

REPRODUCTIVE POTENTIAL OF *IN VITRO* RASPBERRY CULTIVARS GROWN ON POORLY PRODUCTIVE SOILS

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Abstract

Biotechnological approaches for the production of raspberry planting material is a fundamental technology to obtain healthy, homogeneous and cultivar authentic plants.

The objectives of the present study were raspberry cultivars, such as: 'Willamette', 'Meeker', 'Samodiva' and 'Magdalena' - a candidate cultivar. The experiment was carried out in the collection plantation of the Research Institute of Stockbreeding and Agriculture, Troyan, in the period of 2018/2019. The field experiment was set with various intra row spacing (0.30 and 0.50) and inter row spacing (3.00 m).

The highest average fruit weight was found in 'Meeker' (2.91 g) at a planting distance of 0.50 m and 'Magdalena' - a candidate cultivar (2.87 g) at a planting distance of 0.30 m. The highest average yield per 1 m² was registered for 'Willamette' (1707.84 g), 'Magdalena' - a candidate cultivar (1605.92 g) and 'Meeker' (1469.17 g) at intra row spacing of 0.30 m.

Key words: raspberry, cultivars, agrotechnics, fruit weight, yield.

INTRODUCTION

The distribution area of raspberry is from the temperate climate zone to the polar regions of Siberia, but it still does not tolerate heavy colds and heat (Dinkova et al., 2000)

The global warming of the Earth's climate has a significant impact on the phenological and reproductive manifestations of small-sized fruit species, including raspberries. Phenological calendar and reproductive characteristics are directly dependent on latitude, agrometeorological conditions of the area, cultivar characteristics and applied agrotechnics.

A number of researchers have focused their studies on testing the fertility of raspberry cultivars (Hristov, 1991; Stanisavljevic et al., 1996; Boicheva, 1999; Buskiene, 1999; Koron, 2004; Georgiev, 2006; Leposavić et al., 2015). Clozza et al. (1994) found that 'Meeker' and 'Schonemann' cultivars show better fruit quality and strength, unlike 'Glen Clova' and 'Heritage' cultivar, which are smaller and of unsatisfactory taste. Leposavić et al., 2006, compared 6 raspberry cultivar ('Willamette', 'Meeker', a yellow branch of 'Meeker', 'Polana', 'Polka', 'Poranna Rossa' and 'Samodiva') and one raspberry branch and found that

'Willamette' had the largest fruit (4.22 g) followed by 'Meeker' (4.13 g), yellow fruit branch of 'Meeker' (3.95 g) and 'Samodiva' (3.55 g).

The purpose of this study is to follow the occurrence of different phases of the phenological calendar and the effect of different intra row spacing (0.30 m and 0.50 m) in cultivation on fruit weight and the average yield of cultivars.

MATERIALS AND METHODS

The survey was conducted during the period of 2018-2019. The experiment included raspberry cultivars from the collection plantation of RIMSA: 'Willamette', 'Meeker', 'Samodiva' and 'Magdalena' - a candidate cultivar. The plants were grown under irrigation conditions, the area was maintained in black fallow in the intra row spacing and with naturally grassed row spacing. The planting distances were 3.00/0.30 m и 3.00/0.50 m. The necessary agrotechnical events for cultivating were applied.

The following cultivation variants were used for plants:

- planting at 0.30 m intra row spacing;
- planting at 0.50 m intra row spacing;

The following indicators were observed:

- phenological calendar;
- Reproductive indicators:
- average yield of 1m² (kg);
- average fruit weight (g).

The indicators were measured according to the methodology of plant resources (Nedev et al., 1979).

Data processing was performed by a two-way dispersion analysis (Lidanski, 1988), using MS Excel software - 2010.

RESULTS AND DISCUSSION

During the study period, the beginning of the vegetation of raspberry cultivars began in March. It was first registered in candidate cultivar 'Magdalena' - 04.03 (2019), and at the latest for 'Samodiva' - 30.03 (2018).

Flowering began from the end of April in the first year of the experiment until about the

middle of May ('Meeker' 16.05) the following year. The mass flowering of all cultivars took place in May to early June. It ended with 'Meeker' on 06.06 (2019).

It is noteworthy that in 2018, the phenophases of flowering, fruit ripening and harvesting occurred earlier than in the following 2019.

