Prunus salicina ‘Crown’, a Yellow-fruited Chinese Plum

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Additional index words. plum breeding, stone fruit, yellow plums

Plum [*Prunus salicina* Lindl. (syn. *Prunus triflora* Roxb. or *Prunus thibetica* Franch.)], commonly known as Chinese plum or Japanese plum, is a diploid ($2n = 2x = 16$) fruit tree native to China. It is one of the most important stone fruit crops in the world (Bhutani and Joshi, 1995). The total world production of plums was 10,776,232 t in 2009, of which 5,372,899 were produced in China (Potter, 2012). China also has rich plum germplasm resources, which are attributed to a long history of natural and artificial selections for fruit yield and quality as well as for adaptation to a wide range of ecological conditions (Liu et al., 2007). ‘Naili’ and ‘Furongli’ are two groups of famous landraces in Fujian Province (Zhang and Zhou, 1998), located on the southeast coast of China. ‘Naili’ was described in ancient Chinese books as ‘Ba Min Tong Zhi’ in Song Dynasty in 1214 and ‘Pu Yang Zhi’ in Ming Dynasty in 1485. ‘Naili’ includes ‘Hua Nai’ and ‘Qing Nai’ (Qiu and Lu, 1980). The fruit of ‘Qing Nai’ is round with a green yellowish color (142D, Royal Horticultural Society, 2001). This variety has been widely produced as fresh fruit due to its delicious taste. This report describes a new selection of plum derived from ‘Qing Nai’.

Origin

A natural-occurring bud sport was found in a ‘Qing Nai’ tree in the village Xiyan, Gutian County, Fujian Province, China. In

contrast to the green yellowish fruit, fruits produced from the branch were yellow (7B), and ripened 5 to 6 weeks earlier than ‘Qing Nai’. Buds of the mutant branches were propagated by T-budding onto ‘Qing Nai’ at Yutao Zheng’s orchard in the Changbei village in 1999 and also in the Tenganli village in 2000, Gutian County. The two villages are 80 km apart and have similar climate and soil conditions. The mutant was then increasingly propagated, and yellow fruits were sold at first under the name ‘Huanxing’ in 2003. Subsequent evaluation showed that this selection was stable and renamed ‘Crown’ in accordance with the International Code of Nomenclature for Cultivated Plants (Brickell et al., 2009). A specimen of the cultivar has been deposited at the Experimental Station in Gutian County as a cultivar standard.

Description

‘Crown’ has long elliptic leaf with an acute or acuminate apex. The blade margins are crenate with a nearly smooth upper surface. A full size leaf is 6.93 ± 0.5 cm long and 2.45 ± 0.1 cm wide. Young leaves are initially reddish brown (172A), turn to light yellow (2B), and green (140A) ≈ 30 d later (Fig. 1A). Petioles are light brown (N163A).

A 3-year-old tree is ≈ 3.1 m in height with a canopy spreading to an area of $3.1 \text{ m} \times 2.6 \text{ m}$. ‘Crown’ branches easily. After pruning, new branches can reach a length of more than 1.2 m. The branches 1- to 2-year old are green (134A) and turn to brown (170A) in the sun. Three-year-old branches are taupe (N199A), with smooth bark, sometimes having downy white spots. The bearing branches can be divided into four types: long fruit branches, medium fruit branches, fruit spur, and flower cluster spur. After 3 to 5 years, $\approx 69\%$ of fruit is produced on fruit

spur, and 75% of fruit is produced on the cluster spur thereafter.

Phenological observations of ‘Crown’ in Fujian Province from 2012 to 2014 are shown in Table 1. Flower buds spout in February, and abundant white flowers appear before leaf appearance in March (Fig. 1B). First and second cycles of pre-harvest physiological fruit drop occur in early and late April, respectively. Fruit ripens late May or early June. Leaves fall off by the end of November. Flowers are hermaphroditic, five white petals with a length of 2.5 ± 0.2 cm and a width of 1.7 ± 0.02 cm. Stamens are 5 to 9 mm long. Anthers are yellow (7B). The stigma is positioned only slightly beyond the anthers at full bloom. Flowers could be autogamous as 18.6% of flowers that were sealed with paper bag before they opened set fruit. Sepals are green (134A). Each anthotaxy has one to three white flowers. ‘Crown’ flowers 2 weeks later than ‘Cuipin-wannai’ but 2 weeks earlier than *P. salicina* ‘Wickson’, ‘Santa Rosa’, ‘Laroda’, and ‘Qishi Wase’.

