

# ‘Prima’ Sour Cherry

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‘Prima’ is a sour cherry variety released in 2013 by Farmers Association “Gazdaker” from Feketić, Autonomous Province of Vojvodina, Serbia. It is an excellent commercial cultivar for both, fresh consumption and processing markets, as well as for placement in amateur orchards. In the climatic conditions of northern Serbia, ‘Prima’ blooms relatively late, generally 3–5 d after ‘Érdi bőtermő’, and its fruits mature at the end of the second week of June, five days before ‘Érdi bőtermő’. ‘Prima’ is a medium vigor cultivar with distinctive upright growth, good fruit set and outstanding fruit quality. Its large dark purple red fruit is firm and possesses excellent eating quality due to high soluble solids content and acidity. The fruit flavor is pleasantly aromatic, described by consumer taste panels as “intense.” This cultivar is tolerant to fungal diseases, making it interesting for organic production.

## Origin

‘Prima’ was selected from domesticated regional landrace of sour cherry, locally called ‘Feketička’, traditionally grown in villages Feketić and Mali Idoš (central part of Autonomous Province of Vojvodina, Serbia). Landrace genetic variability is a result of numerous chance seedlings mixed with suckers, traditionally used in propagation. It is a morello type of sour cherry. The cultivar was selected by Prof. Dr. János Apostol (NARIC Fruitculture Research Institute, Budapest, Hungary), Mr. Gábor Bácsi (Head of Economy, Agriculture, Housing and Municipal Affairs and Environmental Protection, Municipality Mali Idoš), and Mr. Zsolt Horkai (local selection activist), as one of nine initially selected genotypes tested in parallel trials in Feketić and Čačak with cultivar Čačanski rubin as standard.

Historical narrative traces the origin of sour cherry growing in Feketić and

Mali Idoš to Bosnia and Herzegovina, where it was likely brought by Hungarian soldiers at the time of Austro-Hungarian rule. Over several centuries, interactions among the environment, human uses, and farming practices increased the phenotypic uniformity toward a few heritable fruit quality characters by which ‘Prima’ can be differentiated from other cultivars. It is a ‘Duke’ or ‘Morello’ type of sour cherry.

The official trials, funded and started by the Ministry of Agriculture of Serbia, were planted in two locations—Novi Sad and Čačak. At least 15 trees, divided in three replications, were used as test plots. The experimental design was completely randomized with ‘Čačanski rubin’ as standard cultivar. Officially elected Ministry Committee of experienced horticulturists and growers assessed the developmental characteristics of the new cultivar three times a year. Distinctness, uniformity, and stability and value for cultivation and use tests were conducted based on characterization and evaluation data during

the three consecutive fruiting years—2011 to 2013—using the International Union for the Protection of New Varieties of Plants (UPOV) descriptor for ‘Duke’ cherry (2006).

The aim of the research was to provide information on the new sour cherry cultivar Prima and to conduct its evaluation in comparison with standard cultivars with respect to tree habit, productivity, fruit quality attributes, and disease tolerance.

## Genetic Analyses

Total genomic DNA was extracted using Dellaporta et al. (1983) protocol. DNA quality and concentrations were assessed by NanoDrop 1000 spectrophotometer (Thermo Scientific, Wilmington, DE). A set of 10 simple sequence repeat primer pairs were used in the diversity analysis: UCD-CH12, UCD-CH17, UCD-CH19, BPPCT005, BPPCT008, BPPCT027, BPPCT028, BPPCT032, BPPCT034, and BPPCT038, with polymerase chain reaction (PCR) performed according to published protocols (Dirlewanger et al., 2002; Struss et al., 2003). PCR reactions were performed in a Biometra T Personal thermocycler (Biometra GmbH, Goettingen, Germany). PCR products were separated by electrophoresis using 2% MetaPhor<sup>®</sup> agarose (Cambrex Bio Science Rockland, Inc., Rockland, ME) at 80 V for 12 h in 1 × Tris-borate-EDTA, stained with ethidium bromide (0.8 mg·mL<sup>-1</sup>), and visualized using ultraviolet light on FOTO/Analyst<sup>®</sup> Investigator/FX Workstation (Fotodyne Incorporated, Hartland, WI). Fragment sizes

