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A morphological and phenological comparison of chestnut (*Castanea*) cultivars 'Serdar' and 'Marigoule'

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Abstract

Morphological and phenological characteristics of the chestnut (*Castanea sativa* Mill.) cultivar (cv) 'Serdar' were examined and compared to the cv 'Marigoule', a European × Japanese (*C. sativa* × *C. crenata*) hybrid. Morphological characteristics such as tree vigor and growth habit, shoot, leaf, flower, bur and fruit characteristics and phenological characteristics such as time of bud break, flowering, nut ripening and leaf fall were studied. Three trees per genotype and 10-50 samples per tree were examined for each quantitative characteristic. Cultivar 'Serdar' was represented by vigorous trees with semi-upright growth similar to cv 'Marigoule'. Shoots of 'Serdar' were thinner and the shoot bark was browner than 'Marigoule'. 'Serdar' had a higher lenticel density than 'Marigoule' and 'Serdar' had relatively short internodes similar to 'Marigoule'. 'Serdar' initiated break bud 11 days later than 'Marigoule', bloomed 1-2 days later than 'Marigoule', and nuts ripened 20 days later than nuts from 'Marigoule'. Leaf fall of cv 'Serdar' was one day earlier than cv 'Marigoule'. The lamina, petioles and leaves of the 'Serdar' were longer than those of 'Marigoule'; however, 'Serdar' had a lower ratio of lamina width/lamina length and lamina width/leaf length. 'Serdar' and 'Marigoule' were placed in the same group with respect to all flower characteristics investigated. 'Serdar' had globular burs with long spines. Its density of spine was also higher than 'Marigoule'. 'Serdar' had very bright, reddish brown coloured shells, with light cream coloured kernels; and, the fruit had good flavor. Peeling of the seed coat of 'Serdar' was easier than that of 'Marigoule'. The fruit of 'Serdar' was smaller than those of 'Marigoule' and the relative size of the hilum in relation to the upper part of fruit was intermediate in 'Serdar' and large in 'Marigoule'. 'Serdar' showed a higher propensity for splitting of the pericarp although both cultivars were placed within the same group. The cv 'Serdar' can be recommended for new chestnut orchards due to some of its positive advantages such as earlier bearing, blooming twice in a single growing season, resistance to spring frosts and its low susceptibility to chestnut blight.

Key words: nut crops, pomology, variety registration, cultivar releasing, Turkey.
Abbreviations: cv; cultivar, TTSM; Turkey Variety Registration and Seed Certification Centre.

Introduction

Chestnut (*Castanea* spp. Mill.) has been placed in the *Fagaceae* family which includes beech (*Fagus*), oak (*Quercus*) and *Castanopsis*. In total, 13 *Castanea* species are recognized and are native to the temperate zone of the Northern Hemisphere; five in East Asia, seven in North America and one in Europe (Burnham et al., 1986). All *Castanea* species and their hybrids are edible and some are used in commercial nut production around the world. China, Korea, Turkey, Italy, Spain, Bolivia, Japan and Portugal are the leading chestnut producing countries. There are two geographical areas of interest regarding European chestnut (*C. sativa*) genetic resources in Europe: Turkey and the Iberian Peninsula, which is one of the original centers of chestnut production (Villani et al., 1999). Turkey is the origin of several different fruit species such as almond (Balta et al., 2001), apricot (Balta et al., 2002), cherry (Demirsoy and Demirsoy 2003; Demir et al., 2011), chestnut (Soylu, 2004), fig (Koyuncu 2004), hazelnut (Beyhan, 2007), strawberry tree (Celikel et al., 2008), walnut (Balci et al., 2001) and vaccinium sp. (Celik, 2009). There are about 2.5 million chestnut trees in Turkey and chestnut production is 60000 tons per year. The chestnut is native to the Black Sea, Marmara and Aegean Regions in Turkey (Davis, 1982; Soylu, 2004) and is a species that requires cross fertilization. Because seed propagation is dominant in areas where the chestnut grows naturally, seedling trees have different characteristics from each other. Thus, chestnut selection studies have been performed to determine superior genotypes in terms of yield and quality in these regions of Turkey (Ayfer and Soylu, 1995; Ozkarakas et al., 1995; Akca and Yilmaz, 1999; Serdar, 1999; Serdar and Soylu, 1999; Serdar, 2002; Ozkan, 2003; Ertan et al., 2007; Koyuncu et al., 2008; Yarilgac et al., 2009). Chestnut genotypes representing the Black Sea Region of Turkey are generally characterized by small, easy peeling, and delicious fruits when compared to genotypes grown in the Marmara and Aegean Regions of Turkey. Chestnuts grown in Black Sea Region are popular with consumers, especially for fresh consumption. One of the chestnut genotypes selected from the Black Sea Region for fresh consumption was *C. sativa* cv. 'Serdar' (formerly known as 556-8) (Serdar and Soylu, 1999). Variety registration and the release of cultivar (cv) 'Serdar' was completed in 2010 by the Turkey Variety Registration and Seed Certification Centre (TTSM). However, there was no concomitant report regarding morphological and phenological characteristics of this new cultivar. The purpose of this study was to verify the morphological and phenological characteristics of this cultivar, which may have the potential to improve chestnut production and fruit quality in the Black Sea Region of Turkey.