Fruit is heart shaped with convex apex (Fig. 1C). It is initially green (134C) (Fig. 1C and D) and turns to yellow (7A) at maturity (Fig. 1E) and maintains the yellow color after harvest (Fig. 1F). Fruit of its parental plant ‘Qing Nai’, however, is green yellowish (142D) (Fig. 1G) and stays as green yellowish after harvest (Fig. 1H). Compared with ‘Wickson’, also a yellow-fruit cultivar (Karp, 2015), the convex apex of ‘Crown’ is more pronounced, the fruit at harvest are slightly larger, and fruit mature 3 weeks earlier. The average weight of a fruit from unpruned trees is 62 ± 5.2 g. A fruit from pruned trees is 88 ± 10.5 g, which was greater than fruit weights of ‘Qing Nai’ and ‘Hua Nai’ (Table 2). The outermost surfaces of the fruit are covered with a thick epicuticular wax layer. The fruit’s shallow symmetric sutures are similar to those of ‘Wickson’. The flesh is yellow (7B), tender, translucent, and juicy. The flesh of ‘Qing Nai’ and ‘Hua Nai’ is lightly yellow (150C) and carmine (35A), respectively (Table 2). The pit is small and the flesh thickness of ‘Crown’ ranges from 1.7 to 2.0 cm. The ratio of edible fruits is 98%, similar to ‘Qing Nai’ and ‘Hua Nai’.

‘Crown’ is an early-maturing cultivar. Stone hardens around 11 May. The harvest season for the fruits is late May or early June in Fujian, which is 5 to 6 weeks earlier than ‘Qing Nai’ and ≈ 8 weeks earlier than ‘Hua Nai’. Ripened ‘Crown’ fruits can remain on the trees for up to 3 weeks. The fruit skin had extremely low cracking rate compared with the medium cracking rate of ‘Qing Nai’ and the high rate of ‘Hua Nai’. Based on the University of California firmness penetrometer (Valero et al., 2007), the fruit firmness of ‘Crown’ was 26.8 ± 4.5 N, but the firmness of ‘Qing Nai’ and ‘Hua Nai’ were 32.5 ± 5.8 and 29.5 ± 4.2 N (Table 2), respectively. Our laboratory testing of numerous ‘Crown’ plum fruit samples harvested from multiple sites over a 5-year

Received for publication 5 Oct. 2015. Accepted for publication 10 Nov. 2015.

This study (breeding for fruit quality in plum and peach) was funded by the Fujian Agriculture and Forestry University, China.

We thank Ralf Oelmüller and Irena Sheremeti, Institute of Plant Physiology, Friedrich-Schiller-University Jena, Germany; Terri Mellich at the University of Florida for their constructive comments and critical review of this manuscript.

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Fig. 1. New plum cultivar Crown (*Prunus salicina*) is a mutant selected from a 'Qing Nai' plant in the village Xiyan, Gutian County, Fujian Province, China. (A) Leaves are purple when they begin to appear and gradually become green, (B) a plant with heavy white flowers before leaf emergence, (C) the fruit is heart shaped with convex apex, (D) abundant green fruit, (E) fruit became yellow at maturation, (F) fruits stored up to 25 d at 25 °C without deterioration, (G) green yellowish fruit on parental plant 'Qing Nai', and (H) the fruit of 'Qing Nai' stays green yellowish color after harvest.

Table 1. Phenological stages of *Prunus salicina* 'Crown' grown in Gutian County, Fujian Province, China.^z

Yr	Flower bud sprout	Bloom start	Full bloom	End of bloom	First cycle of fruit drop ^y	Second cycle of fruit drop	Fruit ripening	Leaf fall
2012	23 Feb.	7 Mar.	16 Mar.	28 Mar.	2 Apr.	20 Apr.	27 May	24 Nov.
2013	22 Feb.	8 Mar.	18 Mar.	31 Mar.	5 Apr.	22 Apr.	28 May	26 Nov.
2014	28 Feb.	13 Mar.	22 Mar.	3 Apr.	8 Apr.	26 Apr.	5 June	28 Nov.

^zThe observations were made from 2012 to 2014 for 3 years.

