Bulgarian Journal of Agricultural Science, 21 (No 1) 2015, 153-159
Agricultural Academy

VEGETATIVE AND YIELD POTENTIAL OF CULTIVARS AND SELECTION OF RASPBERRY CULTIVATED IN CONDITIONS OF WEST SERBIA

A. LEPOSAVIC[1], D. DUROVIC[2], Z. KESEROVIĆ[3] and D. JEVREMOVIC[1]
[1]*Fruit Research Institute, 32000 Čačak, Serbia*
[2]*Faculty of Agronomy, Čačak, Serbia*
[3]*Faculty of Agriculture, Novi Sad, Serbia*

Abstract

LEPOSAVIC, A., D. DUROVIC, Z. KESEROVIC and D. JEVREMOVIC, 2015. Vegetative and yield potential of cultivars and selection of raspberry cultivated in conditions of West Serbia. *Bulg. J. Agric. Sci.*, 21: 153–159

Over a four-year trial conducted in agro-ecological conditions of the West Serbia, research was done into major vegetative characteristics and yield potential of the Tulameen, Latham and Meeker cultivar and the K 81-6 selection, in comparison with the standard Willamete cultivar. The examined traits included the number of young shoots in the first and the second generations, as well as the impact of multiple removals of young shoots on the number of mature shoots. The height and the diameter of mature shoots were also measured. The yield potential was determined based on the number of fruit-bearing branches per shoot, the number of flowers per fruit-bearing branch, branch length, number of nodes, number of reproductive nodes, number of fruits per reproductive node, number of inflorescence flowers and number of developed leaves.

Key words: Red raspberry, shoots, vigour; fruit-bearing branches, inflorescences

Introduction

The number and level of development of young raspberry shoots represent significant parameters in evaluation of the vegetative and yield potential. It is based on these traits that implementation of certain pomo-technical measures is determined (removal of first series), as well as the system of raspberry cultivation (row, espalier, trellis and others).

According to Crandall (1980), a major impact on raspberry yield is made by the number of shoots and their vigour, that are directly dependent on the implemented pomo-technical and agro-technical measures. Freeman et al. (1989) determined that the removal of shoots ought to be adapted to the specific traits of a cultivar, as well as to the specific climatic conditions of the area where the raspberry is grown, since cultivars with a lower production of shoots demonstrate less need for this measure, compared to the cultivars characterised by a lower fruit yield and quality, caused by a high production of shoots.

Crandall et al. (1974) concluded that larger-diameter shoots secure higher and more stable yields, due to a better supply of nutrients to the buds, as compared to smaller-diameter shoots. In the research conducted by Cicala et al. (2002), the height of shoots in fall-bearing raspberry cultivars ranged from 106.6 cm (Polana) to 186.6 cm (Sumo), while the length of the inter-nodes ranged from 3.1 cm (Sumo) to 6.7 cm (Joan Squire). In their research of the biological and pomological characteristics of a number of single-bearing and ever-bearing red raspberry cultivars, Joublan et al. (2002) point to the large height of shoots and fruit-bearing branches in the Tulameen and Meeker cultivars. Marinkovic et al. (2008) stated that the average diameter of the shoots in different cultivars ranges between 7.89 mm (Willamette) and 10.23 mm (Skeena). According to the same authors, the number of fruit-bearing branches per shoot in different cultivars ranged between 13.25 and 22.0. Eyduran et al. (2008) point to a significant impact of the number of shoots, their height and diameter, on the yield and fruit mass, in the 10 tested raspberry cultivars in the region of Central Anatolia (Turkey).

The length of fruit-bearing branches in the various raspberry cultivars and selections ranged between 29.2 mm and 89.4 mm, while the number of fruits per fruit-bearing branch was between 12.0 and 17.4 (Veličković et al., 2004). The same authors have established that the largest number of shoots

Corresponding author: aleksandarleposavic@yahoo.com

per metre of espalier length was present by the K 81-6 selection, while the smallest number of shoots was recorded in the Meeker cultivar. Stanisavljević (1990) states that the length of the fruit-bearing branches was in the range from 28.9 cm (Zeva) to 52.3 cm (Podgorina). The number of inflorescences per fruit-bearing branch depends on the genotype, i.e. the cultivar. Orhan et al. (2006) stated that this number in the Heritage cultivar was in the range of 12.0 to 15.7.