Result and discussion

Vigor and growth between the cultivars 'Serdar' and 'Marigoule' were similar (Table 2), however 'Serdar' initiated bud break after 11 days later than 'Marigoule', bloomed 1-2 days later than 'Marigoule', and 'Serdar' ripened 20 days later than 'Marigoule'. Leaf fall of 'Serdar' was one day earlier than 'Marigoule', thus, the vegetation period of 'Serdar' was approximately 12 days shorter than that of 'Marigoule'. The late bud break and short vegetation period of 'Serdar' may be advantageous in regard to spring frosts and also for its ability to adapt to different regions. To emphasize this point, 'Serdar' was not damaged during a spring frost (3-4 April 2004) although some genotypes and cultivars including 'Marigoule' were damaged slightly (unpublished data). Zappia et al. (1989) also reported that 'Marigoule' is damaged from spring frosts in some years in Calabria due to early bud break. Furthermore, it has been reported that that the susceptibility of 'Serdar' to chestnut blight (*Cryphonectria parasitica* (Murrill) Barr) was low (Erper et al., 2004). 'Serdar' had thin and brown shoots and a higher lenticel density than 'Marigoule'. Both had short internodes on the shoots. The lamina, petioles and leaves of 'Serdar' were longer than those of 'Marigoule' (Table 2; Fig. 1-2). Some ratios, in relation to leaf dimensions have importance for cultivar identification. 'Serdar' had lower ratios of lamina width/lamina length and lamina width/leaf length than 'Marigoule'. 'Serdar' could be clearly differentiated from 'Marigoule' by the attenuate acuminate shape of its leaf tip and mucronate teeth. 'Serdar' and 'Marigoule' cultivars were placed in the same group with respect to all flower characteristics (Table 2). In addition, 'Serdar' blooms twice in the growing season, firstly in June and secondly in August-September (Serdar and Soylu, 2005), which is an advantage for chestnut honey production. However, this cultivar is sensitive to graft incompatibility, thus the compatible rootstock(s) for this cultivar should be determined. According to our observations, when the 554-14 genotype (Soylu and Serdar, 2000) was used as rootstock, successful grafting to 'Serdar' was achieved. However, when genotypes such as SA 5-1, SE 21-9, SE 18-2 and 552-10 were used as rootstock, graft incompatibility commonly occurred and scions would die in one or two years (unpublished data). 'Serdar' produced globular burs with long spines on the burs (Table 2). Its density of spine was higher than 'Marigoule'. Susceptibility to chestnut weevils was lower in this cultivar according to our observations (unpublished data). Popova (1960) indicated that there is an inverse ratio between density of spine and infestation of chestnut weevil in chestnut (Webster, 1975). The fruit shell color of 'Serdar' was bright and reddish brown (Table 2). It had good tasting fruit with light cream coloured kernels. Peeling of the seed coat was easier in 'Serdar' when compared to 'Marigoule'. Fruit size of 'Serdar' was smaller than 'Marigoule' (respectively 8.0 g and 16.3 g, respectively). The relative size of hilum in relation to its fruit was smaller (0.56) in 'Serdar' than "Marigoule' (0.84). Splitting of the pericarp and polyembyony are important problems in chestnut. 'Serdar' showed more splitting of the pericarp than 'Marigoule', however, both cultivars were in the same group in terms of this characteristic and splitting was not considered problematic in either cultivar. Penetration of seed coat into the embryo is low (≤ 2 mm) in 'Marigoule' and absent in 'Serdar'. Furthermore, polyembyony was absent in both of the cultivars. Stripes on the pericarp were present in 'Serdar' and absent in 'Marigoule'. For six years after planting, a cumulative yield of 5912 and 6702 g/tree were obtained from 'Serdar' and 'Marigoule' cultivars, respectively (Serdar et al., 2009). 'Serdar' was more precocious than 'Marigoule' and started bearing in the second year while 'Marigoule' did not bear until the fifth year. The productivity of 'Serdar' as the number of burs was higher than that of 'Marigoule', but 'Marigoule' had a higher yield because of its larger nuts. In the Black Sea Region, easy peeling and good taste are highly sought chestnut traits. Growers are generally not interested in large fruited chestnuts because there is a belief that as the fruit weight of the chestnut increases, it loses flavor. Although 'Serdar' has small fruits (8.0 g), it has great potential to be preferred by growers and consumers, alike, because of its ease of peeling and good flavor. Cultivar 'Serdar' had a very long flowering period for both male and female flowers; therefore, in some years its flowering time coincided partially with 'Marigoule'. However, in order to guarantee pollination, it is recommended that the genotype SE 3-12, a candidate for cultivar registration, be used as a pollinizer for 'Serdar' (Serdar et al., 2010).