The fruits began to ripen in 2018 about 29.05 (candidate cultivar 'Magdalena') until 01.06 ('Willamette').

The next year, the phase continued until the middle of June. Similarly, the fruit harvesting began from 05.06 and 06.06 in 2018 and continued until 25.06. In 2019 it began from 13.06 (candidate cultivar 'Magdalena') and 18.06 ('Willamette' and 'Meeker') until the middle of July. The end of the vegetation occurred in November-December.

Higher average fruit weight was measured in the first year of the experiment for all cultivars and variants (Table 2).

Table 1. Phenological calendar of raspberry cultivars for the period 2018-2019

Cultivars	Bud sprouting	Beginning of blossoming	Mass blossoming	End of blossoming	Beginning of fruit ripening	Harvesting	End of harvesting	End of vegetation
2018								
'Willamette'	25.03.	30.04	4.05.	14.05.	01.06.	06.06.	25.06	09.12
'Meeker'	27.03.	30.04	5.05.	15.05.	30.05.	05.06.	25.06	07.12
'Samodiva'	30.03	30.04	6.05.	14.05.	31.05.	05.06.	25.06	02.12
Candidate cultivar 'Magdalena'	22.03.	30.04	4.05.	15.05.	29.05.	05.06.	25.06	23.12
2019								
'Willamette'	29.03	11.05	18.05	03.06	14.06	18.06	15.07	12.12
'Meeker'	29.03	16.05	27.05	06.06	13.06	18.06	15.07	18.11
'Samodiva'	16.03	08.05	15.05	30.05	12.06	16.06	15.07	18.11
Candidate cultivar 'Magdalena'	04.03	07.05	15.05	03.06	10.06	13.06	15.07	30.11

Table 2. Average weight (g) of raspberry fruit from different cultivars and variants for 2018 and 2019

Cultivars	'Willamette' (50 cm)	'Willamette' (30 cm)	'Meeker' (50 cm)	'Meeker' (30 cm)	'Samodiva' (50 cm)	'Samodiva' (30 cm)	Candidate cultivar 'Magdalena' (50 cm)	Candidate cultivar 'Magdalena' (30 cm)
2018								
	2.6	2.74	3.07	2.81	2.89	2.66	3.30	3.26
2019								
	2.08	2.42	2.74	2.57	2.28	2.07	2.32	2.48
Average for the period	2.34	2.58	2.91	2.69	2.59	2.37	2.81	2.87

The largest fruit weight was measured in the first year in candidate cultivar 'Magdalena' in both variants (3.30 g at 0.50 m; 3.26 g at 0.30 m) and 'Meeker' (3.07 g at 0.50 m).

In the second year, the values ranged from 2.07 g ('Samodiva' at 0.30 m to 2.74 g for 'Meeker' at 0.50 m).

The highest average weight of 2.91 g for the two-year period was reported for 'Meeker' (0.50

m) and candidate cultivar 'Magdalena' - 2.87 g (0.30 m) and 2.81 g (0.50 m).

It can be stated that fruits with higher average weight predominated at planting distances of 0.50 m in 'Meeker' and 'Samodiva'.

For 'Willamette' and candidate cultivar 'Magdalena' higher average weight was registered at 0.30 m planting distance.

Table 3. Yield of raspberry cultivars per 1 m² (g) for different variant in 2018-2019

Cultivars	'Willamette' (50 cm)	'Willamette' (30 cm)	'Meeker' (50 cm)	'Meeker' (30 cm)	'Samodiva' (50 cm)	'Samodiva' (30 cm)	Candidate cultivar 'Magdalena' (50 cm)	Candidate cultivar 'Magdalena' (30 cm)
2018 г.								
	896.5	1767.5	873.17	1620.33	1422.67	1161.17	821.17	944.5
LSD _{0,001} Among variants	460.89							
LSD _{0,01} Among cultivars	351.02							
2019 г.								
	1138	1648.17	806.17	1318	782	1048.5	1843.5	2267.33
LSD _{0,01} Among variants	346.17							
LSD _{0,001} Among cultivars	454.53							
Average for the period	1017.25	1707.84	839.67	1469.17	1235.59	1104.84	1332.34	1605.92

