Evaluation of selected quality traits of storage roots of ten beet cultivars

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Summary

In 2004–2006 an experiment was carried out to evaluate selected quality traits of yield of ten cultivars of beetroot with storage roots of different shapes (flattened, round and elongated). At the end of the vegetation season Rocket cultivar (of elongated root) was characterized by the longest root of the smallest diameter. Whereas, Egipski cultivar was characterized by the shortest root, but of the greatest diameter. Rocket cultivar was also characterized by the highest percentage of storage roots weight in the whole plants weight (83.1%). Content of macroelements was significantly dependent on evaluated cultivars (except Ca and Mg in 2005, when differences between cultivars were not significant).

Key words: beetroot, quality of yield

INTRODUCTION

Beetroot (*Beta vulgaris* L.) has been cultivated in Poland since the sixteenth century. It belongs to the species of great economic importance. Simple cultivation, unfailing yielding, availability all the year round, high nutritive value and tradition of beetroot consumption affect its popularity [4]. Its medicinal properties are also known. Beetroot whets the appetite, affects profitably digestion, deacidifies human organism [2, 3].

According to Michalik et al. [7] also the cultivar selection, apart from the term of cultivation, affects the quality of roots. It is one of the most important factors affecting yielding and chemical composition of edible part of beetroot. Beetroot cultivars differ in the length of vegetation season and in shape and color of roots.

Cultivars of cylindrical roots which can be sliced are especially valuable [12]. Improvement of roots quality and increase of roots fertility are the most important in cultivation research to cope with the increasing needs of the market [8].

The aim of conducted experiment was to evaluate selected quality traits of the yield of ten cultivars of beetroot of different shape of storage root.

MATERIALS AND METHODS

In 2004–2006 in the Agricultural University in Szczecin a field experiment was carried out. The one-factorial experiment was conducted in the randomized blocks design, in four repetitions. Ten beetroot cultivars were used in the experiment:

1. of flattened roots – Egipski, Patryk,
2. of round or oval roots – Bikores, Chrobry, Crosby, Czerwona Kula, Nochowski and Pablo F1,
3. of elongated roots – Opolski and Rocket.

The area of every experimental plot was 2.4 m^2 (2.0 x 1.2 m).

Before seeds sowing the field was prepared according to the principles of agricultural technology. On the basis of conducted soil analysis and actual abundance in nutritive components a mineral fertilization was carried out [10]. Seeds of evaluated cultivars of beetroot were sown on 15 May (in 2004) and on 18 and 19 May (in 2005 and 2006, respectively) in rows every 30 cm, using seed rate 16.0 $kg \cdot ha^{-1}$.

From 15 June to 15 September, in 30-day intervals increase of roots length and width was evaluated.

During the vegetation season cultivation of the soil and plants watering were carried out. After plants germination the thinning was conducted and plants were cultivated every 6 cm in the row.

Storage roots were harvested once, in the last decade of September. Plant height, number of leaves, average weight of roots and leaves were evaluated. In 2005 and 2006 content of dry matter (by the method of drying to the stable weight in 100°C) and content of macroelements – nitrogen (according to the method recommended by Kjeldahl), phosphorus (according to the colorimetric method), potassium and calcium (according to the flame photometry method) and magnesium (according to the flame method of atomic spectrophotometry absorption, ASA) were estimated in harvested storage roots. Obtained results of experiment were verified statistically using Tukey's test at the significance level $\alpha=0.05$.

RESULTS AND DISCUSSION

Results regarding increase of storage roots weight of ten cultivars of beetroot in the time from germination to the harvest were given in table 1. On the basis of average results of the measurements conducted on 15 July it was found that Bikores, Chrobry, Rocket and Opolski cultivars were characterized by longer roots than the other evaluated cultivars, whereas Bikores and Chrobry cultivars were characterized by the greatest roots diameter. At the end of the vegetation season root length was dependent on cultivar and ranged from 4.0 cm (Egipski cultivar) to 13.0 cm (Rocket cultivar). Rocket cultivar was also characterized by the smallest and Egipski cultivar – by the greatest diameter of storage root.

Table 1.

Dynamics of increase of root length and its diameter during the vegetative period of tested beet cultivars (mean for 2004–2006)

measurement date	cultivar									
	Bikores	Chrobry	Crosby	Czerwona Kula	Egipski	Nochowski	Opolski	Pablo F_1	Patryk	Rocket
	root length [cm]									
15.06	2.1	2.0	1.7	1.5	1.3	1.1	1.9	1.8	1.3	2.0
15.07	3.8	3.9	3.4	4.6	2.7	3.7	3.7	3.4	3.2	3.9
15.08	4.4	4.8	4.2	5.1	3.2	4.8	8.6	5.9	6.6	8.1
15.09	5.7	8.2	8.0	5.4	4.0	6.5	12.8	7.6	7.9	13.0
	root diameter [cm]									
15.06	1.7	1.7	1.6	1.5	1.4	1.1	1.2	1.4	1.4	1.1
15.07	4.2	4.0	3.6	4.4	5.2	4.1	3.8	4.2	3.6	3.9
15.08	5.0	5.7	5.4	5.3	6.6	5.7	4.6	5.8	6.8	4.3
15.09	6.0	7.1	7.0	6.1	8.7	6.1	5.0	6.4	7.4	4.8