Material and methods

Material background

The wildtype seedling (genotype) 556-8 was selected from the Black Sea Region in 1996 (Serdar and Soylu, 1999). Evaluations for registration occurred from 1996 to 2005. For evaluation, scion from 556-8 was grafted to rootstocks and planted in a trial orchard in the Central Black Sea Region in 1998 along with grafts from 9 other promising genotypes from the Central Black Sea Region (Serdar, 1999; Serdar and Soylu, 1999). Preliminary results, primarily focusing on the time to bearing, plant growth, and pomological and phenological traits under the same ecological conditions were reported (Serdar and Soylu, 2005). The yield and some fruit traits of the genotypes were determined in 2000-2005. In 2005, five genotypes (SE 3-12, SE 21-2, SE 21-9, 552-8 and 556-8) were selected as candidates for cultivar registration (Serdar et al., 2009). Genotype 556-8 was selected for fresh consumption and chestnut paste end use (Serdar et al., 2009). An application for cultivar registration of 556-8 was made to TTSM in 2006. Further evaluations of characteristics of the genotype were performed and checked by TTSM in 2006-2009. This genotype was registered as cultivar (cv.) 'Serdar' in the name of the Agricultural Faculty of Ondokuz Mayıs University.

Experimental area

The research reported here was carried out in the 2006-2009 growing seasons in an orchard established with 10 promising genotypes (7 × 7 m) in Fatsa/Ordu in 1998. The cv. 'Marigoule' (a European × Japanese hybrid) was planted in 2000 and was used as a standard cultivar in which to make comparisons. The planting is located in northern Turkey (40°58'38''N and 37°36'35''E, 240 m a.s.l.) in the Center Black Sea Region. According to data (mean of 1975-2008) obtained from the Turkish State Meteorological Service (TSMS, 2010), the climate of the area is characterized by an annual mean temperature of 14.3ºC, and a total rainfall of 1047.4 mm. The soil was a pH 5.75 clay loam with 1.14 % organic matter.

Collection and Evaluation of the Samples

Tree vigour and growth habits were evaluated by observing the height of the tree, width of tree crown, and area occupied by tree crown after leaf fall (Kotobuki, 1996; UPOV, 1989). The shoot density and color of shoots were determined