In the first year, the highest yield per 1 m² was gathered from 'Willamette' 1767.5 g (30 cm), followed by 'Meeker' 1620.33 g (30 cm), 'Samodiva' 1422.67 g (50 cm) and 'Magdalena' 944.5 g (30 cm). The smaller the planting distances, the higher the yield in the variants (with the exception of 'Samodiva'). The lowest yield was gathered from 'Magdalena' candidate cultivar 821.17 g (50 cm). The differences were mathematically very well proven among variants, while the distinctions among cultivars were well proven. The highest yield in the second experimental year was obtained from candidate-cultivar 'Magdalena' 2267.33 g (30 cm planting distance). It was lower in another variant of the same cultivar (1843.5). The third place was for 'Willamette' 1648.17 g (30 cm). Higher results were registered for all variants at a planting distances of 30 cm. The lowest yield

was registered in 'Samodiva' 782 g (50 cm). The differences among variants were statistically well proven and very well proven among cultivars.

The highest average yield for the experimental period was registered for 'Willamette' 1707.84 g (30 cm), candidate-cultivar 'Magdalena' 1605.92 g (30 cm) and 'Meeker' 1469.17 g (30 cm), i.e. the smallest planting distances. Only for 'Samodiva', the average yield was higher than the other variant (1235.59 g) (Table 3).

CONCLUSIONS

The study conducted significantly determines the relationship between cultivars and the impact of planting distances on reproductive performance.

The phases in the phenological calendar indicate that fruit ripening can be registered

significantly early, at the end of May, which is a special case that is not characteristic of raspberry crop.

The highest average weight was found in 'Meeker' and 'Magdalena' candidate cultivar in both variants.

The reported average yield shows higher results mainly from smaller planting distances. The most fertile cultivars were 'Willamette', 'Magdalena' candidate cultivar and 'Meeker'. There was an exception for 'Samodiva' with higher yield from a planting distance of 0.50 m.

REFERENCES

- Boicheva, R. (1999). Study of raspberry resources - average fruit weight, *Rastenievadni - Nauki*, 36(4), 224-229. 12 ref.
- Buskiene, L. (1999). Effect of pruning first shoots on growth and productivity of raspberry, *Sodininkyste-ir-Darzininkyste*, 18(2), 3-15. 14 ref.
- Clozza, M., Vilella, F. (1994). Yield and fruit quality of four raspberry cultivar at Tandil (Buenos Aires, Argentina) *Horticultura - Argentina*, 13(33), 17-21. 17 ref.
- Dinkova, H., Petkov, T., Mihaylova P. (2000). Growth and development of plums and raspberries planted on slope terrains with minimum soil cultivation, *Proceedings of the First National Conference on Humic Substances and Soil cultivation*, Borovets, 126-128.
- Georgiev, D. (2006). Agrobiological and economic evaluation of new varieties of raspberries and black currants. PhD Thesis, Troyan.
- Hristov, St. (1991). Studies on some biology and economic qualities of raspberry cultivars and ellites, PhD Thesis, Troyan.
- Koron, D. (2004). Testing of new raspberry varieties in Slovenia, *Jugoslovensko voćarstvo*, 634.711: 631.526.32.
- Leposavić, A., Durovic, D., Keserović Z., Jevremovic, D. (2015). Vegetative and yield potential of cultivars and selection of raspberry cultivated in conditions of west Serbia, *Bulgarian Journal of Agricultural Science*, 21(1), 153-159.
- Leposavić, A., Janković, M., Stefanović, D., Stefanović, S., Jevremović D. (2006). Biological and pomological properties of some red raspberry cultivars, *Journal of Mountain Agriculture on the Balkans*, 9(5), 793-804.
- Lidanski, T. (1988). *Statistical methods in biology and in agriculture*. Zemizdat, Sofia (Bg), 148-155.
- Nedev, N., Grigorov, Y., Baev, Hr., Serafimov, S., Strandzhev, Al., Kavardzhikov, L., Lazarov, Kr., Nikolov, N., Dzhuvinov, V., Popova, L., Slavov, N., Iliev, P., Stoyanov, D., Kanev, Il., Krinkov, H., Vishanska, Yu., Topchiyska M., Petrova, L. (1979). *Methods for Studying of Planting Resources of Fruit Crops*, Plovdiv, 111-116.
- Stanisavljevic, M., Rankovia M., Mitrovic, O., Milosevic, S., Dzajevic, R. (1996). Comparative studies of some raspberry cultivars under different agroecological condition, *Jugoslovensko voćarstvo*, 30(3-4), 391-398 ref.