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Occurrence of phenological stages in currant cultivars (*Ribes* sp.)

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ABSTRACT

An experiment was conducted over a period of three years to systematically examine patterns of occurrence of periodic life-cycle events or phenological stages (beginning of leaf unfolding, full leaf unfolding, inflorescence emergence, beginning of flowering, full flowering, beginning of berry set and berry ripening) in currant cultivars (Ribes sp.). The experiment included nine black currant cultivars, ten red currant cultivars and three white currant cultivars. The phenological properties of tested currant cultivars were determined using international descriptors for black currants (CPVO-TP/040/2 – UPOV, 2009), and for red and white currants (CPVO-TP/52/1 – UPOV, 2004). The tested cultivars showed differences in the phenological traits. Under the agro-environmental conditions of Čačak, black currant cultivars entered earlier into phenological stages compared to red currant and white currant cultivars. The earliest occurrence of phenological events was observed in black currant cultivars 'Čačanska Crna' and 'Tisel', red currant cultivar 'Junifer', and white currant cultivar 'Primus'. On the other hand, almost all phenological stages of the latest were recorded in cultivars 'Titania' (black currant), 'Rovada' (red currant), and 'Weisse aus Juteborg' (white currant), except for the ripening phase, which occurred the latest in 'Ben Lomond'(black currant) and 'Industria' (red currant). The results indicated that the tested cultivars are suitable for growing under the agroclimatic conditions of Čačak, Western Serbia, given their late entry into the flowering stage as their important characteristic in terms of preventing damage due to late spring frosts.

Keywords: *black, red and white currant, cultivar, phenological traits.*

INTRODUCTION

Currants (*Ribes* sp.) are ranked the second small fruit globally after strawberries in terms of the volume of production. However, currant production in Serbia is negligible, although there are demands for this fruit species and favorable natural conditions for its growing. Serbia is among the lowest-ranked countries in Europe and globally for currant production, with yields ranging from only 100 to 150 tons. Currants are generally grown in home gardens as individual bushes, but it is produced in orchards rarely in Serbia. The importance of currant growing is mainly based on its early cropping, high and regular yields, and relatively lesser investments in establishment and maintenance plantations. It's an early-season small fruit crop that begins the growing season much earlier than other continental fruit species (Mišić, 2002). The onset and length of phenological stages are genotype-specific

and affected not only by heritable factors but also by agro-environmental conditions. Currants thrive in humid mountainous areas characterized by cool summers, high rainfall amounts, and high humidity levels. It is characterized by winter hardiness, while high summer temperatures and drought during summer cause problems in black currant cultivation and directly affect productivity and fruit quality. Sønsteby et al. (2012) reported that day length and temperature directly impact phenological stages overall, particularly flowering, causing currant cultivars to respond differently to climatic variations. According to Nikolić and Milivojević (2010), climatic conditions in a particular environment affect the planting longevity, productivity, fruit quality, and overall profitability of currant production. Generally, the occurrence of phenological stages in currant is very important to obtain high yields and good fruit quality.

With this in mind, the purpose of the investigation was to examine the phenological traits of the different black, red, and white currant cultivars.

MATERIALS AND METHODS

The research was conducted at the Fruit Research Institute, Čačak, West Serbia, during 2017–2019. The currant orchard was established in the spring of 2011 using two-year-old plants. Currants are grown as bushes at a spacing of 3 m between rows and 1 m in the row. The currant planting is located at 242 m a.s.l. The experiment included nine black currant cultivars (‘Ben Lomond’, ‘Ben Sarek’, ‘Tsema’, ‘Titania’, ‘Čačanska Crna’, ‘Tisel’, ‘Tiben’, ‘Tenah’, ‘Black Reward’), ten red currant cultivars (‘Losan’, ‘Redpoll’, ‘Rovada’, ‘Detvan’, ‘Junifer’, ‘Jonkherr van Tets’, ‘Industria’, ‘Red Lake’, ‘Rondom’, ‘Rolan’) and three white currant cultivars (‘Weisse aus Juteborg’, ‘Primus’, ‘Blanka’). During the experimental period, standard cultural and cane management practices were employed, and a drip irrigation system was used.