Materials and Methods

A comparative study of the vegetative characteristics and the yield potential was conducted using a selection of red raspberry cultivars Meeker, Latham, Tulameen, the K 81-6 selection and the Willamette cultivar (the latter being used as the standard, or control). The cultivars and the selection were planted in a random order, in four repetitions of 50 plants each, and were grown using the Leposavić et al. (2013) method.

The number of young shoots was determined in the first and the second generations, and so were the number of young shoots per mature stem and the number of young shoots per metre of espalier length. The counting of the young shoots was performed in every year, in two sessions – one in mid-April and the other one, in mid-May. After the counting, all the shoots were mechanically removed all the way to the base (regardless of their height). The counting of the shoots was performed in 4 repetitions for each of the tested raspberry cultivars and the raspberry selection. The width across which the shoots were counted measured 60 cm on either side of the espalier.

The number of mature shoots was determined (the total number of shoots per meter of length, the shoot heights and the shoot diameter at a height of 40 cm above the soil surface). The verification of numbers, as well as the bio-metric traits of the mature raspberry shoots was performed following the harvest, immediately after the cutting and removal of the shoots that yielded fruits in the given year. The testing was performed in the same fields where the young shoots were counted.

The traits of the fruit-bearing branches that were monitored included the number of fruit-bearing branches per shoot (20 shoots), the number of flowers per fruit-bearing branch (20 shoots), length of branch (mm), number of nodes, number of reproductive nodes, number of fruits per reproductive node, number of flowers per inflorescence, and the number of developed leaves.

Results and Discussion

The analysis of variance of the number of young shoots of the first generation indicates the presence of significant differences among the cultivars, years of growth, as well as the presence of a major interaction cultivar x year (Table 1). Compared with the Willamette cultivar, a significantly higher number of the first-generation shoots was found in the Latham

Table 1
Number of young and mature shoots of the examined raspberry cultivars and raspberry selection

Treatment		First generation	Second generation	Number of young shoots per metre	Number of young shoots per mature stem	Number of mature stems per metre
Cultivar (A)	Meeker	124.56**	236.69**	361.25**	65.68**	11.50**
	Latham	190.00**	360.63**	550.63**	100.33**	17.00**
	K 81-6	164.00*	306.13*	470.13*	85.63*	15.06**
	Tulameen	49.00**	109.88**	158.88**	29.01**	5.88**
	Willamette	151.75	293.5	445.25	80.95	13.63
Year (B)	2003	85.60 c	160.55 c	246.15 d	44.85 d	11.65 c
	2004	167.95 a	257.05 b	425.00 b	77.42 b	13.25 b
	2005	123.55 b	269.70 b	393.25 c	71.54 c	10.90 c
	2006	166.35 a	358.15 a	524.50 a	95.474 a	14.65 a
ANOVA						
Cultivar (A)		**	**	**	**	**
Year (B)		**	**	**	**	**
A × B		**	**	**	**	**

**significant differences among means at $P < 0.05$ and $P < 0.01$ based on the Dunnett's test and ANOVA results (F-test); A, B treatments in cultivars and years; ns – non-significant; a-d non-justified differences at $P < 0.01$ based on the Duncan's multiple range test

cultivar ($P < 0.01$) and the K 81-6 selection ($P < 0.05$), while the Meeker and Tulameen cultivars had a significantly lower number of shoots ($P < 0.01$). Similar results have been reported by Koron (2004), pertaining to the research conducted in Slovenia, involving the same cultivars. A significantly higher number of young shoots was recorded in the second and the fourths years (with recorded values being very similar), whereas the lower number that was recorded in the third and the first years occurred as a consequence of the extremely low rainfall during the winter and spring, especially in the first year of the trial.

The presence of the significant cultivar x year interaction is an indication of the different behaviour of the cultivars in the trial period. In the first year, characterised by the lowest production of the first-generation shoots, a significantly higher number of shoots in comparison with the control group was observed in the Latham cultivar, whereas it was significantly lower in the Tulameen cultivar. In the following two years, however, the Meeker cultivar also showed a significant difference in relation to the control cultivar. Finally, in the fourth year of growth, the only the Tulameen cultivar showed a significant difference in relation to the control group. The cause of this phenomenon lies in the different patterns of behaviour of cultivars with smaller, i.e. higher production of shoots. Precisely, unlike the cultivars characterised by a high shoots production (Latham and K 81-6) which reached their maximum in the second year of growth, the cultivars with the lower shoot production reached their maximum in the first year, so that their number of young shoots did not vary significantly, with the exception of the Tulameen cultivar.

