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Production of strawberry (*Fragaria x Ananassa Duch.*) in the mother plantation in a sand substrate

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Abstract

In the fruit growing of humid and humid continental climate, strawberry represents an important fruit species in the group of berry fruit cultures. Permanent efforts of science and practice for improvement in production of strawberries, with a special emphasis on improving the quality of its fruits, gave special attention to the production of rosettes. The aim of this study is to examine the possibility of producing fresh rosettes of strawberries in the mother plantation in a sand substrate. Planting material, suitable for planting in summer, is provided by direct rooting of rosettes in the sand substrate. Vegetative growth and the quality of rosettes were examined in six cultivars of the June-bearing garden strawberry (*Fragaria ananassa* Duch.): 'Honeoye', 'Chandler', 'Cortina', 'Marmolada', 'Idea' and 'Senga Sengana'. The highest number of runners and rosettes per plant was recorded by 'Honeoye'. The lowest vigor and the lowest number of rosettes per plant were recorded by 'Senga Sengana'. The highest quality of primary and secondary rosettes was recorded by 'Senga Sengana'. The 3rd node rosettes are not used for summer planting of fresh strawberries due to low quality. This way of production, by direct rooting in the mother plantation in a sand substrate, allows obtaining seedlings with developed root system, prepared for planting during the summer months. Therewith, it is more economical and less expensive way of production in comparison with others.

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Introduction

In practice, there are several ways of producing strawberry planting material. Regardless of the way, planting material should be high quality, healthy and monovarietal. The situation for the production of strawberry rosettes in the Republic of Serbia is very bad nowadays, because the largest number of rosettes for the growing of commercial plantings is used from the production plantings. On that occasion, rosettes are often mixed with seedlings, and very often the real name of the cultivar or degree of infection diseases and pests is unknown, contributing mostly to the low yield and poor quality fruit.

Rooting rosettes in the mother plantation on soil as bed, provides high-quality and well-built rosettes. Maintaining this type of mother plantation of strawberries is hampered due to persistent struggle with weeds and additional engagement of labor. Thus obtained rosettes have to be transplanted and therefore suffer stress, it takes more time to adapt and provide lower yields compared to directly planted rosettes (Selamovska *et al.*, 2008a).

In order to obtain high yields of strawberries in an open field, the best time to plant the rosettes is during the summer months. If strawberries are grown as annual crops, an earlier planting in July is better. The earlier planting in summer provides 30-40% higher yield per plant compared to planting in October or March (Mišić and Nikolić, 2003; Selamovska *et al.*, 2008b).

For summer planting of strawberries, fresh plant material is required. In the absence of fresh plants, frigo rosettes can be used. However, during the hot summer in Southern Serbia, the use of frigo materials for summer planting in an open field is not recommended due to the effects of high temperatures. Plant material, that is stored in a cold place for a long time, shortly after planting starts to blossom. High temperatures during summer have a negative effect on pollination and fertilization, and therefore a small number of fruits are being formed. Blossoming in this period exhausts the plant, because its blossoms occur

at a time when the flower buds differentiate for the following year (Selamovska, 2007). In August, when the plant is about to enter the reproductive stage, it enters unprepared, which leads to distortion of the succeeding stages of organogenesis (Vitkovskii, 1984). These problems have led us to look for an option and method of their resolving that is based on finding more efficient and profitable ways of producing strawberry planting material, more favorable for planting in August, by direct rooting of plants in a substrate in the mother plantation. The advantages of this method of producing strawberry planting material are: it is more economical and less expensive when compared to other; there are no additional costs for labor in order to maintain and root rosettes; plants do not experience stress during transplanting, as was the case with the rooted plants (Selamovska *et al.*, 2006; Selamovska *et al.*, 2008b). Kiprijanovski *et al.* (2001) examined the vegetative potential and quality of rosettes in rooted strawberry rosettes of the cultivar 'Pocahontas' in different plantings: black plastic mulch in the mother plantation, applied between the rows with sand, straw and sawdust in June for better rooting; another variant is black plastic mulch without substrates; and rooting in the production plantings. The authors recommend the usage of mother plantations and avoidance of production plantings for the production of planting material. The objective of this study was to find efficient and profitable methods for the production of strawberry planting material during the summer months by direct rooting in the mother plantations.