The phenological properties of tested currant cultivars were determined using international descriptors for black (CPVO-TP/040/2 – UPOV, 2009), and for red and white (CPVO-TP/52/1 – UPOV, 2004) currant. The following phenological parameters were examined: i) Time of leaf unfolding – recorded as the date of first leaf emergence from the winter bud. Based on the leaf unfolding date, the tested cultivars were classified into early, medium, and late leaf unfolding; ii) Time of inflorescence emergence, i.e. the date of first inflorescence emergence from the generative bud; iii) Time of beginning of flowering – i.e. the moment when 10% of the total number of flowers were open; full flowering – the moment when 90 % of flowers were open. According to their flowering times, the cultivars were classified into early, medium, and late flowering; iv) Time of first berry set – recorded as the date of first berry set, and v) Time of berry ripening, i.e. date of full or harvest maturity of the fruit (harvest date), according to which the cultivars were classified into very early, early, medium, late, and very late ripening.

RESULTS AND DISCUSSION

The research conducted over the three-year period involved systematic monitoring and examination of patterns of occurrence of periodic life-cycle events or growth stages in currant cultivars. Data on leaf unfolding and inflorescence emergence dates in the tested cultivars are presented in Table 1. Under the agro-environmental conditions of Serbia, the average first leaf unfolding date was 14 March for black currant, 23 March for red currant and 22 March for white currant. On average, full leaf unfolding occurred 7 days after the the

date of first leaf unfolding day in black and white currants (21 March and 29 March, respectively) and 8 days in red currants (31 March). The average difference in the date of first leaf unfolding between black and red currants was 9 days, black and white currants 8 days, and red and white currants 1 day. In terms of full leaf unfolding, the differences were 10 days between black and red currants, 8 days between black and white currants, and 2 days between red and white currants. The studied cultivars differed in the time of the first leaf unfolding. The earliest date of the beginning of leaf unfolding and full leaf unfolding were observed in black currant cultivars 'Čačanska Crna' and 'Tisel', and the latest in 'Titania'. In terms of red and white currants, the earliest date of leaf unfolding and full leaf was in 'Junifer' and 'Primus', while the latest occurred in 'Rovada' and 'Weisse aus Juteborg'. The period between the beginning of leaf unfolding and full leaf unfolding was shortest in the black and red currant cultivars 'Ben Sarek' and 'Redpoll' (5 days on average), and in the white currant cultivars 'Primus' and 'Weisse aus Juteborg' (7 days on average). In contrast, the longest periods were recorded in the black currant cultivars 'Tsema', 'Black Reward' and 'Tenah' (9 days on average), in the red currant cultivar 'Rovada' (10 days on average), and in the white currant culivar 'Blanka' (8 days on average).

According to international descriptors for black currants (CPVO-TP/040/2 – UPOV, 2009) based on the time of first leaf unfolding, the cultivars were classified into two groups: i) Medium early (6–10 March): 'Čačanska Crna' and 'Tisel', and ii) Late (after 11 March): 'Ben Lomond', 'Titania', 'Tsema', 'Ben Sarek', 'Tiben', 'Black Reward' and 'Tenah'. Based on the international descriptor for red and white currants (CPVO-TP/52/1 – UPOV, 2004), the tested cultivars were classified as follows: i) Early (up to 15 March): 'Junifer' and 'Detvan'; ii) Medium early (16–20 March): 'Losan', 'Jonkherr van Tets', amd 'Primus'; and iii) Late (after 21 March): 'Redpoll', 'Industria', 'Red Lake', 'Rovada', 'Rondom', 'Rolan', 'Weisse aus Juteborg' and 'Blanka'.