The analysis of variance of the number of the second-generation shoots is also indicative of the presence of significant differences among the cultivars and the years of growth, as well as the presence of the cultivar x year interaction. Notwithstanding the considerably higher number of the second-generation shoots, the differences between certain cultivars in comparison with Willamette as the control cultivar are in agreement with the differences established in the first-generation young shoots (Table 1). The obtained results were in accordance with the results obtained by Freeman et al. (1989).

Considerably higher values of the second-generation young shots were established in the fourth year, as compared to the second and the third years, while a significantly lower number was recorded in the first year. The mutual relations of the mean values of the number of young shoots per mature stem and the number of young shoots per metre of length observed per cultivar, year and cultivar x year combination are mostly compliant. The number of mature shoots chosen to yield fruits has shown a minor variability in relation to cultivars and years, since this value is directly controlled by selecting a certain number of properly developed and healthy shoots per metre of length, at the beginning of vegetation (Table 1).

The analysis of variance of the number of young shoots per mature stem and the number of young shoots per metre of length has also indicated the presence of significant differences among the cultivars, years of growth and the significant interaction cultivar – year (Table 1). The differences between the examined cultivars and the selection on one side, and the Willamette cultivar on the other side are concordant with the previously established differences regarding the first and the second-generation young shoots.

The mean values of the number of young shoots per mature stem are significantly different in all of the trial years, with this parameter reaching its highest value in the fourth year and lower values in years two, three and one, when the value was at its lowest. The analysis of variance of the number of mature stems per metre of length points to the presence of significant differences among the cultivars and years of trial, as well as a significant reaction of the cultivars to the changeable conditions in the environment (the cultivar x year interaction).

A significantly higher number of mature stems per metre of length was recorded in the Latham cultivar ($P < 0.01$) and the K 81-6 selection ($P < 0.05$), while a significantly smaller number of shoots was determined in the Tulameen and Meeker cultivars ($P < 0.01$). The results obtained in the research concerning the Latham cultivar are in accordance with the results quoted by Kazakov (1995) who, due to the high vegetative potential and the high resistance, recommends that this cultivar be grown in less favourable agro-ecological conditions.

The number of mature stems per metre of length was considerably higher in the fourth year than in year two of the trial, while year two demonstrated considerably higher values of this parameter then the ones obtained in years one and three of the trial. This was mostly caused by the pattern of rainfall and optimum air temperatures in the fourth and the second years, as well as the shortage of moisture accompanied by extremely high air temperatures in the third and especially in the first year of the trial.

The analysis of variance of the height of mature stems points to the fact that the demonstration of this quality is significantly influenced by the cultivar and the year (Table 2). This cultivar feature can also be significantly influenced by ecological factors, first and foremost by the volume and pattern of rainfall during the vegetation period; while at the same time the impact made by these factors on the examined cultivars and the selection was uniform (there was an absence of the cultivar x year interaction).

As opposed to the Latham cultivar and the K 81-6 selection, where no significant differences in the height of mature shoots was detected in comparison with the Willamette cultivar, the Meeker and Tulameen cultivars recorded a significantly larger height of shoots, which is in agreement with the results obtained Joublan et al. (2002).

The height of shoots in all the raspberry cultivars and the selection was the largest in the first year, and was also significantly lower in the third year, while the values recorded in years two and four of the trial did not show significant differences in comparison with the values recorded in years one and three of the trial.

All of the cultivars and the selection demonstrated a significantly larger height of mature stems in comparison with the values established by Cicala et al. (2002) and Marinkovic et al. (2008), which is an indicator of the fact that this feature is dependent on a large number of factors, primarily on the agro-ecological conditions of the area, the quantity of fertiliser and the level of agro-technical measures applied.

The analysis of variance of the diameter of mature stems (Table 2) points to the presence of significant differences exclusively among the cultivars, i.e. it indicates that this is a cultivar trait, not significantly influenced by ecological factors. All of the cultivars and the selection recorded a significantly larger diameter of the stem, in comparison with the control cultivar.

The selection of the yielding shoots for is performed in spring, before the start of vegetation, when the buds are in the swell, in order to avoid the risk of tying frost-bitten or damaged, i.e. non-productive shoots (Petrović and Leposavić, 2011).

The number of nodes, number of reproductive nodes, number of fruit-bearing branches per shoot and the length of branches of the examined red raspberry cultivars and the selection are shown in Table 2. The presence of the significant differences concerning the number of nodes in the respective cultivars, the year and the significance of the cultivar x year interaction, point to the fact that a demonstration of this feature is influenced by the surrounding environment in the same way in all of the raspberry cultivars and its selection (Table 2).