Table 1. Description of tree, leaf, flower, bur and fruit for chestnut

Descriptor name	Scala
Tree and shoot characteristics	
Tree vigor	Very weak, weak, medium, vigorous, very vigorous
Growth habit	Erect, semi upright, spreading
Shoot density	Low, intermediate, high
Color of shoot	Grayish yellow, yellow, yellowish brown, light brown, brown, reddish brown
Thickness of lateral shoot (mm)	Thin (≤ 5.63 mm), intermediate (5.64-5.99 mm), thick (≥ 6 mm)
Length of internodes of lateral shoot (mm)	Short (≤ 29.7mm), intermediate (29.8-33.7 mm), Long (≥ 33.8 mm)
Lenticel density of lateral shoot (no. per cm^2)	Sparse (≤ 25.1), medium(25.2-29.8), dense (29.9)
Phenological characteristics	
Time of leaf bud burst	Very early (Before or on 1 April), early (Between 2-5 April), medium (Between 6-9 April), late (Between 10-13 April), very late (Later than 14 April)
Beginning to bloom of male catkins	Very early (Before or on 28 May), early (Between 29-31 May), medium (Between 1-3 June), late (Between 4-6 June), very late (Later than 7June)
Beginning to bloom of female catkins	Very early (Before or on 28 May), early (Between 29-31 May), medium (Between 1-3 June), late (Between 4-6 June), very late (Later than 7June)
Ripening time	Very early (Before or on 15 September), early (Between 16-24 September), medium (Between 25 September-3 October), late (Between 4-12 October), very late (Later than 13 October)
Time of leaf fall	Early (Before or on 24 November), intermediate (Between 25-28 November), late (Later than 29 November)
Leaf characteristics	
Shape of leaf tip	Aristate, attenuate acuminate, acuminate, acute
Incisions of margin (habit of teeth)	Mucronate, dentate
Leaf area, leaf size (cm^2)	Small (≤85.6), intermediate (85.7-98.8), large (≥98.9)
Lamina width (cm)	Short (≤5.10), intermediate (5.11-5.88), large (≥5.89)
Lamina length (cm)	Short (≤20.4), intermediate (20.5-22.0), long (≥22.1)
Leaf length (cm)	Short (≤ 22.5), intermediate (22.6-24.1), long (≥ 24.2)
Petiole length (mm)	Short (≤ 21.4), intermediate (21.5-24.1), long (≥ 24.2)
Ratio of lamina width/lamina length	Small (≤ 0.23), intermediate (0.24-0.26), large (≥0.27)
Ratio of lamina width/leaf length	Small (≤ 0.20), intermediate (0.21-0.24), large (≥ 0.25)
Ratio of teeth width/teeth length	Small (≤ 0.32), intermediate (0.33-0.43), large (≥ 0.44)
Flower characteristics	
Habit of male catkin	Upright, intermediate, spreading
Length of stamen filament in male catkin (mm)	Astaminate (no filament), brachystaminate (1-3 mm), mesostaminate (3-5 mm), longistaminate (5-7 mm)
Length of male catkin (cm)	Short (≤14.4), intermediate (14.5-18.6), long (≥ 18.7)
Length of mixed catkin (cm)	Short (≤ 9.2), intermediate (9.3-12.5), long (≥12.6)
Bur characteristics	
Shape of bur	Globular, flat globular, squarely globular
Length of spine (mm)	Short (≤ 15.4), intermediate (15.5-19.5), long (≥ 19.6)
Density of spines (number. per cm^2)	Low (≤180), intermediate (181-242), high (≥ 243)
Size of bur	Small (≤ 5544), intermediate (5545-7500), large (≥ 7501)
Fruit characteristics	
Fruit shape	Ovoid (<100), broad ovoid (101-109), globose (100), transverse ellipsoid (>120), transverse broad ellipsoid (110-120)
Relative size of hilum in relation to fruit	Small (≤ 0.59), intermediate (0.60-0.73), large (≥ 0.74)
Brightness of pericarp	Absent, bright, very bright
Color of pericarp	Light brown, brown, dark brown, reddish brown, blackish brown
Density of tomenta on fruit tip	Low, intermediate, high
Chestnuts with a split pericarp (%)	Low (<15), medium (15-29.9), high (≥ 30)
Fruit size	Very small (≥121 nuts/kg), small (101-120 nuts/kg), medium (81-100 nuts/kg), big (61-80 nuts/kg), very big (≤ 60 nuts/kg)
Color of kernel	Light cream, cream, dark cream
Peeling of seed coat in fresh fruit	Very easy, easy, intermediate , difficult
Penetration of seed coat into the embryo	No penetration, weak penetration (visible ≤ 2 mm), strong penetration (visible > 2.0 mm)
Polyembryony (%)	Absent , Low (1-4), intermediate (5-8), high (8-12), very high (≥ 12.1)
Sweetness	Poor:1, intermediate: 4, good: 7, tasteful: 10
Hilum size	Small (≤ 348), intermediate (349-521), large (≥ 522)
Shape of hilum	Elliptical broad (≤ 1.8), elliptical medium (1.9-2.1), elliptical long (≥ 2.2)
Nut stripes	Absent, Exist

