

Djina BOŽOVIĆ and Vučeta JAĆIMOVIĆ¹

PHENOLOGICAL PROPERTIES OF PLUMS UNDER THE CONDITIONS OF NORTHERN MONTENEGRO

ABSTRACT

In the three-year period the study of phenological characteristics of plum varieties in the conditions of northern Montenegro was performed. The following varieties were used as materials: *stenlej*, *čačanska lepotica*, *valjevka*, *čačanska rodna*, *kalifornijska plava*, *čačanska najbolja*, *čačanska rana*, *požegača*, *valerija*, *ana špet* and *anđelena*.

The studied varieties flower mainly in the third decade of April. Flowering intensity was in the interval from 1,7 (*anđelena*) to 4,7 (*čačanska najbolja* and *stenlej*).

In average, the earliest fruit ripening was identified at *čačanska rana* variety, and the latest at *ana špet* variety. Different periods of ripening enable fresh consumption of studied varieties' fruit in the interval of around two and a half of month.

Anđelena variety, during the three years of studying, although flowering each year (although the flowering intensity was low), has never managed to keep the set fruit and it was not possible to identify the period of ripening. Accordingly, it can reliably be said that *anđelena* variety cannot be grown in agro-ecological conditions of northern Montenegro.

Key words: Plum, variety, phenological properties, northern Montenegro.

INTRODUCTION

Variety is the basic prerequisite for profitable plum production (Misić, 2006; Milatović et al., 2011). The success in growing and producing fruit products to the largest extent depends on the correct choice of varieties. Genetic defects of a bad variety can neither be eliminated by natural optimal conditions, nor by application of modern cultivating technology. The variety, regardless to its quality, if cultivated in unsuitable agro-ecological conditions, will not be able to express its genetic potential. Therefore, the matter of variety selection is a fundamental question that any producer is facing with when cultivating plum trees on a particular site (Nenadović-Mratinić et al., 2007; Miletić and Petrović 1996; Miletić et al., 2001; Glišić et al., 2011; Dinka and al., 2007).

During the annual cycle of plum, flowering is the most critical phase due to the possibility of freezing of flowers caused by the late spring frosts which often occur in agro ecological conditions of northern Montenegro.

¹ Djina BOŽOVIĆ (corresponding author: bdjina@yahoo.com), Vučeta JAĆIMOVIĆ, University of Montenegro, Biotechnical faculty - Podgorica

The time of fruit ripening is a significant factor in selecting varieties for a specific site, as it is determining the realization of the fruit in the market. The aim of this study was, by identifying the time of flowering and ripening of significant plum varieties in northern Montenegro, to enable proper selection of varieties for commercial cultivation in this area.

MATERIAL AND METHODS

In the period from 2008 to 2010., the testing of phenological properties of 11 varieties of plums has been undertaken, in the conditions of northern part of Montenegro. Plantation is located in Kostenica village, at 860 m of altitude, exposition is north and northeast, and terrain inclination is around 2 %. One variety of Japanese or Chinese plum was used as a material in this study (*Prunus salicina* L) *anđelena* and 10 varieties of local plum (*Prunus domestica* L): *stenlej*, *čačanska lepotica*, *valjevka*, *čačanska rodna*, *kalifornijska plava*, *čačanska najbolja*, *čačanska rana*, *požegača*, *valerija*, *ana špet*.

All of the varieties were grafted on the cherry plum seedlings, except for the *požegača* which is of coppice form, the crown was established as improved pyramids and the distance between the seedlings was 6 x 5 m.

The area of northern Montenegro is characterized by humid, moderately continental, continental and mountainous climate. Meteorological conditions in the study period are given in Tables 1, 2, 3 and 4. and concern the largest municipality in the area - Bijelo Polje and are processed by the Hydrometeorological Service from Podgorica.