A significantly higher number of nodes in comparison with the control cultivar was recorded in the Latham and Meeker cultivars ($P < 0.01$), while a significantly lower number of nodes was recorded in the K 81-6 selection ($P < 0.01$). No significant difference was recorded between the Tulameen and the control cultivars. As opposed to the previously analysed

Table 2
Height and diameter of mature shoots and features of lateral fruit-bearing shoots of the examined raspberry cultivars and raspberry selection

Treatment		Shoot height, cm	Shoot diameter, mm	Number of noduses	Nuber of reproductive noduses	Number of fruit-bearing branches per nodus
Cultivar (A)	Meeker	239.07**	13.85**	47.81**	25.25*	18.66 ns
	Latham	223.07 ns	13.76**	50.24**	22.58**	16.90**
	K 81-6	220.12 ns	13.68**	41.55**	23.31*	16.98**
	Tulameen	236.32**	13.38**	42.71 ns	23.46 ns	16.53**
	Willamette	213.49	11.84	44.66	24.28	19.04
Year (B)	2003	235.58 a	13.49	46.99 a	24.88 a	18.2
	2004	226.82 ab	13.33	44.94 bc	23.41 b	17.38
	2005	216.11 b	12.98	45.47 b	23.43 b	17.74
	2006	227.14 ab	13.41	44.18 c	23.38 b	17.16
ANOVA						
Cultivar (A)		**	**	**	**	**
Year (B)		*	ns	**	**	ns
A ´ B		ns	ns	**	**	ns

**significant differences among means at $P < 0.05$ and $P < 0.01$ based on the Dunnett's test and ANOVA results (F-test); A, B treatments in cultivars and years; ns – non-significant; a-c non-justified differences at $P < 0.01$ based on the Duncan's multiple range test

features, whose values tended to be higher in the years with favourable ecological conditions, significantly higher numbers of nodes were recorded in the first, then in the second year of the trial, while the lowest number of nodes was recorded in the fourth trial year. This trend occurred due to the fact that nodes and fruit-bearing branches are formed in the previous year and – on a year-old shoots – in the second half of the vegetation period. The years of the trial period (2002 and 2004) were characterised by favourable meteorological conditions.

The analysis of variance of the number of reproductive nodes points to the presence of significant differences among cultivars, years and their different interaction in the respective years (Table 2). A significantly higher number of reproductive nodes in comparison with the control cultivar were recorded in the Meeker cultivar ($P < 0.05$), while significantly lower values of this feature were found in the Latham cultivar ($P < 0.01$) and the K 81-6 selection ($P < 0.05$). Similarly to the number of nodes, the number of reproductive nodes was also bigger in the first year in comparison with the subsequent years of growth, which can be related to the very favourable weather conditions in the previous vegetation.

Regardless of the relatively narrow range within which the variations in the number of reproductive nodes occur, the raspberry cultivars and the selection showed significantly different behaviour during the trial. The smaller number of reproductive nodes in the Latham cultivar is mostly a result of the vigour, i.e. the larger length of the mature shoots.

The analysis of variance of the number of fruit-bearing branches has revealed significant differences among the cultivars, which points to the fact that this feature predominantly a cultivar-related trait and the impact made on it by the ecological factors during the trial was minimal. Apart from the Meeker cultivar, whose number of fruit-bearing branches did not significantly differ from the control cultivar, the other raspberry cultivars and the selection demonstrated a significantly lower number of fruit-bearing branches per shoot, when compared with the Willamette cultivar ($P < 0.01$), thus confirming the results obtained by Marinkovic et al. (2008).

The analysis of variance revealed the presence of significant differences in the length of fruit-bearing branches among the cultivars (Table 3). As regards the length of the fruit-bearing branches, all of the red raspberry cultivars and the selection recorded significantly higher values than the control cultivar ($P < 0.01$), which is in accordance with the results obtained by Stanisavljević (1990), Joublan et al. (2002) and Veličković et al. (2004).