Inflorescence emergence occurred an average of 17 days after full leaf unfolding in black currant (7 April), 12 days in red currant (12 April), and 16 days in white currant (14 April). The difference in the time of inflorescence emergence was 5 days between black and red currants, 7 days between black and white currants, and 2 days between red and white currants. The earliest inflorescence emergence was observed in the black currant cultivars 'Čačanska Crna' and 'Tisel,' the red currant cultivar 'Junifer,' and the white currant cultivar 'Primus.' In contrast, the latest emergence was recorded in 'Titania' (black currant), 'Rovada' (red currant), and 'Weisse aus Juteborg' (white currant). The period between full leaf unfolding and inflorescence emergence was shortest for the black currant 'Black Reward' (14 days on average), red currant 'Rovada' (10 days on average), and white currant 'Blanka' (15 days on average). On the other hand, the longest periods were observed in black currant 'Tiben' (18 days on average), red currant 'Detvan' (17 days on average), and white currant 'Primus' (17 days on average).

The classification of the cultivars in this experiment according to the onset dates for leaf unfolding is partially comparable with the classification provided by Laugale (2007), who classified the examined cultivars of black currants into three groups: early, mid-early, and late, determining that the largest number of cultivars belongs to the mid-early group. Comparison of the present data on the time and dynamics of leaf unfolding suggests their compliance with the results of Djordjević (2012) obtained under the agro-environmental conditions of Serbia, but not with those of Georgiev et al. (2008) in Bulgaria, nor with the findings of Rotundo et al. (1998) in Southern Italian mountains where currants enter the leaf unfolding stage at the end of March/beginning of April, with black currant cultivars entering this phase a few days earlier than red currant cultivars. Following the phenological dynamics

of red currant cultivars, Čolić et al. (2007) established that in the territory of Serbia, red currants enter the vegetative period from 28 March to 3 April, while Stanisavljević et al. (1999) noted that black currant cultivar 'Čačanska Crna' is characterized by particularly early entry into the vegetative phase.

Table 1. Dates of leaf unfolding and inflorescence emergence in currant cultivars

Cultivars	**Beginning of leaf unfolding**	**Full leaf unfolding**	**Inflorescence emergence**
'Ben Lomond'	17 March	24 March	9 April
'Ben Sarek'	13 March	18 March	6 April
'Tsema'	16 March	25 March	11 April
'Titania'	19 March	27 March	13 April
'Čačanska Crna'	10 March	16 March	2 April
'Tisel'	10 March	17 March	2 April
'Tiben'	14 March	20 March	7 April
'Tenah'	16 March	25 March	10 April
'Black Reward'	13 March	22 March	5 April
Average across black currant cultivars	14 March	21 March	07 April
'Losan'	19 March	28 March	13 April
'Redpoll'	24 March	29 March	10 April
'Rovada'	29 March	8 April	18 April
'Detvan'	14 March	21 March	7 April
'Junifer'	13 March	20 March	5 April
'Jonkherr van Tets'	20 March	26 March	11 April
'Industria'	26 March	3 April	14 April
'Red Lake'	25 March	2 April	13 April
'Rondom'	28 March	6 April	17 April
'Rolan'	27 March	4 April	15 April
Average across red currant cultivars	23 March	31 March	12 April
'Weisse aus Juteborg'	24 March	31 March	16 April
'Primus'	20 March	27 March	13 April
'Blanka'	22 March	30 March	14 April
Average across white currant cultivars	22 March	29 March	14 April

The beginning of flowering was 7 days on average after inflorescence emergence in black and white currants (14 April and 21 April, respectively), and 8 days on average in red currants (20 April), while full flowering was 7 days after the beginning of flowering in black currants (21 April) and 6 days in red currants (26 April) and white currants (27 April). Data on flowering dates in the tested cultivars are given in Table 2. The difference in the time of beginning of flowering was 6 days between black and red currants, 7 days between black and white currants, and 1 day between red and white currants. Conversely, the difference in the time of full flowering was 5 days between black and red currants, 6 days between black and white currants, and 1 day between red and white currants. Flowering was the earliest in 'Čačanska Crna' and 'Tisel' (black currant), 'Junifer' (red currant), and 'Primus' (white

currant), and the latest in 'Titania' (black currant), 'Rovada' (red currant) and 'Weisse aus Juteborg' (white currant). The shortest period between inflorescence emergence and the beginning of flowering in currant was observed in 'Ben Sarek', 'Tsema', 'Losan', and 'Primus', which averaged 5 days, whereas the longest was recorded for black currant 'Tiben' (9 days on average), red currant 'Redpoll' (10 days on average), and white currant 'Weisse aus Juteborg' (8 days on average). The period between the beginning of flowering and full flowering was shortest in black currant 'Black Reward' and red currant 'Jonkherr van Tets' (4 days on average), and in 'Blanka' (5 days on average). In contrast, the longest period was noted for black currant 'Ben Lomond' (9 days on average), red currant 'Detvan' (8 days on average), and white currant 'Primus' (7 days on average).

