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YIELD AND CHANGES IN THE FRUIT QUALITY OF CHERRY TOMATO GROWN ON THE COCOFIBRE AND ROCKWOOL SLABS USED FOR THE SECOND TIME

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Abstract. Greenhouse cultivation of four cultivars of cherry tomato (Goldita, Faworita, Flavorino, Organza) on the substrates used for the second time (cocofibre and rockwool) did not show any differences in their yielding. Fruits obtained from cultivation on the cocofibre contained less dry matter and vitamin C. During the vegetation period some changes in fruit quality were observed. In the first weeks of fruiting more organic acids and less of vitamin C were observed in fruits. At the time of full fruiting (II period) the content of vitamin C was at its highest and at the same time the content of organic acids and dry matter at the lowest. At the end of vegetation (III period) fruits contained more dry matter and total sugars). Cultivars significantly differed in respect to yielding and fruit quality. The highest content of the investigated components was characteristic for Faworita and Goldita cultivars and the lowest for Organza. However, that cultivar produced the highest total and marketable yield.

Key words: cherry tomato, yield, fruit quality, growing media

INTRODUCTION

Common use of mineral substrates and in particular rockwool slabs in greenhouse cultivation leads to the increase of environmental pollution due to the accumulation of significant amounts of wastes which are not biodegradable [Michajłojć and Nurzyński 1998, Rumpel 1998]. One of the alternative substrate is the biodegradable cocofibre.

The possibility of repeated using the substrate in the greenhouse cultivation not only reduces the cost of production but also, as it is underlined by Piróg [1998], in the case of rockwool significantly reduces the amounts of wastes dangerous for the environment. The investigations by Benoit and Ceustermans [1998] as well as Piróg and Gembiak

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[2001] showed that both rockwool and cocofibre are substrates useful for the repeated cultivation of tomato.

Cultivars of cherry tomato of different colour, size and fruit shape not only add the variety to the offered greenhouse production but also may be the response to the consumer growing interest in fruit quality. They are characterized by a significantly higher content of nutritional compounds than traditional tomatoes of large size of fruits [Halmann and Kobryń 2003, Helyes et al. 2006]. That content is not a constant trait but according to Toor et al. [2006] changes during the vegetation period.

The aim of the present investigation was the determination of the yield size and changes in fruit quality during vegetation of plants cultivated on cocofiber and rockwool used for the second time as a growing media.

MATERIAL AND METHODS

The investigations were carried out in the years 2006–2007 in the experimental greenhouse of Warsaw University of Life Sciences – SGGW in Warsaw. Four tomato cultivars with various weight, shape and fruit colour were used in the experiment: Favorita (red fruits, round in shape, weight 13–17 g), Goldita (round fruits, yellow, weight 15–18 g), Flavorino (red, oval fruits, weight 25–35 g) and Organza (orange colour fruits, oval, weight 45–50 g). Rockwool mats Pagro (100 × 15 × 10 cm) and cocofibre mats Cocovita (100 × 15 × 1.5 cm) were used in the experiment. All the mats were used for the second time for the greenhouse tomato cultivation. Tomato plants were planted on their permanent places in mid-February at the density of 2.7 plants per m^2. The cultivation was carried out in the annual cycle until mid-December using the same nutrient solution of the following content in 1 dm^3: N – 170 mg, P – 70 mg, K – 360 mg, Mg – 60 mg, Ca – 200 mg, Fe – 1.8 mg, Mn – 0.55 mg, B – 0.33 mg, Cu – 0.05 mg, Zn – 0.38 mg and Mo – 0.05 mg. The solution was prepared on the bases of water from our own source with pH 7.1 and EC 0.6, while the pH of the nutrient solution was 5.6 and EC 2.4 $mS \cdot cm^{-1}$. The experiment was established using the method of independent variables in 3 replications of 8 plants each. Fruits were picked twice a week and fruits for analyses were picked at full consumption maturity three times during the vegetation period: I – at the beginning of fruiting (23.03.2006 and 04.06.2007), II – at full fruiting (21.08.2006 and 20.08.2007) and III – at the end of fruiting (06.10.2006 and 05.10.2007). The dry matter content, total sugars (Luff-Schoorl method), vitamin C (Tillmans method) and organic acids (expressed as citric acid equivalents – PN-90-A--75101/04) were determined in tomato fruits. Statistical analysis was done with the help of the Statgraphics 4.1 programme using the Tukey's test at the significance level of $\alpha = 0.05$.