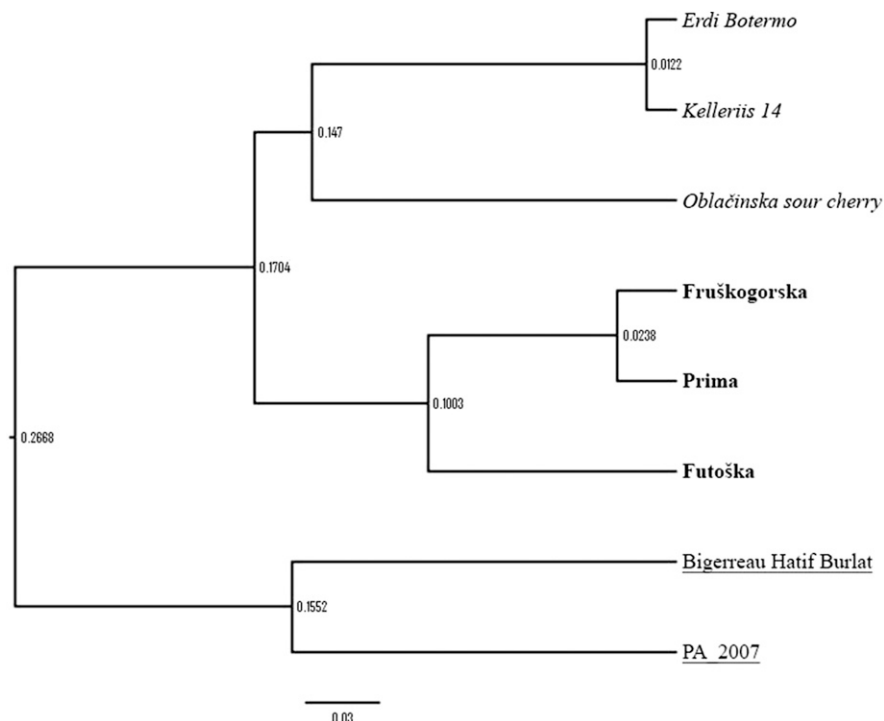


Fig. 1. Dendrogram constructed from 10 simple sequence repeat markers supporting interspecific origin of ‘Prima’ as duke cherry (sour cherry accessions are in italic, morello types are in bold, and sweet cherry accessions are in underline).

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Fig. 2. 'Prima' has dense and compact upright tree habit of medium vigor.

were estimated in relation to the GeneRuler™ Low Range DNA Ladder (Thermo Scientific).

Genetic similarity between accessions was calculated by the Nei and Li similarity coefficient (Nei and Li, 1979) using FreeTree (Pavlicek et al., 1999). Cluster analysis was performed using the unweighted pair group method with arithmetic average and dendrogram was constructed using FigTree v1.4.2 software (<http://tree.bio.ed.ac.uk/software/figtree/>). 'Prima' was clustered together with 'Duke' cherry landraces 'Fruškogorska' and 'Futoška', between sour cherry: cultivars 'Érdi bőtermő', 'Kelleriis 14', 'Oblačinska', and sweet cherry: wild accession PA\_2007 and 'Bigerreau Hatif Burlat'. The position of 'Prima' (Fig. 1) in relation to *Prunus cerasus* and *Prunus avium* samples is in agreement with its potential hybrid origin between these two species and classification as *Prunus ×gonduinii* (Iezzoni et al., 1990).

### Description

The evaluations presented in this paper were carried out over three consecutive years (2013 to 2015, when the trees were 6 to 8 years old) according to UPOV (2002, 2006) using the samples that were a part of the experimental trial conducted in Feketić (45°40' N, 19°42' E; altitude 95 m above sea level). The soil of the experimental orchard at a depth of 0 to 60 cm was characterized as a "chernozem" with low organic matter content (1.98%) and soil acidity of pH 6.3. Soil nutrient contents included phosphorus 27.6 mg·kg<sup>-1</sup>, potassium 31 mg·kg<sup>-1</sup>, calcium 4.6%, and nitrogen 1.59%. Climatic conditions were continental, of mid-European character. According to the data from the nearest meteorological station, the average year-round temperature was 11.2 °C with 612.4 mm of rainfall per year. Furthermore, the latest set of 30-year average climate records indicate that the absolute

Table 1. Comparisons of tree and fruit characteristics between 'Prima' and 'Érdi bőtermő', during three consecutive years of trials.