^yPreharvest physiological fruit drop.

period showed fruit nutritional values as follows: total soluble solids: 15.1 ± 0.5 °Brix; total carbohydrate content: 10.80%;

monosaccharides: 6.40%; disaccharide: 4.30%; titratable acidity: 0.83 ± 0.1 g/100 mL, which was mediated by malic acid; and the

average juice pH: 3.15. The values were not significantly different over the years or locations (Chen et al., unpublished data). On the other hand, total soluble solids of 'Qing Nai' and 'Hua Nai' were 12.7 ± 0.4 and 11.4 ± 0.3 °Brix, and titratable acidity for the two are 0.92 ± 0.2 and 1.04 ± 0.3 g/100 mL (Table 2), respectively. 'Crown' can be stored up to 25 d at 25 °C (Fig. 1F) without deterioration. The fruit maintains its firmness and juiciness under standard cold storage conditions (0 to 1 °C) for 7 months.

Table 2. Main characteristics of harvested fruit from pruned *Prunus salicina* 'Crown', 'Qing Nai', and 'Hua Nai' trees.^z

Cultivar	Fruit shape	Skin cracking	Fruit drop	Harvest date	Mean wt (g)	Skin color	Flesh color	Ratio of edible fruit	Fruit firmness ^y (N)	TSS (°Brix)	TA (g/100 ml)
Crown	Heart shape with convex apex	Extremely low	Low	Late May to early June	88 ± 10.5	Yellow (7A)	Yellow (7B)	98%	26.8 ± 4.5	15.1 ± 0.5	0.83 ± 0.1
Qing Nai	Heart shape with apex	Medium	Extremely high	Mid July	80 ± 9.8	Green yellowish (142D)	Lightly yellow (150C)	98%	32.5 ± 5.8	12.7 ± 0.4	0.92 ± 0.2
Hua Nai	Heart shape	High	Extremely high	Late July	70 ± 8.7	Magnet (43A)	Carmine (35A)	98%	29.5 ± 4.2	11.4 ± 0.3	1.04 ± 0.3

^zBased on data collected from 2012 to 2014 with an exception of TSS and TA, which were based on 5-year data (2010–14).

^yBased on the University of California firmness penetrometer test method (Valero et al., 2007).

TSS = total soluble solids; TA = titratable acidity.

Culture and Performance

Rooting of cuttings is possible but bud grafting is the primary method for propagating 'Crown'. It can be easily propagated by the T-budding onto *Amygdalus davidiana* (Carriere) Franch. rootstocks and *P. salicina* as intermediate stocks such as 'Qing Nai', 'Furongli', 'Wickson', and 'Black amber'. However, we failed to graft it onto *Prunus mume*, which could be due to the incompatibility between the two species.

'Crown' can grow in soils from clay to light sandy soils, but best performance occurs in loam and sandy loam with good drainage. It grows well in a soil pH ranging from 5.5 to 7.5. Established grafted plants are generally planted 4 m apart. For tree at the sapling stage, each tree needs to be fertilized with 0.1 kg of 10N–10P₂O₅–10K₂O in April; additional application of 0.2 kg of the fertilizer in August; and 0.2 kg of the fertilizer with 10 kg manure after defoliation. For mature trees, each needs 50 g of urea and 50 g potassium sulfate in early March, and 0.3 kg of 10N–10P₂O₅–10K₂O fertilizer or 0.5 kg of fused calcium magnesium phosphate fertilizer in early May. After defoliation, application of 20 kg of manure is recommended.

Common pest problems in plum production include aphids and oriental fruit fly *Bactrocera dorsalis* (Hendel). In addition, leaf curl (*Taphrina deformans*), powdery mildew (*Sphaeroteca pannosa*), and shot hole (*Wilsonomyces carpophilus*) also occur. Integrated pest management practices have

been recommended to control pest problems, including cleanup of orchard in winter, timely pruning or burning of infested branches, leaves, and small trees, and spraying of lime sulfur. The oriental fruit moth can be prevented using frequency vibration insecticidal lamps.

Two important traits separate 'Crown' from the other cultivars. The first is the early maturation. Since fruits are harvested before 10 June, the early harvesting naturally avoids attacks of the oriental fruit fly. Oriental fruit flies oviposit on fruit. Larvae damage fruit and other organs of plants. Larvae damage also causes fungal or bacterial infection. This fly can be responsible for up to 65% loss in 'Wickson' and other plum cultivars. The earlier maturation also avoids fruit drop and damage caused by tropical cyclones during the typhoon season from the end of June to September in Fujian coast. In addition, 'Crown' has no longitudinal dehiscent problem, which significantly enhances its marketability.

'Crown' is highly productive in Fujian. The average yield is 9 kg for 3-year-old trees and 30 kg for 5-year-old trees. The tendency for biennial bearing was not observed.

Availability

Small numbers of rooted cuttings or budwood can be obtained from Prof. Dr. Faxing Chen at the College of Horticulture, Fujian Agriculture and Forestry University, Fuzhou, China.

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