Significant differences between evaluated cultivars in plant height and number of leaves were found (tab. 2), what was conformable to results obtained by Krężel [8]. Czerwona Kula, Chrobry and Egipski cultivars were significantly higher than Opolski, Crosby, Pablo F_1, Bikores, Nochowski and Rocket cultivars. Chrobry and Nochowski cultivars were characterized by significantly greater number of leaves. During the harvest the percentage of roots weight in the whole plants weight ranged from 64.6% (Chrobry) to 83.1% (Rocket). Irrespectively of evaluated cultivars the percentage of roots weight in the whole plants weight amounted to 68.9% and the percentage of leaves weight in the whole plants weight amounted to 31.1% (on average). Also Rekowska and Słodkowski [9] obtained similar results in the experiments conducted in the years 2000–2001. Depending on cultivar, the percentage of roots weight in the whole plants weight amounted to 74.9% and the percentage of leaves weight in the whole plants weight amounted to 25.1% (on average).

Table 2.

Evaluation of selected biometic treits of plants of ten cultivars of beet (during the harvest, mean for 2004–2006)

cultivar	height of plants [cm]	number of leaves	percentage of root and leaf mass in whole biomass	
			roots	leaves
Bikores	45.8	10.8	65.9	34.1
Chrobry	52.3	15.6	64.6	35.4
Crosby	48.2	12.5	66.5	33.5
Czerwona Kula	53.1	12.8	65.6	34.4
Egipski	52.2	11.9	65.7	34.3
Nochowski	45.2	14.3	66.0	34.0
Opolski	48.8	13.2	64.8	35.2
Pablo F_1	46.1	9.5	76.8	23.2
Patryk	49.8	10.6	70.0	30.0
Rocket	44.5	9.9	83.1	16.9
LSD at α=0.05	2.85	2.52	-	-

Results regarding content of dry matter and macroelements in the roots of evaluated cultivars of beetroot were given in table 3. In 2005 significantly higher content of dry matter in the roots of Rocket cultivar was estimated in comparison with Patryk, Nochowski, Egipski, Chrobry and Czerwona Kula cultivars. Whereas, in 2006 Opolski, Egipski, Rocket and Czerwona Kula cultivars were characterized by high content of dry matter in the roots.

Table 3.

Evaluation of content of dry matter and macroelements in roots of selected cultivars of beet (in % of dry matter)

cultivar	dry matter (%)		N		P		K		Ca		Mg	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Bikores	10.7	10.3	0.63	1.71	0.22	0.20	1.77	2.23	0.22	0.36	0.11	0.19
Chrobry	11.8	9.4	0.91	1.10	0.20	0.18	1.93	2.20	0.10	0.20	0.13	0.10
Crosby	13.0	10.6	0.88	1.30	0.29	0.23	1.90	2.41	0.13	0.11	0.10	0.09
Czerwona Kula	14.2	9.1	0.69	1.23	0.20	0.30	1.75	1.85	0.10	0.14	0.09	0.12
Egipski	14.6	9.4	0.90	0.96	0.35	0.23	1.92	1.80	0.24	0.17	0.10	0.08
Nochowski	12.2	9.9	1.11	1.24	0.30	0.36	2.01	1.94	0.20	0.13	0.13	0.11
Opolski	14.9	10.9	0.83	0.96	0.28	0.20	2.08	2.30	0.13	0.20	0.10	0.08
Pablo F_1	11.7	10.3	1.14	1.18	0.20	0.27	2.35	2.58	0.17	0.28	0.15	0.09
Patryk	13.3	10.2	0.85	1.20	0.13	0.20	2.20	2.10	0.24	0.17	0.21	0.09
Rocket	14.4	11.8	0.97	1.21	0.33	0.24	2.26	3.01	0.12	0.20	0.11	0.07
LSD at α=0.05	1.29	1.58	0.211	0.165	0.107	0.135	0.520	0.443	n.s.	0.171	n.s.	0.074

Also Drabowicz [1] and Krężel [5] are of the opinion that roots of evaluated cultivars of beetroot cultivated for autumn harvest differ significantly in dry matter content.