	'Prima'	'Érdi bőtermő'
Harvest date	15 June	20 June
Full bloom date	17 Apr.	13 Apr.
Fruit wt (g)	7.6 a <sup>2</sup>	7.7 a
Fruit cracking (%)	Resistant	Resistant
Color after harvest	Dark purple red	Dark red
Color after storage	No changes	No changes
Color after defrostation	No changes	No changes
Juice color	Dark red	Medium red
Tree habit	Upright	Spreading
Disease resistance		
Susceptibility to <i>Monilinia</i> spp.	Highly tolerant	Low susceptible
Susceptibility to <i>Blumeriella jaapii</i>	Tolerant	Low susceptible

<sup>2</sup>Means within a row followed by the same letter are not significantly different at  $P \leq 0.05$ , as established by Duncan's multiple range test.

temperature in Feketić ranges between -26.8 °C and +40.3 °C.

**Tree and leaf.** 'Prima' is characterized by dense and compact upright tree habit of medium vigor that can extend up to 4 m in height and 3.5 m in width when grafted on seedling rootstock grown without pruning (Fig. 2). Dormant 1-year-old shoots are thick with normal internode length and large number of lenticels. Position of the vegetative bud in relation to the shoot is markedly held out, medium in size and acute in shape. The foliage is dense and evenly distributed across the entire tree. The leaves are leathery, thick, dark green, long, and elliptical, characterized by an acute long tip and obtuse shape of the base. Leaf blade length/width ratio is 1.82, with serrate margin incisions. The ratio of petiole length to blade length is 0.21, whereas anthocyanin coloration of upper and lower petiole surface is weak. There are two large circular-shaped, light red nectaries positioned at the base of the leaf blade and on the petiole.

**Inflorescence.** 'Prima' has medium onset of flowering, 3 to 5 d after 'Érdi bőtermő'. Flower diameter is medium-sized, with intermediate arrangement of light pink petals. As 'Prima' is not self-fertile, 'Čačanski rubin' and 'Oblačinska' sour cherry are recommended as pollinating varieties. 'Prima' differentiates flower buds equally frequently on 1-year-old and along the entire length of 2-year-old branches, in contrast to 'Érdi bőtermő' where greater frequency was noted on 1-year-old wood.

**Fruits.** The fruit characteristics presented in this paper are the mean values of five fruits per tree harvested from 15 trees of each cultivar. In 'Prima', the onset of fruit ripening starts 5 d earlier than in 'Érdi bőtermő' (Table 1). Its fruit is medium sized (7.6 g), circular in shape, with flat pistil end. Stalk is long and of medium thickness. The fruit skin is dark purple red in color at maturity (Fig. 3). It is thin and smooth, and tenacious to flesh. Fruit is characterized by medium firmness. It is rich in flavor, melting, with medium juiciness, and is thus of excellent eating quality. The juice color is dark red with excellent balance of sweetness and acidity. The stone is medium sized and of narrow elliptic shape in ventral view. The fruit/stone



Fig. 3. Fruits of 'Prima' sour cherry.

weight ratio is 94.11%. In all producing areas, it is resistant to rain cracking.

### Performance and Uses

Fruit samples used in chemical analysis were harvested at the time of commercial maturity from both cultivars, Prima and 'Érdi bőtermő', with the latter serving as a well-adapted standard cultivar in an experimental field located at Faculty of Agriculture, Novi Sad, Serbia. Plants grafted on 'Mahaleb' were spaced 4 × 2 m apart. Fruit weight was measured with a weighing scale (Kern 572-35; Kern & Sohn GmbH, Balingen, Germany), while the juice pH was measured with pH meter (MP220 Basic; Mettler Toledo, Schwerzenbach, Switzerland). Total soluble solids value was obtained via a refractometer RH-32/ATC (Huake instrument Co. Ltd., Shenzhen, China), whereas total titratable acidity (TTA) was obtained using a digital bottle-top burette (BRAND® Titrette®, Germany) (Table 1). Skin and flesh color were observed visually and recorded as the number of fruits per color designation compared with standard varieties suggested by the UPOV descriptor (2006). Total phenolics (TP) in the extracts were determined colorimetrically (Kroyer, 2004), and the Folin-Ciocalteu procedure was used to determine total tannins (TT) (Makkar et al., 1993). The procedure for determining the total flavonoids (TF) was adopted from Marckam (1989). Total anthocyanins (TA) were determined by Lee et al. (2005). Proanthocyanidins (PAs) in the sample solutions were determined by Sun et al.

Table 2. Chemical parameters (2013–15) and nutraceutical qualities (2015) of fruit harvested from ‘Prima’ and ‘Érdi bőtermő’.