Based on the international descriptor for black currant (CPVO-TP/040/2 – UPOV, 2009), and for red and white currant (CPVO-TP/52/1 – UPOV, 2004), all cultivars were classified into late flowering cultivars.

The analysis of the experimental data on the classification of the tested cultivars according to the time of flowering suggests that the data are partially comparable with the classification provided by Laugale (2007) and Djordjević (2012). Madry et al. (2010) classified 'Ben Lomond' into late flowering cultivars, 'Tiben', 'Tisel' and 'Titania' into medium flowering cultivars, and 'Ben Sarek' into early flowering cultivars, whereas Denisow (2004) grouped 'Ben Lomond' and 'Titania' into medium early flowering cultivars. These findings are not in agreement with the present data. Pedersen (2008) found that the 'Čačanska Crna' cultivar stands out for its earliest flowering initiation and earliest entry into full flowering. Vulić et al. (2012) recorded that the red currant 'Junifer' enters the flowering phenological phase first, and 'Rovada' enters last. The experimental results on flowering time in currant cultivars are not comparable with those of numerous studies conducted under the conditions of Poland (Pluta and Zurawicz, 2008; Pluta et al., 2008), Denmark (Pedersen, 2010; Pedersen and Andersen, 2012), Estonia (Kaldmae et al., 2013) and Italy (Rotundo et al., 1998). The differences are due to colder climates and higher altitudes, as well as to the later occurrence of the growing season and, hence later flowering in these studies.

Berry set occurred 5 days on average after full flowering in black currants (26 April), 8 days in red currants (4 May), and 6 days in white currants (3 May). On the other hand, berry ripening started 58 days on average after berry set in black currants (23 June), 55 days in red currants (28 June), and 51 days in white currants (23 June). Data on the onset dates of berry set and berry ripening in the tested cultivars are presented in Table 2. The difference in the dates of the beginning of berry set was 8 days between black and red currants, 7 days between black and white currants, and 1 day between red and white currants. Conversely, the difference in the time of berry ripening was 5 days between black and white currants, and red and white currants, while there was no difference between black and white currants. 'Čačanska Crna' (black currant), 'Junifer' (red currant), and 'Primus' (white currant) had the earliest berry set and berry ripening dates, and 'Titania' (black currant), 'Rovada' (red currant) and 'Weisse aus Juteborg' (white currant) had the latest. The period between full flowering and berry set was the shortest in the black currant 'Titania' (4 days on average), followed by the red currant 'Detvan' and white currant 'Weisse aus Juteborg' (5 days on average). In contrast, the longest period was observed in the black currants 'Tiben' and 'Tisel' (7 days on average), the red currant 'Rovada' (8 days on average), and the white currant 'Blanka' (6 days on average). The period between berry set and berry ripening was shortest for the black currant 'Tenah' (55 days on average), the red currant 'Rolan' (47 days on average), and the white currant 'Primus' (50 days on average). The longest period was in

the black currant 'Ben Lomond' (60 days on average), the red currant 'Rovada' (67 days on average), and the white currant 'Weisse aus Juteborg' (53 days on average).