Content of selected mineral components in the roots of beetroot in 2005–2006 amounted to (on the average): N – 0.89 and 1.21%, P – 0.25 and 0.24%, K – 2.02 and 2.24%, Ca – 0.17 and 0.20%, Mg – 0.12 and 0.10%, respectively. Krężel and Kołota [6] assessed higher content of P, K, Ca and Mg (0.31%; 3.45%; 0.24%; 0.20% air dry matter, respectively) in the roots of beetroot harvested in the middle of July. According to Shannon [11] at the beginning of vegetation season young leaves of beetroot contain much more mineral components than roots.

On the basis of the results of own experiment it was found that content of macroelements was significantly dependent on evaluated cultivars (except Ca and Mg in 2005, when differences between cultivars were not significant).

In 2005 significantly more N was estimated in the roots of Pablo F_1 cultivar in comparison with Crosby, Patryk, Opolski, Czerwona Kula and Bikores cultivars and more K in comparison with Crosby, Bikores and Czerwona Kula cultivars. Significantly more N, Mg and Ca was estimated in the roots of Bikores cultivar (in the year 2006) in comparison with Czerwona Kula, Nochowski and Crosby cultivars.

In 2005 significantly more P was estimated in the roots of Egipski and Rocket cultivars in comparison with Bikores, Chrobry, Czerwona Kula, Pablo F_1 and Patryk cultivars, whereas in 2006 Nochowski cultivar contained more K than Bikores, Patryk, Opolski and Chrobry cultivars.

CONCLUSIONS

1. At the end of the vegetation season Rocket cultivar was characterized by the longest storage roots, of the smallest diameter. Whereas, Egipski cultivar was characterized by the shortest roots, but of the greatest diameter.
2. Rocket cultivar was characterized by the highest percentage of roots weight in the whole plants weight (83.1%).
3. Significant differences in content of dry matter and N, P, K, Ca and Mg in the storage roots of evaluated cultivars of beetroot were found.
4. Content of macroelements in roots of beetroot amounted to (on the average): N – 1.05%, P – 0.25%, K – 2.13%, Ca – 0.19%, Mg – 0.11%.

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OCENA WYBRANYCH CECH JAKOŚCIOWYCH KORZENI SPICHRZOWYCH DZISIĘCIU ODMIAN BURAKA ĆWIKŁOWEGO

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Streszczecie

Burak ćwikłowy (*Beta vulgaris* L.) jest uprawiany w Polsce od XVI wieku. Należy do gatunków o dużym znaczeniu gospodarczym. O jego popularności decyduje łatwość uprawy, niezawodność w plonowaniu, dobre przechowywanie, dostępność w stanie świeżym przez cały rok, duże tradycje spożycia oraz wysoka wartość odżywcza. Znane są jego właściwości lecznicze. Pobudza apetyt, jest odświeżający i łatwo strawny, działa odkwaszająco na nasz organizm.
Jednym z ważniejszych czynników wpływających na plonowanie oraz skład chemiczny części jadalnej jest dobór odpowiedniej odmiany. Różnią się one między sobą długością okresu wegetacji oraz kształtem i intensywnością zabarwienia korzeni spichrzowych. Na rynku bardziej cenione są odmiany o kształcie kulistym i intensywnym zabarwieniu, bez wyraźnych pierścieni. Natomiast dla przemysłu cenne są również odmiany o korzeniach cylindrycznych, przydatne do krojenia w plastry. Celem pracy była ocena ważniejszych cech jakościowych plonu dziesięciu odmian buraka o różnych kształtach korzenia spichrzowego (spłaszczonym, kulistym lub owalnym i wydłużonym). Doświadczenie przeprowadzono w latach 2004–2006 w Akademii Rolniczej w Szczecinie. Nasiona ocenianych odmian wysiewano w połowie maja, a korzenie zbierano w ostatniej dekadzie września. Na początku okresu tworzenia się korzeni spichrzowych stwierdzono większą ich długość u roślin odmiany 'Bikores', 'Chrobry' i 'Rocket'. U odmiany 'Bikores' i 'Chrobry' zanotowano również

największą średnicę w porównaniu z pozostałymi odmianami. Pod koniec okresu wegetacji (15 września) długość korzeni, w zależności od badanych odmian, wahała się od 13,0 cm (u odmiany 'Rocket') do 4,0 cm (u odmiany 'Egipski'). Odmiana 'Rocket' charakteryzowała się jednocześnie najmniejszą średnicą, zaś odmiana 'Egipski' – największą średnicą korzeni spichrzowych. W czasie zbiorów wykazano również zróżnicowanie ocenianych odmian w odniesieniu do liczby liści oraz stosunku masy korzeni do masy liści. Największy udział korzeni w stosunku do masy liści stwierdzono u odmiany 'Rocket' (średnio 73,1%), najmniejszy u odmiany 'Nochowski' (46,0%). U ocenianych odmian wykazano również istotne różnice dotyczące zawartości suchej masy oraz zawartości w korzeniach spichrzowych azotu ogólnego i potasu.

Słowa kluczowe: *burak ćwikłowy, jakość plonu*