

‘Zhongli No. 3’: A Mid-season Plum Cultivar from ZFRI-CAAS

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Additional index words. breeding, fruit maturity, fruit quality, *Prunus salicina* Lindl.

Plum, belonging to the genus *Prunus* of *Rosaceae* family, is one of the most important fruit crops in the world, with a high economic value and an extensive genetic diversity. China is now the largest plum producer, with an annual production of 6,801,187 t in 2018, accounting for 53.9% of the world's total (FAOSTAT, <http://www.fao.org/faostat/en/#data>). Chinese plum (*Prunus salicina* Lindl., $2n = 2x = 16$), also known as Japanese plum, is widely grown for fresh market consumption and the processing industry. During the past decades, Chinese plum cultivars introduced from the United States and Japan, including ‘Black Amber’, ‘Formosa’, ‘Angelino’, ‘Fortune’, ‘Friar’, and ‘Akihime’, have been widely cultivated in China for their productivity and storability (Liu et al., 2019). With the substantially improved living standards, consumers' demand for better eating quality increases gradually, which brought Chinese native or improved plum cultivars into sight, such as ‘Zaohongxiang’, ‘Qingcuili’, ‘Yuhuangli’, ‘Zuili’, ‘Naili’, and ‘Sanhuali’, being known for their excellent flavor and unique aroma (Huang et al., 2019; Liu et al., 2019). In this context, the breeding objectives of our group are to select plum cultivars that possess not only high productivity and fruit storability, but also high eating quality to meet the needs of both the consumer and the market.

Here, we introduced a newly selected high-quality Chinese plum cultivar Zhongli

No. 3, which was developed by the Plum and Apricot Group in ZFRI-CAAS and released in 2019. The fruit matures in late-July in Zhengzhou and the fruit development period is about 120 d. The fruit of ‘Zhongli No. 3’ is oval and has an attractive peel color. The fruit flavor is sour-sweet with a strong aroma, and the soluble solid content is about 16.4%. The average fruit weight is about 98.2 g, and the maximum fruit weight could be 150.0 g. The average yield of a 5-year tree could reach up to 31.0 kg.

Origin

‘Zhongli No. 3’ was selected from a natural-crossing population derived from the female parent ‘Fali’, which was discovered in Tonghai County, Yunnan Province. The fruit of ‘Fali’ matures in early-July, and it is round with an average fruit weight of 43.9 g. The peel is mostly covered with purple-red (Fig. 1). The soluble solid content, the total soluble sugar content, and the total titratable acid content are 12.5%, 6.05%, and 1.03%, respectively (Table 1).

Initially, 316 natural-crossing seeds were harvested in 2005 from three ‘Fali’ trees maintained at the plum germplasm repository at ZFRI-CAAS (lat. 35°09' N, long. 113°47' E). Of these, 98 seedlings successfully germinated and survived transplantation in 2006. The seedlings started bearing fruits in 2009 under conventional management and pest control techniques. The primary agronomic traits of fruits and trees were investigated, referring to the standards described by Yu and Liu (2006). Among the 98 descendants, the hybrid numbered F-1 was selected as advanced accession for its best performance. From 2010 to 2013, hybrid F-1 was further assessed using top-grafting tests. The tests indicated that fruit quality and other economically valuable traits were uniform across replicates. Some clones were propagated for subsequent pilot and regional tests in Henan and its neighboring provinces. Over four successive years (2014–18), the agronomic traits were tested and found to be stable across different clones and regions.

Finally, in 2019, accession F-1 was approved by the Approval Committee for Improved Varieties of Forest Tree of Henan Province, and it was named ‘Zhongli No. 3’.

Description

Tree. The canopy of the mature ‘Zhongli No. 3’ tree is semicircular, with an open growth habit, and the tree vigor is relatively strong. The color of the trunk is deep brown, and there are longitudinal light-grey cracks on the surface. The color of the perennial branch is dark grey, and the one-year branch is reddish-brown. The surface of the one-year branch is smooth without pubescence. The internode length is 2.0 ± 0.2 cm. The lenticels are dense and small, gray-white in color, and elliptical in shape. The growing season of ‘Zhongli No. 3’ lasts for about 220 d annually, and the chilling requirement is observed to be 450–500 h according to the “0 to 7.2 °C” model (Wang et al., 2003).

Leaf. The leaf of ‘Zhongli No. 3’ is deep-green, long, elliptic, and has a cuneiform base, a mucronate apex, and a neat crenate leaf margin. The leaf is 12.2 ± 1.0 cm long, 6.4 ± 0.3 cm wide, and 0.15 ± 0.04 cm thick. The color of the primary and lateral leaf veins is yellowish-green. The petiole is green and 1.4 ± 0.5 cm in length. There are 2–4 petiole nectaries, which are round and relatively large in size. In Zhengzhou, the leaf bud begins opening in late-March, the leaf begins to expand in early-April, and the leaf starts falling in mid-November.