Table 2. Dates of flowering, berry set and berry ripening in currant cultivars

Cultivars	Beginning of flowering	Full flowering	Beginning of berry set	Berry ripening
'Ben Lomond'	15 April	24 April	29 April	28 June
'Ben Sarek'	11 April	19 April	25 April	21 June
'Tsema'	16 April	23 April	29 April	25 June
'Titania'	19 April	26 April	30 April	27 June
'Čačanska Crna'	8 April	14 April	20 April	19 June
'Tisel'	9 April	15 April	21 April	19 June
'Tiben'	16 April	21 April	28 April	23 June
'Tenah'	17 April	25 April	30 April	24 June
'Black Reward'	14 April	18 April	25 April	22 June
Average across black currant cultivars	14 April	21 April	26 April	23 June
'Losan'	18 April	24 April	1 May	21 June
'Redpoll'	20 April	27 April	3 May	7 July
'Rovada'	25 April	30 April	8 May	4 July
'Detvan'	14 April	22 April	27 April	21 June
'Junifer'	12 April	19 April	25 April	20 June
'Jonkherr van Tets'	19 April	23 April	30 April	20 June
'Industria'	20 April	26 April	2 May	11 July
'Red Lake'	21 April	27 April	3 May	25 June
'Rondom'	24 April	30 April	7 May	5 July
'Rolan'	23 April	29 April	6 May	22 June
Average across red currant cultivars	20 April	26 April	4 May	28 June
'Weisse aus Juteborg'	24 April	30 April	5 May	27 June
'Primus'	18 April	25 April	1 May	20 June
'Blanka'	21 April	26 April	3 May	24 June
Average across white currant cultivars	21 April	27 April	3 May	23 June

According to berry ripening time (CPVO-TP/040/2 – UPOV, 2009), the tested cultivars were designated to three groups: i) Early (15–20 June): 'Tisel' and 'Čačanska Crna'; ii) Medium (21–25 June): 'Ben Sarek', 'Tsema', 'Titania', 'Tiben','Tenah' and 'Black Reward'; and 3. Late (26–30 June): 'Ben Lomond' and 'Titania'. Based on the international descriptor for berry ripening time in red and white currants (CPVO-TP/52/1 – UPOV, 2004), the tested cultivars were classified as follows: i) Medium early (15–25 June): 'Losan', 'Detvan', 'Junifer', 'Jonkherr van Tets', 'Red Lake', 'Rolan', 'Primus' and 'Blanka'; ii) Late (26–30 June): 'Weisse aus Juteborg'; and iii) Very late (from 1 July): 'Redpoll', 'Industria', 'Rovada' and 'Rondom'.

The classification according to the berry ripening time is generally consistent with those made by Moyer et al. (2002), Laugale (2007), Pluta and Zurawicz (2008), Djordjević (2012) and Sasnauskas et al. (2012), but it does not correspond to the classification presented by Mišić (2002), Stanisavljević et al. (2002) and Nikolić and Milivojević (2010), who

classified 'Čačanska Crna' as medium early ripening and 'Ben Lomond' and 'Ben Sarek' as early ripening cultivars. According to Pedersen (2010), the berries of red currant cultivars grown under the same agro-climatic conditions ripened later than those of black currant cultivars. Also, Brennan (1996), Mišić (2002), Čolić et al. (2007), and Estrella et al. (2007) reported that the period for berry growth and development a length of 70 to 93 days, depending on weather conditions, which is significantly different from the findings in the present study. By monitoring the phenological characteristics of red currant cultivars over fifteen years in Slovak conditions, Štastný et al. (2002) concluded that their fruits generally ripen on average on 2 July, with variations from 24 June to 13 July, while under German conditions, ripened on average on 4 July, with variations from 24 June to 16 July. Toldam-Andersen and Jensen (2004) found that the ripening phase of red and white currant fruits begins in the second half of July and lasts about 15 days, while Dalman (1999) noted that in Finland cultivars ripen by mid-July, i.e. 'Jonkherr van Tets' ripened early, and 'Rondom' ripened late. Also, in Bulgaria, Georgiev et al. (2008) recorded that the cultivar 'Jonkherr van Tets' had the earliest berry ripening, on average 24 June, while the latest had the cultivar 'Rovada', about three weeks later. Estrella et al. (2007) determined that the harvest of red currant fruits begins on average 9 July, while Čolić et al. (2007) recorded that in the area of Belgrade, red currant fruits generally ripened from 8 June to 24 June, with an average of 17 June. Generally, research findings on the time of berry ripening in many foreign studies (Kawecki et al., 2006; Pluta et al., 2007; 2008; Pedersen and Andersen, 2012; Kaldmae et al., 2013) are not comparable with the results of the present three-year experiment conducted under temperate continental climate conditions. The differences in the phenological stages may be attributed to colder regions and higher altitudes in the other studies, leading to a late onset of the growing season and, hence, late fruit harvest.

