27								

The root mass of the carrots (117-187 g) was optimal for sale in the trade network. The marketability of the carrot varieties ranged from 54.3 to 85.5%. The yield of marketable root crops was higher in the variety Samson by grain predecessor. The lower yield of marketable root crops was in the variety Shantane 2461 - 69.9% and in the variety Samson - 54.3% by grain predecessor, with the main part of the unmarketable fraction in Shantane 2461 were small root crops, and in the variety Samson - damaged by pests and crooked.

The yield and marketable qualities of the beet varieties are shown in Table 2. In our research beetroot yields were also the highest for the potato predecessor 34.3 t/ha (Detroit) and 31.4 t/ha (Boro F1). Placing the beets on a cereal precursor resulted in low yields of 17.3 t/ha (Detroit) and 11.1 t/ha (Boro F1).

Table 2 - Yield and marketability of garden beet

Variety	Yield, t/ha		Output of marketable products, %	Average root mass, g	Non-marketable root crops, %				
	general	commercial			small	epinastic	branched	cracked	pest damage
Foregoing crop - potato									
Detroit	34,3	28,5	83,1	245,3	2,5	-	2,5	6,5	5,4
Boro F1	31,4	24,3	77,4	218,5	5,9	-	-	10,2	6,5
Foregoing crop – spring wheat									
Detroit	17,3	12,1	70,0	124,4	18,2	-	8,5	3,3	-
Boro F1	11,1	7,1	64,0	108,2	23,8	-	-	12,2	-

HCP_{05} 1,17

In the varieties we studied, the marketability was 64.0 to 83.1 %. The Detroit variety had a high yield of marketable yield (83.1 %) for potato, while the Boro F1 hybrid had a marketable yield of 77.4 %. The marketable yield of the beetroot was lower for the cereal precursor - 70% (Detroit) and 64.0% (Boro F1).

In the yield of hybrid Boro F1 (cereal precursor) the highest percentage of unmarketable root crops were small (23.8%) and cracked (12.2%); in the variety Detroit small (18.2%), branched (8.5%) and cracked (3.3%); The Detroit variety (predecessor of potatoes) had no curved roots, and the branched and small ones were the least (2.5% each), cracked (6.5%), damaged (5.4%), thus providing the highest marketability.

Thus, the table beet, cultivated on the predecessor of potatoes in the forest-steppe conditions of the Kemerovo region, formed a fairly high yield and standard in shape and size of root crops. According to the results of 2020 can be recommended for growing hybrid Boro F1 and variety Detroit as productive, with a yield of 77.4 - 83.1 % and the average mass of the root crop of 218 - 245 g.

The quality of carrots is of great importance when growing carrots. Dry matter content is one of the main indicators of technological properties of vegetables [9].

According to the results of biochemical studies of carrots (Table 3), the highest accumulation of dry matter was noted for the precursor potato in the variety Shantane 2461 - 16.6% and in the variety Samson - 15.4%.

Table 3 - Root quality of carrots

Foregoing crop	Sugar content, %	Mass fraction of dry matter , %	Mass fraction of raw ash, %	Mass fraction of carotene, mg/100 g
Shantane 2461				
Potato	11,86	16,66	5,24	3,16
Spring wheat	12,26	15,14	6,00	4,49
Samson				

Potato	12,36	15,44	7,29	2,12
Spring wheat	14,96	14,23	7,03	2,64

The indicator of sugar content by forecrop in carrot root crops ranged from 11.86 to 14.96%, there was a positive trend in the accumulation of sugar when growing carrots of the variety Samson on the forecrop spring wheat. The most valuable component of the chemical composition of carrots are carotenoids. Carotene pigment is a precursor (provitamin) of vitamin A. In animals and humans carotene is converted into vitamin A [9]. For the content of carotene the best indicators were observed in the variety Shantane 2461 4.49 mg/100 g for the grain precursor.

The dry matter content of table beet roots directly correlates with storability: the higher the percentage of dry matter, the higher the degree of preservation of the roots [10]. The results showed that the table beet precursors had no significant effect on the dry matter content of the root crops (Table 4).

Table 4 - Quality of table beet roots

Foregoing crop	Sugar content, %	Mass fraction of dry matter , %	Mass fraction of carotene, mg/100 g
Detroit			
Potato	10,36	14,87	9,25
Spring wheat	13,26	15,82	7,07
Boro F1			
Potato	11,86	15,56	10,24
Spring wheat	10,76	15,71	9,57

A slight increase in dry matter was observed when beets of the variety Detroit were placed on spring wheat - 15.8%. Sugars content varied from 10.3% in the Detroit variety (potato precursor) to 13.2% in the Boro F1 hybrid (spring wheat precursor). The Boro F1 hybrid showed the highest raw ash content of 10.2% for the potato precursor.

Conclusion

According to the results of 2020 in the application of organic technology in the forest-steppe zone of Kemerovo region revealed that the best predecessor for the cultivation of root crops is potatoes. The highest yield and marketable qualities of root crops on the studied predecessor formed the carrot variety Shantane 2461 yield was 35.1 t / ha, marketability and the average mass of root crops - 73.2% 187.2 g, respectively. Also high yield and standard in shape and size of root crops were formed by Boro F1 and Detroit beets with the yield of 31.4 - 34.3 t/ha, marketability - 77.4 - 83.1 % and average weight of root crops from 218 to 245 g.

The highest sugar content of root crops was recorded for the precursor spring wheat in the carrot variety Samson - 14.96%, in the beet variety Detroit - 13.26%. In terms of carotene content, the best indicators were observed in the variety Shantane 2461 - 4.49 mg/100 g for the grain predecessor.

Conflict of Interest

None declared

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