Flower. The pistils in most of the flowers of ‘Zhongli No. 3’ are equal in height or taller than the stamens, and the proportion of complete flowers is observed to be higher than 70%. The entire petal of ‘Zhongli No. 3’ is pure white. The self-pollination rate of the ‘Zhongli No. 3’ plum has been observed to be low; thus, it is believed to be self-incompatible. In Zhengzhou, the floral bud of ‘Zhongli No. 3’ breaks in mid-March, the full bloom date is near 20 Mar., and the flowering period is about 7 d.

Fruit. The fruit development period of ‘Zhongli No. 3’ plum is ≈ 120 d, and the fruit maturity date is in late-July. The fruit is oval, with an average fruit weight of 98.2 ± 6.3 g, and the maximum fruit weight can reach up to 150.0 g (Table 1). The fruit is nearly symmetric, the apex is a light round bulge, the suture is shallow, and the cavity is medium deep and narrow. The vertical diameter, transverse diameter, and lateral diameter of the fruit are 5.3 ± 0.3 cm, 6.0 ± 0.2 cm, and 5.2 ± 0.3 cm, respectively. The ground color of the mature fruit is greenish-yellow, and the cover color is bright red. The moderately thick peel can be easily separated from the mesocarp, and it is covered with skin powder. The fruit flesh is yellow, crisp and delicate in texture, and has a low fiber content. The fruit has abundant juice, intense fruity aroma, and the edible rate can reach up to 97.0%. The soluble solids content is $16.4 \pm 0.3\%$, the total soluble sugar content is $10.21 \pm 0.12\%$, the reducing sugar content is $3.28 \pm 0.08\%$, the total acid content is $1.09 \pm 0.02\%$, and the vitamin C content is 5.93 ± 1.13 mg/100 g.

Received for publication 12 Aug. 2020. Accepted for publication 20 Aug. 2020.

Published online 23 September 2020.

This work was supported by the key scientific and technological project of Henan Province (No. 202102110049), the Scientific Institution Basal Research Fund of ZFRI, CAAS (No. ZGS202005), the Central Public-interest Scientific Institution Basal Research Fund (No. 1610192020406), and the Agricultural Science and Technology Innovation Program (CAAS-ASTIP-2016-ZFRI).

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Fig. 1. The comparison between fruit appearances of 'Zhongli No. 3' (left) and 'Fali' (right).

Table 1. The fruit economic traits of 'Zhongli No. 3' and their comparative plum cultivars.

Cultivar	Ripening date	Avg fruit wt (g)	Fruit shape	Soluble solids content (°Brix)	Total soluble sugar content (%)	Titrateable acid content (%)	Chilling requirement (h)
Zhongli No. 3	20–30 July	98.2 ± 6.3 a ^z	Oval	16.4 ± 0.3 a	10.21 ± 0.12 a	1.09 ± 0.02 a	450–500
Fali	1–10 July	43.9 ± 3.3 d	Round	12.5 ± 0.3 c	6.05 ± 0.17 c	1.03 ± 0.02 b	300–350
Friar	25 July–10 Aug.	72.2 ± 4.1 b	Slightly flat	13.5 ± 0.4 b	9.40 ± 0.20 b	0.83 ± 0.11 c	400–450
Black Amber	25 June–10 July	65.3 ± 5.5 c	Slightly flat	11.8 ± 0.2 d	5.88 ± 0.13 d	1.04 ± 0.09 b	400–450

^zData were obtained from three replicates, and each replicate comprised nine uniform fruits from three different trees and was expressed as mean ± SD. Data followed by different letters are significantly different from each other ($P < 0.05$) according to Duncan's test.



Fig. 2. The fruits of 'Zhongli No. 3' plum.

'Zhongli No. 3' is a semi-clingstone plum cultivar (Fig. 2). The stone is obovate, with a coarse surface, and the average fresh stone weight is $\approx 1.7 \pm 0.2$ g. The vertical diameter, transverse diameter, and lateral diameter of the stone are 2.4 ± 0.1 cm, 1.7 ± 0.2 cm, and 0.9 ± 0.2 cm, respectively. The shelf life of 'Zhongli No. 3' fruit at room temperature is 15–20 d.

Growth and fruiting habits. In Zhengzhou, the 5-year-old 'Zhongli No. 3' tree is about

3.0 m in height, with a canopy diameter of 2.6 m and a trunk circumference of 45.1 cm. The average length and diameter of annual shoots are $\approx 38.5 \pm 6.3$ cm and 0.84 ± 0.22 cm, respectively. The fruit of 'Zhongli No. 3' is primarily produced on bouquet spurs and short fruiting branches. For grafted seedlings of 'Zhongli No. 3' plum, flowering begins in the second year and the high-yielding period occurs the fourth year after planting. The

average yield of the 5-year-old tree is ≈ 31.6 kg per tree.

In conclusion, 'Zhongli No. 3' is a mid-season cultivar with excellent eating quality, and it is a high-yielding and stable plum producer suitable for Henan and its neighboring provinces. It is believed to be a strong competitor in the fresh fruit market.

Availability

'Zhongli No. 3' is the property of Zhengzhou Fruit Research Institute of Chinese Academy of Agricultural Sciences (ZFRICAAS) and has been approved by the Approval Committee for Improved Varieties of Forest Tree of Henan Province (No. Henan S-SV-PS-011-2019). A limited quantity of bud wood is available upon request for trial and research purposes and commercial propagation.

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