Fig 1. 'Serdar' cultivar: leaves, male catkins and fruits

according to Kotobuki (1996). Lateral shoot samples were taken in February of each year. Ten shoots per tree and three trees per genotype were sampled. The thickness of the lateral shoot (at the middle of the shoot), internode lengths and number of lenticels per cm^2 (between 3^{rd}-5^{th} internodes in the base of shoot) were determined. Measurements for internodes lengths were done on 5 internodes in the middle part of the shoot (UPOV, 1989). Leaf samples were taken from the fifth through the seventh nodes in well developed lateral shoots in the second week of August each year. Ten leaves per tree and three trees per genotype were sampled. The shape of the tip of the leaf was determined according to the methods of Kotobuki (1996). Incisions of the margin were determined by following the guidelines of The International Union for the Protection of New Varieties of Plants (UPOV)(UPOV, 1989). Leaf width was measured in the middle of the leaf lamina length. Length and width of the teeth were measured in the middle part of the leaf. Two measurements were done for these traits per leaf. Ratios of the lamina width/lamina length, lamina width/leaf length, and teeth width/teeth length were calculated. The leaf area was determined according to Serdar and Demirsoy (2006). Habit of male catkin was determined during full bloom according to Kotobuki (1996). Flower catkin samples were also taken at this time. Lengths of stamen and length of male and hermaphroditic catkins were determined. For each trait, 30 measurements were taken. Bur samples that contained three fruits were taken from genotypes just before cracking. Ten burs per tree and three trees per genotype were sampled. The length and width of the burs were measured. Bur size was calculated by multiplying the length and width of the bur. Density of the spine was measured at $1cm^2$ samples taken from lateral parts of the burs. The length of the spine was also measured in these samples (Kotobuki, 1996). Fruit samples were taken after cracking of the bur and the original colour of the nuts was observed. Fifty fruits per tree and three trees per genotype were sampled. Chestnuts with a split pericarp (%) were determined according to Furones-Perez and Fernandez-Lopez (2009a). The brightness of fruit and kernel colour was rated on a scale. The colour of fruit was evaluated according to UPOV (1989). Fruit size was determined by counting the fruit in a kilogram and polyembryony was determined by dividing the number of kernels including double or more embryos in a fruit by the total number of fruit sampled. These characteristics were classified according to Bounous (2001). For fruit and hilum shape, lateral fruits in the bur were used. The fruit and hilum shapes and hilum size were determined according to Furones-Perez and Fernandez-Lopez (2009a). The relative size of hilum in relation to the hilum part of the fruit was determined by calculating the ratio of hilum length x hilum width to fruit length x fruit thickness. Density of tomenta on fruit tips was determined according to Kotobuki (1996). Nut stripes were determined according to Bounous (2001). Phenological observations included three trees per genotype recorded once or twice a week. Mean values were calculated for each parameter for 3 growing seasons (2006-2008).

Classification of characteristics

For the evaluation of distinctness, uniformity and stability (DUS) of the cv. 'Serdar', morphological and phenological characteristics were classified according to UPOV descriptors (UPOV, 1989) and other new descriptors improved specifically for chestnut (Kotobuki, 1996; Furones-Perez and Fernandez-Lopez, 2009a; b). Values for the classification of phenological characteristics and quantitative traits such as shoot, leaf, and flower, etc. were performed to compare five genotypes to each other and to the cv. 'Marigoule' planted in the Central Black Sea Region. The range of values for a category was determined by dividing the difference between the maximum and minimum values by the number of classes. Indices according to Furones-Perez and Fernandez-Lopez (2009a) were used for the length of stamen filament in male catkins and chestnuts with a split pericarp, fruit and hilum shape and degree of penetration of seed coat into the embryo; and, the scale of Serdar and Soylu (2005) was used for sweetness. Description of tree, leaf, flower, bur and fruit are listed in Table 1 and based on data of UPOV (1989), Kotobuki (1996), Serdar and Soylu (2005), Furones-Perez and Fernandez-Lopez (2009a) and Serdar et al. (2009).

