‘Zao Jinyan’ and ‘Mei Xiang’: Two Early-ripening Apricot Cultivars from ZFRI-CAAS

Zhenyu Huang, Lehan Xia, Long Chen, Zexuan Cui, Shuai Ren, Yibin Feng, and Yuling Chen

Zhengzhou Fruit Research Institute, Chinese Academy of Agricultural Sciences (ZFRI-CAAS), Zhengzhou 450009, Henan, China

Additional index words. breeding, fruit maturity, fruit quality, *Prunus armeniaca*

The apricot (*Prunus armeniaca* L.), which is native to China, is popular for its attractive appearance, unique flavor, and high nutritional value. Some apricot cultivars bear fruit early in the season; therefore, they are important competitors in the early summer fruit market (Chen et al., 2015; Liu and Liu, 2006). Recently introduced apricot cultivars, such as Katy and Sungold, have been widely planted in China; these cultivars are highly productive and amenable to long-term storage. As the standard of living increases, consumers value other fruit properties in addition to yield, such as taste and quality. Consumers increasingly demand Chinese local or improved apricot cultivars, such as Meishuo, Chuan Zhi Hong, Luo Tuo Huang, and Guo Zhi Xian, which are known to have an excellent flavor and unique aroma (Huang et al., 2018; Zhao et al., 2016). In this context, our group aims to select and breed early-ripening apricot cultivars with high eating quality to meet consumer demand.

Zao Jinyan and Mei Xiang, two outstanding apricot cultivars with excellent eating quality, were developed by the Plum and Apricot Group at the Zhengzhou Fruit Research Institute of the Chinese Academy of Agricultural Sciences (ZFRI-CAAS). ‘Zao Jinyan’ and ‘Mei Xiang’ were released in Henan Province, China, in 2010 and 2013, respectively. Zao Jinyan is a very early-ripening cultivar, with a fruit development period of 49–55 d and a ripening date of early to middle May in Zhengzhou (Henan Province, China). The fruit of cultivar Zao Jinyan has a bright golden yellow peel, a clean, smooth surface, and a nearly globose shape. These fruits are juicy, with a soluble solids content (SSC) generally higher than 15.0%.

The cultivar Mei Xiang has a fruit development period of 70–80 d and a ripening date of early June in Zhengzhou. The fruit of cultivar Mei Xiang has a golden yellow peel, which is rosy red on the side exposed to the sun, and a nearly globose shape. ‘Mei Xiang’ fruits are juicy, with a pleasant flavor, intense fruit aroma, and SSC of $\approx 14.0\%$. Both ‘Zao Jinyan’ and ‘Mei Xiang’ are self-incompatible and require pollinizers such as ‘Katy’ and ‘Sungold’.

Origin

‘Zao Jinyan’ and ‘Mei Xiang’ share one parent, ‘Zao Shu’, which is a natural chance seedling discovered in Zhengzhou, Henan Province, China. ‘Zao Shu’ was used as the female parent of ‘Zao Jinyan’ and the male parent of ‘Mei Xiang’ (Fig. 1). Zao Shu is a very early-ripening cultivar (3–10 May). ‘Zao Shu’ fruits are heart-shaped, with an average weight of 49.1 g and SSC and titratable acid (TA) contents of 14.8% and 6.2 mg/mL, respectively. The male parent of ‘Zao Jinyan’ is ‘Yang Shao’, which has a ripening date of 10–20 June. ‘Yang Shao’ fruits have an average weight of 86.9 g and SSC and TA contents of 15.3% and 10.3 mg/mL, respectively. The female parent of ‘Mei Xiang’ is ‘You Xi’, which has a ripening date of 20–30 June. ‘You Xi’ fruits have an average weight of 86.9 g and SSC and TA contents of 15.8% and 9.5 mg/mL, respectively. Both ‘Yang Shao’ and ‘You Xi’ are landraces native to Henan Province that bear high-quality fruit.