Tab. 1. Average monthly temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Ann
2008	0.3	3.2	6.7	11.1	15.8	19.5	20.5	20.9	14.3	11.7	6.4	2.5	11.1
2009	-0.4	1.3	4.8	12.5	16.2	18.3	20.9	21	16.5	9.8	6	3.9	10.9
2010	1.3	2.6	6.2	10.9	14.5	18.1	20.3	20.9	15.3	9.8	8.5	2	10.9

Tab.2. Absolute maximum temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Ann
2008	15	22	21	26.1	33.2	34.7	34.4	35.2	34.1	24.4	23.6	17.6	35.2
2009	15	17	18.8	24.2	31.4	33.6	36.5	34.5	33.4	28.1	19	20.1	36.5
2010	18	14.8	22.8	25.6	27.9	34.1	33.9	36	30.6	23.2	22.8	19.5	36

Tab.3. Absolute minimum temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Ann
2008	-17.1	-13.6	-3.8	-0.3	4.4	8.2	10.3	9.4	3.1	0.4	-12.3	-11	-17.1
2009	-17	-13.4	-5.4	1.4	3.3	7.3	9.1	12.6	8.2	-3.5	-3.4	-15.7	-17
2010	-11.2	-15	-10	0.8	5	7.8	11.1	9.6	4.4	-0.8	0.6	-11.6	-15

Tab.4. Monthly precipitations

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Ann
2008	36.3	11.9	115.7	14.7	36.1	65.3	65.5	67.4	69.4	61.2	101	150.9	795.4
2009	95.3	66.3	75.3	26.8	60	117.5	51.8	23.8	39.8	135.1	93.8	94.7	880.2
2010	101.3	80	69.7	79.8	79.6	56.2	85.1	16	80	68.4	131.1	147.3	994.5

Long-term average annual temperature is 8,9 °C. In winter, the temperature may do down to the -27 °C. Spring frosts appearing in April are especially detrimental, when in some years the absolute minimum was - 8 °C. In summer, the absolute maximum reaches up to 38 °C. Average multi-annual sum of precipitations is 893,3 l/m².

Meteorological conditions in the study period have indicated deviations from the multi-annual average. Average annual temperatures were higher in second and third year by 2 °C, and in the first year by 2,2 °C. Absolute minimum temperatures in April ranged from – 0,3 °C (2008) to 1,4 °C (2009).

Based on the multi-annual average for the quantity of precipitations it can be stated that 2008. was drier year, 2009. within the average and 2010. was significantly above the average regarding the humidity.

Phenophase of flowering was followed according to Wertheim (1996).

Flowering abundancy was expressed in numbers. Grade 0 indicates there is no flowering and grade 5 indicates maximum flower abundancy of the crown.

Phenophase of fruit ripening was set up according to Gvozdenović (1990).

RESULTS AND DISCUSSION

The earliest average start (15.04), full (19.04) and the end of flowering (26.04) were recorded in *anđelena* variety, Tab.1. Milatović et al. (2011) report that Japanese plum varieties in Belgrade area bloom in about a week earlier than European plums, and Livertani et al. (2010) suggest that in the conditions of northern Italy during the period of 11 years Japanese plums have blossomed 4-11 days earlier than the varieties of European (domestic) plum.

In a three-year period the early beginning of flowering (19.04) was also observed at *valerija* variety, and it is therefore considered early blooming variety, the same as *anđelena*. *Pozegaca* variety had an average start of blooming on 26th of April, and was therefore classified under late blooming varieties. Varieties of *ana špet*, *valjevka* and *kalifornijska plava* bloom medium late, and other studied varieties medium early. The studied varieties in this region bloom later compared to the Belgrade site, in about twenty days later (Milatović et al., 2011), and compared to the eastern Serbia in around 15 days (Miletic et al., 2001).

During the study, the lowest intensity of blooming was determined at *anđelena* variety, which was graded by 1,5. Varieties of *valerija*, *čačanska rana*, *čačanska najbolja*, *čačanska rodna*, *stenlej*, *čačanska leptica* and *kalifornijska plava* were abundantly flourishing (4 to 4,7). Milatović et al. (2011) report that the Japanese plum varieties flower more abundantly than the European ones. In

this study, it was not the case, which is consistent with the observations presented Nyéki and Szabó (2002) that Japanese plums grow in the areas where peaches and apricots are successfully grown, which the north of Montenegro is certainly not.

Tab.5. Flowering period of studied plum varieties, Kostenica, 2008-2010.