RESULTS AND DISCUSSION

The difference in the total yield of cherry tomato fruits cultivated on the rockwool and cocofibre used for the second time is not significant. Despite that, higher crops, by about 1 kg, were obtained from the cultivation on the rockwool. Commercial yield of

tomato fruits cultivated on that substrate was similarly shaped (tab. 1). It is worth mentioning that average yields of the investigated tomato cultivars cultivated on the fresh substrates of that type also did not differ significantly, however the difference in yields obtained from the cultivation on the cocofibre and rockwool was much smaller [Kobryń et al. 2007].

Table 1. Total and marketable yields of fruit of different cherry tomato cultivars grown for the second time on the same cocofibre and rockwool slabs

Tabela 1. Plon ogólny i handlowy owoców różnych odmian pomidora drobnoowocowego w uprawie na włóknie kokosowym i wełnie mineralnej w drugim roku ich użytkowania

Yield Plon	Medium Podłoże	Cultivar – Odmiana				
		Favorita	Goldita	Flavorino	Organa	mean – średnia
Total yield Plon ogólny kg·m^{-2}	cocofibre włókno kokosowe	13.15	15.76	16.39	26.38	17.92 a
	rockwool wełna mineralna	13.99	16.31	17.51	27.65	18.87a
	mean – średnia	13.57 a*	16.04 b	16.95 b	27.02 c	
Marketable yield Plon handlowy kg·m^{-2}	cocofibre włókno kokosowe	12.18	12.49	16.00	24.78	16.36 a
	rockwool wełna mineralna	12.99	13.32	17.07	25.74	17.28 a
	mean – średnia	12.59 a	12.91 a	16.54 b	25.26 c	

* – Means followed by the same letter do not differ significantly at $\alpha = 0.05$
Średnie oznaczone tą samą literą nie różnią się istotnie przy $\alpha = 0,05$

The share of commercial yield was high amounting to over 90% of the total yield. Obtaining a little lower yields from cultivation on the organic substrate could be caused by its decomposition and sinking thus resulting in worsening its physical traits and air-water conditions in the root system [Islam et al. 2002, Golcz et al. 2006].

Out of the investigated cultivars, significantly higher total and commercial yields were noted in the case of Organza cultivar (tab. 1) which was characterized by the highest fruit weight. Out of cultivars with similar fruit weight Goldita cv. produced significantly higher yield than Favorita cv. but due to the higher per cent share of cracked fruits, the commercial yield in this cultivar did not much differ from the yield produced by Favorita cv. However, cultivars differed in the number of the investigated fruitlets (tab. 2). The highest average dry matter content was noted in Favorita cultivar, then Goldita, Flavorino and the lowest in Organza cv. The differences were statistically significant. Fruits of Favorita cv. contained the highest amounts of sugars – over 4%, and fruits of Organza cv. the least – 2.41%. Out of the investigated cultivars the highest amount of organic acids in fruits were observed in Goldita cv. – 0.61%. Also various amounts of vitamin C were observed in fruits of the investigated cultivars. Significantly more of that compound was contained in fruits of Favorita and Goldita cultivars – over 29 mg in 100 g of fresh matter. Tomato fruits of Organza cultivars had significantly less of the investigated compounds than fruits of the remaining cultivars. Their content can be compared to the value determined in the standard type of fruits by Helyes et al. [2006].

Table 2. Fruit quality of different cherry tomato cultivars
Tabela 2. Jakość owoców różnych odmian pomidora drobnoowocowego

Specification Wyszczególnienie	Cultivar – Odmiana			
	Favorita	Goldita	Flavorino	Organa
Dry matter – Sucha masa, %	8.09 d	7.63 c	6.50 b	4.97 a
Total sugars – Cukry ogółem, %	4.36 c	3.35 b	3.07 b	2.41 a
Organic acids – Kwasy organiczne, %	0.50 c	0.61 d	0.42 b	0.36 a
Vitamin C – Witamina C mg·100g^{-1}	29.31 c	29.71 c	23.00 b	19.08 a

Explanations see table 1 – Oznaczenia jak w tabeli 1

The quality of cherry tomato fruits changed during the vegetation period of plants cultivated on substrates of cocofibre and rockwool used for the second time (tab. 3). At the beginning of fruiting the process of fruit ripening takes part in the lower parts of the plant where the light conditions are poorer and because of that the fruits contain significantly more acids and less of vitamin C. An intensive development of leaves at that time gives the effect of shading thus causing the decrease of the vitamin C content [Toor et al. 2006].