Material and methods

Plant material

The studies were carried out at mother plantation of the social company "Porecje" Vucje, at location of the village Strojkovce. The aim of this study was to obtain cheap, healthy and monovarietal planting material of the fresh rosettes on the annual mother plantation of strawberries. Therefore, in spring, clean river sand was placed between the lines in a layer of 6-8mm as a substrate for rooting. The mother plants were planted in the black plastic mulch in two-row lines 100cm apart. The distance between the rows was 40cm and

50cm in a single row. The mother plantation was established in 2010, on alluvial soil type.

Subject of research

The studies were carried out during 2010 and 2011. The subjects of study were six June-bearing cultivars of strawberry: 'Honeoye', 'Chandler', 'Cortina', 'Marmolada', 'Idea' and 'Senga Sengana'. The size of vegetative growth of the examined cultivars was monitored: number and length of runners, number of rosettes per plant, on 80 mother plants per unit area. Considering the fact that the highest quality is provided by the 1st and the 2nd node rosettes, i.e. the primary and secondary rosettes, its quality rating according to the diameter of root crown and length of root system was carried out. The 3rd node rosettes were taken into consideration due to comparison in relation to the quality. In order to produce fresh rosettes, diameter of root crown more than 10mm is required.

Statistical analysis

The obtained data were subjected to analysis of variance and differences between means were determined by LSD test (Hadživuković, 1991).

Results and discussion

Vegetative growth

The results of examined size of vegetative growth of the strawberry cultivars are given in the Table 1. Cultivars formed 10.4 of runners per plant on the average, with an average length of 76.53cm, 4.0 rosettes per runner, i.e. 51.1 rosettes per plant. The highest vigor was recorded by the cultivar 'Honeoye', which formed the longest runners (81.2cm). This cultivar provides high vigor, forms a large number of rosettes per runner (5.2) and the largest number of rosettes per plant (77.52).

Table 1. Vegetative growth of examined strawberry cultivars in August.

Cultivar	Runners per plant	Length of runners	of Rosettes per runner	Rosettes per plant	Rosettes per ha
Honeoye	15.2	81.2	5.1	77.52	3.876.000
Chandler	8.9	75.8	3.9	34.71	1.735.500
Cortina	13.5	80.3	4.5	60.75	3.037.500
Marmolada	12.1	78.5	4.1	49.61	2.480.500
Idea	11.7	76.9	4.0	46.8	2.340.000
Senga Sengana	15.4	66.5	2.4	36.96	1.998.000
	62.4	459.2	24.00	306.35	15.467.500
x	10.4	76.53	4.00	51.1	2.577.917

The cultivar 'Senga Sengana' forms the largest number of runners per plant (15.4), but compared to other examined cultivars, it forms the shortest runners (66.5cm) and the lowest number of rosettes per runner (2.4). The cultivar 'Chandler' provides the lowest vigor with the lowest number of rosettes per plant (34.71). Vigor cultivars 'Pocahontas' and 'Evita' form a large number of runners per plant (19.6 i.e. 16.6) and length of runners over 90cm (Selamovska *et al.*, 2006). The lowest number of runners per plant was recorded by the cultivars 'Miranda' (8.4) and 'Elsanta' (10.6) according to Selamovska *et al.* (2006).

Quality of the strawberry rosettes

Table 2 presents data concerning the quality of

rosettes per individual cultivar. The analysis of the rosettes of June-bearing strawberry cultivar in Southern Serbia was used for comparison. The 1st node rosettes are formed in June, and later, at the end of July and August, the 2nd node and the 3rd node rosettes are formed. The highest quality is provided by rosettes of the first level, i.e. primary rosettes with diameter of root crown of 10.05cm on the average and root length of 4.4cm, compared to the rosettes of the 2nd and the 3rd node. Considering the fact that the highest quality is provided by the 1st and the 2nd node rosettes, their usage is the most represented in practice. The 3rd node rosettes are not used for planting due to low quality. They can be used for rooting and multiplication.

The cultivar 'Senga Sengana' forms the highest quality rosettes of the first and the second node per unit area. This is a good characteristic in terms of obtaining good quality planting material and it is adequate to the pomological measure of cutting rosettes. Thus, obtaining a smaller number of better quality rosettes on a runner with a larger diameter of root crown and more developed root system is forced. A large number of rosettes and runners per plant exhaust the mother plant (Micić and Đurić, 1989). In relation to the methods of growing, there are significant differences in vegetative potential between the cultivars raised in different plantings. The lower number of rosettes is obtained from the production plantings, with the weak root system and reduced vegetative potential in relation to plants raised in the mother plantations (Ristevski and Simovski, 1986). The 1st node rosettes of the cultivar 'Senga Sengana' have diameter of root crown of 12.5mm and root length of 6.2cm. The cultivars 'Honeoye' and 'Cortina' provide high quality 1st node rosettes, while the lowest quality of the primary rosettes forms cultivar 'Chandler'. The highest quality of the secondary rosettes with diameter of root crown of 10.4mm and root length of