Cultivar/solvent	Prima	Érdi bőtermő
<b>Chemical parameters</b>		
Soluble solid content (%)	16.8 a <sup>z</sup>	14.2 b
pH	3.50 a	3.53 a
Total titratable acidity (% citric acid)	1.18 a	1.13 b
<b>Nutraceutical qualities</b>		
Total phenolics (mg GAE/g DW)	11.3 a	5.7 b
Total tannins (mg GAE/g DW)	2.1 a	2.0 a
Total flavonoids (mg QE/g DW)	1.0 a	0.5 b
Total anthocyanins (mg C3G/g DW)	412.8 a	48.4 b
Proanthocyanidins (mg catechin equivalent/g DW)	102.3 a	28.5 b
DPPH (mg Trolox/g DW)	11.5 a	5.1 b
ABTS (mg Trolox/g DW)	20.0 a	6.2 b
FRAP (mg Trolox/g DW)	19.8 a	7.2 b
Total reducing capacity (mg Trolox/g DW)	12.5 a	7.1 b
Total antioxidant activity (mg Trolox/g DW)	2.9 a	2.2 b
SOD mimetic [% of inhibition of superoxide (O <sub>2</sub> ) radicals production]	42.5 a	7.8 b

<sup>z</sup>Means within a row followed by the same letter are not significantly different at  $P \leq 0.05$ , as established by Duncan’s multiple range test.

ABTS = 3-ethylbenzothiazoline-6-sulphonic acid; DPPH = 1,1-diphenyl-2-picrylhydrazyl radical; FRAP = ferric reducing antioxidant power; SOD = superoxide dismutase.



Fig. 4. Five traditional food products made from ‘Prima’ sour cherry (brandy, jam, liquor, “slatko,” and wine).

(1998). Scavenging of free radicals was tested in a 1,1-diphenyl-2-picrylhydrazyl radical (DPPH) acetone solution using Abe et al. (1998) method. The ferric reducing antioxidant power (FRAP) assay was performed according to the method described by Valentão et al. (2002). For 2,2’-azinobis-(3-ethylbenzothiazoline-6-sulphonic acid) (ABTS) assay, the method recommended by Thaipong et al. (2006) was applied. Total reducing capacity (TRC) of the extracts was determined according to Athukorala et al. (2006), whereas the total antioxidant activities (TAA) were evaluated by the method described by Prieto et al. (1999). Finally, superoxide dismutase (SOD) mimetic was assessed using the nitroblue tetrazolium assay (Fisher et al., 2003).

The results yielded by the estimations of TP, TT, TF, TA, PAs, DPPH, ABTS, FRAP, TRC, TAA, and SOD mimetic are presented in Table 2. TP and DPPH values obtained from the ‘Prima’ were up to 50% higher than the content of phenolics found in the ‘Érdi bőtermő’. TA was almost 10 times higher in ‘Prima’ compared with ‘Érdi bőtermő’. In addition, TAA was statistically significantly higher in ‘Prima’ than ‘Érdi bőtermő’.

The upright distinctive growth habit characterizing ‘Prima’ enables dense planting for commercial fruit production. It has precocious flower bud and spur formation and a large number of flower spurs that develop along the entire shoot length.

Prima represents cultivar that links in situ and on-farm conservation of fruit genetic resources, selection of unique and rare germplasm with indigenous knowledge, rural development, technology, and social organization. Products based on indigenous knowledge and traditional recipes have preserved the value of the unique fresh fruit quality of Prima cultivar. Economic gains associated with ‘Prima’ predominantly arise from profitable employment of local population on their own farms. Product diversification with enhanced health benefits for consumers—as fruit can be eaten fresh, as well as processed into canned, frozen, candied and dried forms, juice, jams, jellies, wine, liqueur, and brandy—brings unique regional identity to Feketić and Mali Idoš (Fig. 4). ‘Prima’ is already benefitting the economic well-being of the rural population, as its production within small and medium *on farm* enterprises is highly profitable, while also possessing potential for a large-scale commercial activities.

### Disease and Pest Reaction

All examined cultivars were evaluated for susceptibility to fungal diseases in naturally infected plots. The findings revealed that ‘Prima’ is not immune to *Monilinia laxa*/Ader et. Ruhl./Honey ex Whetz. and *Blumeriella jaapii* (Rehm.) v. Arx. However, due to its high tolerance, it could serve as a potential donor for polygenic resistance (Table 1).

### Availability

Limited quantities of budwood are available for testing and commercial propagation

from the Faculty of Agriculture, Department of fruit science, viticulture, horticulture, and landscape architecture, Novi Sad, Serbia. Prima is not a patented cultivar. Budwood source trees are virus tested negative.

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