Table 3. Fruit quality changes during the vegetation period of cherry tomato grown for the second time on the same cocofibre and rockwool slabs
Tabela 3. Zmiany jakości owoców pomidora drobnoowocowego w okresie wegetacji uprawianego na włóknie kokosowym i wełnie mineralnej

Specification Wyszczególnienie	Growing medium Podłoże	Period – Termin			Mean Średnia
		I	II	III	
Dry matter Sucha masa, %	cocofibre – włók. kokosowe	6.78	6.04	7.08	6.63 a
	rockwool – wełna min.	7.11	6.27	7.51	6.96 b
	mean – średnia	6.94 b	6.16 a	7.30 c	
Total sugars Cukry ogółem, %	cocofibre – włók. kokosowe	3.23	3.12	3.49	3.28 a
	rockwool – wełna min.	3.11	3.15	3.68	3.31 b
	mean – średnia	3.17 a	3.14 a	3.58 b	
Organic acids Kwasy organiczne, %	cocofibre – włók. kokosowe	0.56	0.40	0.50	0.49 b
	rockwool – wełna min.	0.53	0.39	0.44	0.45 a
	mean – średnia	0.55 c	0.40 a	0.47 b	
Vitamin C Witamina C, mg·100 g^{-1}	cocofibre – włók. kokosowe	21.21	29.67	23.34	24.74 a
	rockwool – wełna min.	23.78	27.17	26.49	25.81 b
	mean – średnia	22.49 a	28.42 c	24.91 b	

Explanations see table 1 – Oznaczenia jak w tabeli 1

At the time of full fruiting significantly less dry matter and organic acids were noted in fruits. However, at that time they contained the highest amounts of vitamin C. The increase of that compound content is explained by Rosales et al [2007] by the fact that a higher temperature in summer and more intensive solar radiation may result in both the increase of oxygen content in fruits and their antioxidative activity. In the final period of yielding tomato fruits contained the biggest amounts of dry matter and total

sugars (tab. 3). Bigger amounts of the mentioned components in fruits may be connected with less intense competition for photoassimilative products after heading tomato plants with their lesser loading with fruits or according to Toor et al. [2006] a greater accessibility of light to ripening fruits in the upper parts of the plant.

In the cultivation on the cocofibre used for the second time a lesser content of dry matter and vitamin C and more organic acids were noted in fruits (tab. 3).

Fruit sugar content is connected with their sweet and tomato taste and their content of acids with sour taste [Gajc-Wolska et al. 2000, Harkier et al. 2002, Abegaz et al. 2004]. Thus, it may be said that tomato fruits picked at the beginning of fruiting were sourer, while at the end of fruiting they were characterized by more sweet and tomato taste. It was also noted that fruits originated from cultivation on the cocofibre were sourer than those obtained from the cultivation on the rockwool.

CONCLUSIONS

1. The type of substrate used for the second time did not affect significantly the yield of cherry tomato fruits.

2. Tomato cultivars within the type of cherry tomato fruits significantly differ both in the yield size and fruit quality.

3. Fruits from plants cultivated on the cocofibre used for the second time contained less dry matter and vitamin C and more organic acids.

4. At the yielding time, the quality of fruits changed. At the beginning of fruiting they had more organic acids and less of vitamin C. At the full of fruiting they contained the biggest amounts of vitamin C and at the end of fruiting they were characterized by the biggest amounts of dry matter and total sugars.

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WYSOKOŚĆ PLONU ORAZ ZMIANY W JAKOŚCI OWOCÓW POMIDORA DROBNOOWOCOWEGO W UPRAWIE NA POWTÓRNIE UŻYWANYM WŁÓKNIE KOKOSOWYM I WEŁNIE MINERALNEJ

Streszczenie. Uprawa szklarniowa czterech odmian pomidora drobnoowocowego (Goldita, Faworita, Flavorino, Organza) na podłożach użytkowanych powtórnie (włókno kokosowe i wełna mineralna) nie wykazała istotnych różnic w ich plonowaniu. Owoce pochodzące z uprawy roślin na podłożu kokosowym zawierały mniej suchej masy oraz witaminy C. W okresie wegetacji obserwowano zmiany w jakości owoców. W pierwszych tygodniach plonowania w owocach notowano więcej kwasów organicznych natomiast najmniej w nich witaminy C. W pełni owocowania (II termin) zawartość witaminy C była w nich największa, a jednocześnie najmniejsza zawartość kwasów organicznych oraz suchej masy. Pod koniec wegetacji (III termin) owoce posiadały więcej suchej masy i cukrów ogółem. Odmiany istotnie różniły się pod względem zarówno plonowania, jak i jakości owoców. Największą zawartością badanych składników odznaczały się owoce odmian Favorita i Goldita, najmniejszą zaś owoce odmiany Organza. Ta odmiana natomiast wydała największy plon ogólny i handlowy.

Słowa kluczowe: pomidor drobnoowocowy, plon, jakość owoców, rodzaj podłoża

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