CONCLUSION

The tested cultivars are suitable for growing under the agroclimatic conditions of Čačak, Western Serbia, given the delayed onset of the growing season in general and flowering stage in particular, which is an important characteristic due to which late spring frost damage is avoided.

Knowledge of the phenology of currant as a fruit species that demonstrates an early entry into the growing season and flowering is of particular importance when choosing an appropriate location for a currant planting and, accordingly, when making a proper choice of cultivars.

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REFERENCES

Brennan, R.M. (1996). Currants and gooseberries. In *Fruit Breeding. Vine and Small Fruits Crops, Janick J. & Moore J. N. (eds). John Wiley and Sons, Inc, New York, 2,* 191–295.

Dalman, P. (1999): Evaluation of red currant cultivars in Finland. *Acta Horticulturae, 505,* 319–322.

Djordjević, S.B. (2012). Production, nutritional and anti-oxidative properties of currant cultivars *Ribes* cv.). *Doctoral dissertation, University of Belgrade, Faculty of Agriculture*, pp. 56–63.

Denisow, B. (2004). The influence of artificial wind blow on the pollination and fructification of blackcurrant (*Ribes nigrum*) cultivars. *Acta Scientiarum Polonorum*, *Hortorum Cultus*, *3*(1), 89–96.

Estrella, N., Sparks, T.H., & Menzel, A. (2007). Trends and temperature response in the phenology of crops in Germany. *Global Change Biology*, *13*, 1737–1747.

Georgiev, D., Dinkova, H., & Georgieva, M. (2008). Study of newly introduced cultivars of black and red currant. In *Proceedings of International Scientific Conference „Sustainable Fruit Growing: From Plant to Product", Latvia*, 44–53.

Kaldmae, H., Kikas, A., Arus, L., & Libek, A. (2013). Genotype and microclimate conditions influence ripening pattern and quality of blackcurrant (*Ribes nigrum* L.) fruit. *Zemdirbyste Agriculture*, *100*, 164–174.

Kawecki, Z., Bieniek, A., Kopytowski, J., & Šiksnianas, T. (2006). Preliminary assessment of productivity and fruit quality of Lithuanian and Ukrainian cultivars of blackcurrant under the climatic conditions of Olsztyn. *Journal of Fruit and Ornamental Plant Research*, *14*, 75–80.

Laugale, V. (2007). Evaluation of black currant collection in Pure horticultural research station, Latvia. *Scientific works of the Lithuanian Institute of Horticulture and Lithuanian University of Agriculture, 26*, 93–101.

Mišić, D.P. (2002). Breeding of fruit crops. *Parthenon, Belgrade*, pp. 397–408.

Madry, W., Pluta, S., Sieczko, L., & Studnicki, M. (2010). Phenotypic diversity in a sample of blackcurrant (*Ribes nigrum* L.) cultivars maintained in the Fruit Breeding Department at the Research Institute of Pomology and Floriculture in Skierniewice, Poland. *Journal of Fruit Ornamental Plant Research*, *18*(2), 23–37.

Moyer, A.R., Hummer, E.K., Finn, E.C., Frei, B., & Wrolstad, E.R. (2002). Antioxidant compounds in diverse *Ribes* and *Rubus* germplasm. *Acta Horticulturae*, *585*(2), 501–505.

Nikolić, M. & Milivojević, J. (2010). *Small fruit crops. Production technology*. Scientific Pomological Society of Serbia, Belgrade, pp. 355–362.

Pedersen, H. L. (2008). Juice quality and yield capacity of black currant cultivars in Denmark. *Acta Horticulturae, 777*, 510–516.