Conclusions

In this study, the morphological and phenological characteristics of two cultivars were compared. These cultivars were cv.'Serdar' and cv. 'Marigoule'. Cultivar 'Serdar' registration was completed in 2010 by TTSM, and 'Marigoule' has been a traditional European × Japanese hybrid planted in Europe and other continents for several years. The morphological and phenological parameters of 'Serdar' may be comparable to other native and foreign

Table 2. Tree, leaf, flower, bur and fruit characteristics of Serdar chestnut cv. comparatively with the 'Marigoule'.

Descriptor name	Serdar	Marigoule
Tree and shoot characteristics		
Tree vigor	Vigorous	Vigorous
Growth habit	Semi-upright	Semi-upright
Shoot density	Intermediate	Intermediate
Colour of shoot	Brown	Reddish brown
Thickness of lateral shoot (mm)	Thin (5.28)	Thin (5.59)
Length of internodes of lateral shoot (mm)	Short (25.8)	Short (29.6)
Lenticel density of lateral shoot (no. per cm^2)	Dense (34.2)	Intermediate (29.0)
Phenological characteristics		
Time of leaf bud burst	Very late (13 April-1 May)	Early (2-20 April)
Beginning to bloom of male catkins	Late (6-13 June)	Intermediate (4-9 June)
Beginning to bloom of female catkins	Late (5-20 June)	Intermediate (5-17 June)
Ripening time	Very late (19-26 October)	Intermediate (29 Sept.-8 October)
Time of leaf fall	Late (1-5 December)	Late (2-10 December)
Leaf characteristics		
Shape of leaf tip	Attenuate acuminate	Aristate
Incisions of margin (habit of teeth)	Mucronate	Dentate
Leaf area, leaf size (cm^2)	Small (81.8)	Small (75.8)
Lamina width (cm)	Intermediate (5.27)	Intermediate (5.67)
Lamina length (cm)	Intermediate (21.3)	Short (18.9)
Leaf length (cm)	Intermediate (23.6)	Short (21.0)
Petiole length (mm)	Intermediate (23.1)	Short (20.9)
Ratio of lamina width/lamina length	Intermediate (0.25)	Large (0.30)
Ratio of lamina width/leaf length	Intermediate (0.22)	Large (0.27)
Ratio of teeth width/teeth length	Large (0.59)	Large (0.46)
Flower characteristics		
Habit of male catkin	Intermediate	Intermediate
Length of stamen filament in male catkin (mm)	Longistaminate (7.52)	Longistaminate (5.77)
Length of male catkin (cm)	Long (19.9)	Long (20.4)
Length of mixed catkin (cm)	Long (13.5)	Long (12.8)
Bur characteristics		
Shape of bur	Globular	Squarely globular
Length of spine (mm)	Long (22.3)	Short (13.6)
Density of spine (number. per cm^2)	High (301.1)	Low (137.0)
Size of bur	Intermediate	Large
Fruit characteristics		
Fruit shape	Transverse ellipsoid	Transverse ellipsoid
Relative size of hilum in relation to fruit	Small (0.56)	Large (0.84)
Brightness of pericarp	Very bright	Bright
Colour of pericarp	Reddish brown	Blackish Brown
Density of tomenta on fruit tip	Low	Low
Chestnuts with a split pericarp (%)	Low (13.0)	Low (7.2)
Size of fruit	Very small (125 nuts/kg))	Big (61 nuts/kg)
Colour of kernel	Light cream	Cream
Peeling of seed coat in fresh fruit	Very easy	Easy
Penetration of seed coat into the embryo	No penetration	Weak penetration
Polyembryony (%)	Absent	Absent
Sweetness	Tasteful	Good
Hilum size	Small (274)	Large (693)
Shape of hilum	Elliptical long (2.3)	Elliptical broad (1.7)
Nut stripes	Exist	Absent

Fig 2. 'Marigoule' cultivar: leaves, male catkins and fruits

chestnut cultivars. The results of this study show that this precocious cultivar is high yielding with small but high quality fruit. These attributes make 'Serdar' suitable for chestnut paste production as well as fresh consumption especially in the Black Sea Region. It has some distinct advantages such as blooming twice in a year, resistance to spring frosts and low susceptibility to chestnut blight and weevil. Thus, it can be used for both the production of fruit and chestnut honey. This cultivar can be recommended for the establishment of new chestnut orchards.

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