A significantly lower length of the fruit-bearing branches was recorded in the red raspberry cultivars and the selection in the third year, which corresponded with an unfavourable pattern of rainfall and very high temperatures, causing a reduction in the vegetative growth, which automatically led to

Table 3
Characteristics of lateral fruit-bearing branches of the examined raspberry cultivars and raspberry selection

Treatment		Branch lenght	Number of flowers per fruit-bearing branch	Number of flowers per inflorescence	Number of fruits per reproductive nodus	Number of developed leaves
Cultivar (A)	Meeker	50.94**	16.85*	3.70 ns	15.96*	44.49*
	Latham	66.29**	12.81**	3.14**	11.28**	45.91**
	K 81-6	48.08**	16.94*	3.74 ns	15.80**	37.25*
	Tulameen	56.70**	16.76**	3.36*	15.50**	38.08 ns
	Willamette	43.50	18.21	3.79	17.28	40.66
Year (B)	2003	53.44 b	16.99 a	3.73 a	16.04 a	42.19
	2004	52.98 b	16.97 a	3.77 a	16.05 a	41.46
	2005	50.20 c	15.31 b	3.19 b	13.47 b	41.26
	2006	55.78 a	15.99 ab	3.49 ab	15.09 a	40.20
ANOVA						
Cultivar (A)		**	**	**	**	**
Year (B)		**	**	**	**	ns
A × B		ns	ns	ns	ns	ns

**significant differences among means at $P < 0.05$ and $P < 0.01$ based on the Dunnett's test and ANOVA results (F-test); A, B treatments in cultivars and years; ns – non-significant; a-c non-justified differences at $P < 0.01$ based on the Duncan's multiple range test

a smaller length of the fruit-bearing branches. As opposed to this, a significantly larger length of fruit-bearing branches was recorded in the corresponding cultivars and the selection in the fourth year of trial, which is due to the favourable weather conditions. No significant differences in the length of fruit-bearing branches were detected in the first and the second years.

The results obtained by the analysis of variance related to the number of flowers per fruit-bearing branch (Table 3) point to the presence of significant differences among the cultivars and the years of the trial, which further on leads to a conclusion that the demonstration of this cultivar trait was to a large degree conditioned by the impact of environmental factors.

Compared with the Willamette cultivar, a significantly lower number of flowers per fruit-bearing branch was recorded in all the cultivars - Latham, Tulameen ($P < 0.01$), Meeker and the K 81-6 selection ($P < 0.05$). The obtained results are in agreement with the results obtained by Orhan et al. (2008). A significantly higher number of flowers per fruit-bearing branch were found in the first and the second year of the trial, when compared to trial year number three, while the values in the fourth year did not significantly differ from the values obtained in the preceding years. A major difference among the cultivars and among the years regarding the number of flowers in the inflorescence (Table 3), as well as in the number of flowers per fruit-bearing branch, point to the fact that this features can be to a large extent influenced by the ecological factors.

The control cultivar had a significantly larger number of flowers in the inflorescence when compared to the Latham ($P < 0.01$) and Tulameen ($P < 0.05$) cultivars, while no significant difference in this parameter was found between the control cultivar on one side and the K 81-6 selection and the Meeker cultivar, on the other side. When contemplated from the aspect of the year, the red raspberry cultivars and the selection recorded a significantly lower number of flowers in the inflorescence in the third year, compared to years one and two of the trial, while at the same time the values in the fourth year did not differ significantly in comparison with the two previous years. The number of fruits per reproductive node was significantly different among the respective cultivars and among the years, whish points to the fact that this trait can vary significantly, due to the impact of the environment.

The Willamette cultivar recorded a larger number of fruits per reproductive node, compared to the other cultivars and the raspberry selection. In the course of the trial, all of the red raspberry cultivars and the selection demonstrated similar tendencies regarding this trait. A significantly lower number of fruits per reproductive node were recorded in the cultivars in the third year of the trial, when compared to other trial years. High temperatures, accompanied by low air humidity during the flowering phase in 2005 made an impact on the pollination process, which automatically led to a reduction in the number of fruits per reproductive node. The most emphasised reduction in the stated year was recorded in the Latham cultivar (Table 3).

Based on the analysis of variance, the number of developed leaves can be considered as a cultivar trait, not significantly influenced by the ecological factors (Table 3). A significantly higher number of developed leaves when compared with the control cultivar, was determined in the Latham ($P < 0.01$) and Meeker ($P < 0.05$) cultivars, while the K 81-6 selection had a significantly lower number of developed leaves ($P < 0.05$).

Conclusion

A significantly higher vegetative potential, reflected in the number of young shoots of the first and the second generations, as well as the number of young shoots per metre of length and mature shoot, was recorded in the Latham cultivar compared to the Willamette cultivar, while cultivars Tulameen and Meeker recorded considerably lower values of this parameter.