Variety	Start	Full	End	Abundancy (0-5)	Description
Valerija	19.04	23.04	29.04	4.0	Early
Ana Špet	24.04	27.04	03.05	2.3	Medium late
Anđelena	15.04	19.04	26.04	1.5	Early
Čačanska rodna	21.04	24.04	29.04	4.5	Medium early
Valjevka	23.04	27.04	01.05	3.9	Medium late
Čačanska rana	21.04	25.04	28.04	4.0	Medium early
Čačanska najbolja	21.04	23.04	28.04	4.7	Medium early
Stenlej	21.04	24.04	30.04	4.8	Medium early
Čačanska lepotica	20.04	23.04	29.04	4.3	Medium early
Kalifornijska plava	23.04	26.04	30.04	4.0	Medium late
Požegača	26.04	29.04	04.05	3.7	Late

In the study period, the average earliest period for picking up fruit was discovered at early grown varieties of *čačanska rana* (21.07-03.08) and *kalifornijska plava* (28.07-13.08), Tab.2. Variety *ana špet* is characterized by very late fruit ripening, in interval from 30th of September to 12th of October. If we compare the period of ripening of studied varieties in this area with the period of ripening of the same varieties in different climate and soil conditions, the diversity can be perceived (Miletić et al., 1996; 2001; Milenković et al., 2006; Popović et al., 2006; Nenadović-Mratinić et al., 2007; Dinkova et al., 2007; Milatović et al., 2011). Thus, the fruit of late varieties of plum in these climate conditions ripen even a month later, which is enabling their market placement in fresh condition during September, when there is a lower supply from other sites.

Anđelena variety, in the three year period of studying, although flowering each year (although the flowering intensity was low), has never managed to keep the fruit set, and it has not been possible to identify the period of ripening. Accordingly, it can reliably be said that *anđelena* variety cannot be grown in agro-ecological conditions of northern Montenegro. *Anđelena* is a variety of Chinese or Japanese plum (*Prunus salicina* Lindl.) characterized by having a short deep winter resting and early flowering, and are therefore sensitive to late spring frosts. Besides, varieties belonging to this type of plum are more sensitive to winter frosts than the European plums. That is why growing of varieties belonging to the *Prunus salicina* variety may provide good results only in the warmest areas, which, in Montenegrin conditions, would cover the Montenegrin coast and Podgorica with the surroundings.

Tab.6. Period of ripening and yield of the studied plum varieties, Kostenica, period 2008-2010.

Variety	Start	Full	End	Description
Valerija	09.08	16.08	22.08	Medium early
Ana Špet	30.09	07.10	12.10	Very late
Anđelena	-	-	-	-
Čačanska rodna	07.09	13.09	25.09	Medium late
Valjevka	17.09	23.09	28.09	Late
Čačanska rana	21.07	27.07	03.08	Early
Čačanska najbolja	17.08	26.08	01.09	Medium
Stenlej	07.09	15.09	24.09	Medium late
Čačanska lepotica	11.08	18.08	24.08	Medium early
Kalifornijska plava	28.07	07.08	13.08	Early
Požegača	22.09	28.09	05.10	Late

CONCLUSIONS

On basis of a three-years studying the following conclusion may be drawn:

-In average the earliest start (15.04), full bloom (19.04) and end of flowering (26.04) was recorded at variety of *anđelena*. The studied varieties belonging to a local plum flower in the third decade of April. Flowering intensity ranged in the interval from 1,7 (*anđelena*) to 4,7 (*čačanska najbolja* and *stenlej*).

-In average the earliest ripening of the fruit was recorded at variety of *čačanska rana*, and the latest at variety of *ana špet*. Different time of ripening provides fresh consumption of fruit of the studied varieties in the interval of around two and a half months.

-*Anđelena* variety, in the period of three years of studying, although flowering each year (although the flowering intensity was low), has never managed to keep the set fruit and it was not possible to identify the period of ripenin. Accordingly, it can reliably be said that *anđelena* variety cannot be grown in agro ecological conditions of northern Montenegro.