4.5cm provides the cultivar 'Senga Sengana'. The highest quality of the 1st and 2nd node rosettes forms the cultivar 'Senga Sengana', while the cultivar 'Chandler' provides the lowest quality rosettes. Statistically significant differences between cultivars at level 0.05 and 0.01 in relation to examined parameters are determined by analysis of variance and LSD test (Tables 3 and 4). Besides sand, sawdust and straw can be used as substrates for rooting strawberries. There are no significant differences regarding the quality of rosettes rooted in a substrate of sand, sawdust or straw (Kiprijanovski *et al.*, 2001). Healthy and well-built strawberry rosettes can be obtained in August by direct rooting in the sand substrate. It has advantages and favorable for growing strawberries in the open field during the summer months. Rootlets easily penetrate into sand, because of its high permeability, but it needs frequent irrigation due to poor water retention. The number of obtained rosettes per plant and unit area is a varietal characteristic. In order to obtain high quality rosettes, a smaller number of runners per plant are needed (Micić *et al.*, 2000).

Table 2. The quality of fresh rosettes of the examined strawberry cultivars.

Cultivar	Order of rosettes	Diameter of root crown (mm)	Length of root (cm)
Honeoye	I	10.3	5.2
	II	9.2	3.8
	III	6.3	1.1
	x	8.6	3.4
Chandler	I	8.4	2.9
	II	7.5	1.8
	III	6.8	0.8
	x	7.6	1.8
Cortina	I	10.1	4.5
	II	9.2	3.3
	III	7.8	2.4
	x	9.0	3.4
Marmolada	I	9.4	3.2
	II	7.9	2.8
	III	6.3	2.5
	x	7.9	2.8
Idea	I	9.9	4.3
	II	8.3	3.2
	III	6.8	2.5
	x	8.3	3.3
Senga Sengana	I	12.5	6.2
	II	10.4	4.5
	III	7.3	3.3
	x	10.1	4.7

The production of strawberry planting material in the mother plantations in the sand substrate is more economical and less expensive in comparison with other methods. The mother planting is clean, without weeds, it is easily maintained, there are no additional

costs for labor in order to root rosettes. Thus obtained rosettes do not suffer stress during the transplantation. They provide healthy and quality rosettes with well-developed root system.

Table 3. The lowest significant difference of diameter of root crown of the examined strawberry cultivars.

Cultivar	x	x - 7.6	x - 7.9	x - 8.3	x - 8.6	x - 9
Senga Sengana	10.1	2.5*	2.2*	1.8	1.5	1.1
Cortina	9.0	1.4	1.1	0.7	0.4	
Honeoye	8.6	1.0	0.7	0.3		
Idea	8.3	0.7	0.3			
Marmolada	7.9	0.3				
Chandler	7.6					

LSD_(0.05) = 2.09; LSD_(0.01) = 2.93; *statistically significant difference at the level 0.05; **statistically significant difference at the level 0.01.

Table 4. The lowest significant difference of root length of the examined strawberry cultivars.

Cultivars	x	x - 1.8	x - 2.8	x - 3.3	x - 3.4
Senga Sengana	4.7	2.9**	1.9*	1.4	1.3
Honeoye	3.4	1.6*	0.6	0.1	-
Cortina	3.4	1.6*	0.6	0.1	
Idea	3.3	1.5	0.5	-	
Marmolada	2.8	1.0	-		
Chandler	1.8	-			

LSD_(0.05) = 1.59; LSD_(0.01) = 2.23; *statistically significant difference at the level 0.05; **statistically significant difference at the level 0.01.

Conclusion

Based on the results obtained in this research, it is confirmed that fresh planting material of strawberries, suitable for planting during the current year, can be obtained using the method of direct rooting of rosettes in the mother plantation on a sand substrate.

Regarding the examined strawberry cultivars, the highest number of runners and rosettes per plant and unit area was recorded by the cultivar 'Honeoye'. The lowest vigor and the lowest number of rosettes per plant were recorded by the cultivar 'Chandler'. The highest quality of the primary and secondary rosettes was recorded by the cultivar 'Senga Sengana'. Planting material production in the mother

plantation in the sand substrate is efficient, profitable and it provides a large number of fresh rosettes for summer planting.

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