The removal of the first series of young shoots ought to be adapted to the specific cultivar traits, and the meteorological characteristics of the region. A considerably larger height of the shoot when compared with the control group was recorded in the Meeker and Tulameen cultivars. The largest diameter of the mature shoots was recorded in the K 81-6 selection, while the smallest one was recorded in the Willamette cultivar.

The largest number of nodes was recorded in the Latham and Meeker cultivars, while the smallest number of nodes was recorded in the K 81-6 selection. As opposed to this, the largest number of reproductive nodes was established in the Meeker and Willamette cultivars, while their smallest number was found in the Latham cultivar.

The largest number of the fruit-bearing branches was recorded in the Willamette cultivar, while the smallest number was found in the Latham cultivar. The largest number of reproductive nodes and fruit-bearing branches per shoot in all the tested cultivars and the selection was recorded in the first and the third year of the trial. The largest length of the fruit-bearing branches was recorded in the Latham cultivar, while the smallest length of the branches was recorded in the Willamette cultivar.

The largest number of flowers per fruit-bearing branch, as well as the number of flowers per inflorescence and fruits per reproductive node, was determined in the Willamette

cultivar, while the smallest values of these parameters were found in the Latham cultivar. The largest number of developed leaves was determined in the Latham cultivar, while the smallest one was determined in the K 81-6 selection.

Acknowledgements

Supported by the Ministry of Education, Science and Technological Development of the Serbia, Projects No. TR-31064 and No. TR-31093.

References

Cicala, A., A. Continella and F. Ferlito, 2002. Preliminary results of primocane-fruiting red raspberry cultivars in Sicily. *Acta Horticulturae*, **585**: 191-195.

Crandall, P. C., J. D. Chamberlain and K. A. Biderbost, 1974. Cane characteristics associated with berry number of red raspberry. *Journal of the American Society for Horticultural Science*, **99**: 370-372.

Crandall, P. C., 1980. Twenty years of red raspberry research in southwestern Washington State. *Acta Horticulture*. **112**: 53-58.

Eyduran, S. P., E. Eyduran and Y. S. Agaoglu, 2008. Estimation of fruit weight by cane traits for various raspberries (*Rubus ideaus* L.) cultivars. *African Journal of Biotechnology*, 7: 3044-3052.

Freeman, J. A., G. W. Eaton, T. E. Baumann, H. A. Daubeny and A. Dale, 1989. Primocane removal enhances yield components of raspberries. *Journal of the American Society for Horticultural Science*, **114**: 6-9.

Joublan, J. P., P. Banados and A. Marchant, 2002. Adaptacion y comportamiento de cultivares de frambueso en la provincia de Ñuble. *Agro Sur*, **30**: 15-27.

Казаков, И. В., 1995. Малина в вашем саду. *Брянск*, 142 pp. (Ru).

Koron, D., 2004. Testing of new raspberry varieties in Slovenia. *Jugoslovensko voćarstvo*, **38**: 67-72.

Leposavić, A., D. Đurović, Z. Keserović, B. Popović, O. Mitrović, N. Miletić and N. Magazin, 2013. Evaluation of raspberry cultivars grown in the western Serbia region. *Horticultural Science*, **40 (**1): 1-7.

Marinkovic, D., S. Djurovic, S. Markovic and C. Kempler, 2008. Response of Seven Red Raspberry Cultivars to the Environmental Conditions of Northern Serbia. *Journal of the American Pomological Society*, **62**: 178-184.

Orhan, E., A. Esitken, S. Ercisli, M. Turan and F. Sahin, 2006. Effects of plant growth promoting rhizobacteria (PGPR) on yield, growth and nutrient contents in organically growing raspberry. *Scientia Horticulturae*, **111**: 38-43.

Petrović, S. and A. Leposavić, 2011. Raspberry – New technologies of cultivation, preservation and processing. Čačak, *Fruit Research Institute*, 230 pp. (Sr).

Stanisavljević, M., 1990. Impact of late snowfall on trimming of fruit-bearing branches of raspberry. *Jugoslovensko voćarstvo*, **24**: 15-20.

Veličković, M., T. Vulić, Lj. Milinković and M. Stanisavljević, 2004. Vegetative and generative potential of major raspberry cultivars and selections in the agro-ecological conditions of the Dragačevo raspberry-growing region. *Jugoslovensko voćarstvo*, **38**: 101-108.

Received January, 22, 2014; accepted for printing December, 2, 2014.