Pedersen, H.L. (2010). Black and red currant cultivars for organic production. *Eco-fruit.14th International Conference on Organic Fruit-Growing, Universität Hohenheim*, 212–217.

Pedersen, L.H., & Andersen, L. (2012). Black and red currant cultivars for organic production. In *Proceedings of 15th International Conference on Organic Fruit-Growing, Hohenheim, Germany*, pp. 215–220.

Pluta, S., Zurawicz, E., Broniarek-Niemiec, A., & Markowski, J. (2007). Production and processing value of new blackcurrant cultivars and breeding clones in central Poland. *Scientific works of the Lithuanian Institute of Horticulture and Lithuanian University of Agriculture*, *26*, 309–317.

Pluta, S., Zurawicz, E., Krawiec, A., & Salamon, Z. (2008). Evaluation of the suitability of Polish blackcurrant cultivars for commercial cultivation. *Journal of Fruit Ornamental Plant Research*, *16*, 153–166.

Pluta, S., & Zurawicz, E. (2008). Suitability of the new Polish blackcurrant cultivars for mechanical fruit harvesting. In *Proceedings of International Scientific Conference „Sustainable Fruit Growing: From Plant To Product", Latvia*, 213–220.

Rotundo, A., Bounous, G., Benvenuti, S., Vampa, G., Melegari, M., & Soragni, F. (1998). Quality and yield of *Ribes* and *Rubus* cultivars grown in Southern Italy hilly locations. *Phytotherapy Research*, *12*, 135–137.

Sasnauskas, A., Siksnianas, T., Stanys V., & Bobinas, Č. (2012). Evaluation of agronomical characters of blackcurrant cultivars and selections in Lithuania. *Acta Horticulturae, 946*, 189–194.

Stanisavljević, M., Rakićević, M., Mitrović, O., & Gavrilović-Damjanović, J. (2002). Biological-pomological properties of some blackcurrant cultivars and selections. *Acta Horticulturae, 585*, 231–235.

Stanisavljevic, M., Tesovic, M., & Pavlovic, K. (1999): New small fruit cultivars from Cacak: 2. the new black currant (*Ribes nigrum* L.) cultivar 'Cacanska Crna'. *Acta Horticulturae, 505*, 297–302.

Sønsteby, A., Opstad N., & Heide, O.M. (2012). Effects of summer temperature on growth and flowering in six black currant cultivars (*Ribes nigrum* L.). *Journal of Horticultural Science and Biotechnology, 87*, 157–164.

Toldam-Andersen, T.B., & Jensen, S.L. (2004). Evaluation of red and white currant cultivars (R*ibes rubrum* L.) in the genebank collection at Pometet. *Acta Horticulturae, 649*, 315–318.

UPOV (2004). *Protocol for distinctness, uniformity and stability tests. Red and white currant (Ribes sylvestre (Lam.) Mert & W.D.J. Koch, Ribes niveum Lindl.).* International Union for the Protection of New Varieties of Plants.

UPOV (2009). *Protocol for distinctness, uniformity and stability tests. Blackcurrant (Ribes nigrum L.).* International Union for the Protection of New Varieties of Plants.

Vulić, T., Đorđević, B., Ruml, M., Đurović, D., Fotirić, M., Radivojević, D., & Oparnica, Č. (2012). Flowering dynamic and susceptibility of the flowers of black currant (*Ribes nigrum* L.) and red currant (*Ribes rubrum* L.) to spring frost. *Acta Horticulturae, 946*, 373–377.

Čolić, S., Zec, G., Marinković, D., & Janković, Z. (2007). Fenološko pomološke karakteristike crvene ribizle u uslovima Pančevačkog rita. *Zbornik naučnih radova XXII Savetovanja „Unapređenje proizvodnje voća i grožđa", 13*(5), 65–69.

Štastný, P., Luknárová, V., Tekušová, M., Dittmann, E., Bissolli, P., Kreis, A., & Müller-Westermeier, G. (2002). Evaluation of phenological data for climatological purposes in Slovakia and Germany. In *Proceedings of XIV. Česko-slovenská bioklimatologická konference, Lednice na Moravě*, pp. 610–618.