REFERENCES

- Dinkova H., Minev I., Stoyanova T. (2007): Vegetative and reproductive characteristics of plum cultivar Čačanska rodna in Troyan region. Voćarstvo, 41, 157-158: 41-44.
- Glišić I., Karaklajić-Stajić Ž., Mitrović O. (2011): Fenološko-pomološke osobine i organoleptička ocjena ploda novih sorti šljive Zlatka i Pozna plava u agroekološkim uslovima Čačka. Voćarstvo, 45, 173-178,15-22. (Phenological-pomological properties and organoleptic evaluation of the fruit of new plum varieties, Zlatka and Pozna plava, in agro-ecological conditions of Cacak. Fruit growing)

- Gvozdenović D, (1900): Berba i čuvanje voća, Nolit, Beograd. (Harvest and preservation of fruit)
- Liverani A., Giovannini D., Versari N., Sirri S., Brandi F. (2010): Japanese and European plum cultivar evaluation in the Po valley of Italy, yield and climate influence. *Acta horticulturae*, 874: 327-335.
- Milatović D., Đurović D., Zec G.(2011): *Voćarstvo*, 45:175-176, 101-108. (Fruit-growing)
- Milenković S., Ružić Đ., Cerović R., Ogašanović D., Tešović Ž., Mitrović M., Paunović S., Plazinić R., Marić S., Lukić M., Radičević S., Leposavić A., Milinković V. (2006): Sorte voćaka stvorene u Institutu za voćarstvo – Čačak. Institut za istraživanja u poljoprivredi Srbije.(Fruit cultivars created in the Fruit-growing Institute-Cacak. Institute for agriculture studies in Serbia)
- Miletić R., Petrović R. (1996): Pomološke osobine gajenih sorti šljive u dolini Timoka. *Jugoslovensko voćarstvo*, 30, 115-117: 263-269.(Pomological properties of plum grown cultivars in Timok valley. Yugoslav fruit-growing)
- Miletić R., Petrović R., Marić M. (2001): Pomološke osobine važnijih sorti šljive u istočnoj Srbiji. *Zbornik radova Proizvodnja, prerada i plasman šljive i proizvoda od šljive*, pp. 51-58.(Pomological properties of more important plum varieties in eastern Serbia. Collection of works> Production, processing and marketing of plum and plum products)
- Mišić P. D. (2006): Šljiva. Partenon, Beograd. (Plum)
- Nenadović-Mratinić E., Milatović D., Đurović D. (2007): Biološke osobine sorti šljive kombinovanih svojstava. *Voćarstvo*, 41, 157-158: 31-35.(Biological properties of plum cultivars of combined properties. Fruit growing)
- Szabó Z., Nyéki J. (2002): Japanese plums in Hungary. *Acta horticulturae*, 557: 65-71.
- Wertheim S. J. (1996): Methods for cross pollination and flowering assessment and their interpretation. *Acta horticulturae*, 423: 237-241.

Djina BOŽOVIĆ and Vučeta JAĆIMOVIĆ

**FENOLOŠKE OSOBINE SORTI ŠLJIVE U
USLOVIMA SJEVERNE CRNE GORE**

SAŽETAK

U trogodišnjem periodu je izvršeno ispitivanje fenoloških osobina sorti šljive u uslovima sjevernog dijela Crne Gore. Kao materijal poslužile su sledeće sorte: *stenlej*, *čačanska leptica*, *valjevka*, *čačanska rodna*, *kalifornijska plava*, *čačanska najbolja*, *čačanska rana*, *požegača*, *valerija*, *ana špet* i *anđelena*.

Ispitivane sorte cvjetaju, uglavnom, u trećoj dekadi aprila. Intenzitet cvjetanja je bio u intervalu od 1,7 (*anđelena*) do 4,7 (*čačanska najbolja* i *stenlej*).

Prosječno najranije zrenje ploda utvrđeno je kod sorte *čačanska rana*, a najkasnije kod sorte *ana špet*. Različito vrijeme zrenja omogućava svježju potrošnju plodova ispitivanih sorti u intervalu od oko dva i po mjeseca.

Sorta *anđelena* tokom tri godine ispitivanja, iako je svake godine cvjetala (mada je intenzitet cvjetanja bio nizak), nikada nije održala zametnute plodove, tako da kod nje nije bilo moguće utvrditi vrijeme zrenja. Na osnovu toga pouzdano se može reći da sorta *anđelena* ne može da se gaji u agroekološkim uslovima sjeverne Crne Gore.

Ključne riječi: Šljiva, sorte, fenološke osobine, sjeverna Crna Gora.