The three parental apricot cultivars (Zao Shu, Yang Shao, and You Xi) were hybridized in the apricot germplasm repository at ZFRI-CAAS (35°09’N, 113°47’E). From the cross ‘Zao Shu’ $\times$ ‘Yang Shao’, 371 hybrid seeds were initially harvested. Of these, 97 seedlings successfully germinated and survived transplantation in 1999. The seedlings began to bear fruit in 2002. From the cross ‘You Xi’ $\times$ ‘Zao Shu’, 287 hybrid seeds were initially harvested. Of these, 97 seedlings successfully germinated and survived transplantation in 2000. Seedlings began to bear fruit in 2003. All plants were grown using conventional management and pest control techniques. The primary agronomic traits of the fruits and trees were determined according to the standards described by Liu and Liu (2006).

Of the descendants of the two hybrid crosses, hybrids 98-6-11 (‘Zao Shu’ $\times$ ‘Yang Shao’) and 99-6-5 (‘You Xi’ $\times$ ‘Zao Shu’) exhibited the best performance. These hybrids were selected as the most advanced accessions. Between 2004 and 2005, hybrids 98-6-11 and 99-6-5 were assessed using top-grafting tests. The tests indicated that fruit quality and other economically valuable traits were uniform across replicates. We performed fruit thinning for fruits with abnormal phenotypes, including those that were extremely small, malformed, cracked, pest-injured, or infected. Some clones were propagated for subsequent pilot and regional tests in Henan and neighboring provinces. Over the course of 4 consecutive years (2006–09), agronomic traits were tested and found to be stable across different clones and regions. Finally, in 2010 and 2013, accessions 98-6-11 and 99-6-5, respectively, were approved by the Approval Committee for Improved Varieties of Forest Tree of Henan Province. Accession 98-6-11 was named ‘Zao Jinyan’ and accession 99-6-5 was named ‘Mei Xiang’.

Description

Tree. Mature ‘Zao Jinyan’ trees are relatively vigorous, with a semi-circular canopy and a semi-open growth habit. The trunk surface of the young tree is smooth and brown, while the trunk of the mature tree is deep brown with slight longitudinal cracks on the surface. One-year-old shoots are thick and strong, purple-red, and contain relatively short internodes (1.3 ± 0.2 cm). Perennial shoots are red-brown. Lenticels are low-density, medium sized, gray, and nearly round. The vegetative growth of ‘Zao Jinyan’ continues for ≈ 225 d per year. In Zhengzhou, the chilling requirement was ≈ 580 –610 h based on the 0 °C to 7.2 °C model described by Wang et al. (2003).

The canopy of the mature ‘Mei Xiang’ tree is semi-circular, with an open growth habit. The trunk is dark gray and relatively thick. Perennial shoots are also dark gray, and 1-year-old shoots are gray-brown, tilted, thick, and strong, with a smooth surface and no pubescence. The internode length is $\approx 1.24 \pm 0.2$ cm. The ‘Mei Xiang’ trunk contains many lenticels that are medium sized, gray-white, and nearly round. The vegetative growth period of ‘Mei Xiang’ is ≈ 220 d annually. The chilling requirement in Zhengzhou is ≈ 600 –640 h.

Leaf. The leaf of cultivar Zao Jinyan is glossy, smooth, deep green, and nearly round, with a round base, a mucronate apex, and a neat crenate leaf margin. Leaves are 6.8 ± 0.2 cm long, 6.2 ± 0.1 cm wide, and 0.03 ± 0.01 cm thick. Both the primary and lateral leaf veins are yellow-green. The petioles are yellow-green.

Fig. 1. Pedigrees of the apricot cultivars Zao Jinyan and Mei Xiang.

Received for publication 18 July 2019. Accepted for publication 6 Sept. 2019.

This work was supported by the Agricultural Science and Technology Innovation Program (ASTIP) (CAAS-ASTIP-2019-ZFRI) and the Central Public-interest Scientific Institution Basal Research Fund (No. 1610192019206). We thank LetPub (www.letpub.com) for linguistic assistance during the preparation of this manuscript.

Z.H. and L.X. contributed equally to this work. Z.H. and Y.C. are the corresponding authors. E-mail: chenyuling@caas.cn or huangzhenyu@caas.cn.

and 3.1 ± 0.2 cm long. The one to three petiole nectaries are round and relatively large.

The leaves of ‘Mei Xiang’ are glossy, deep green, and ovate, with a round base, a short acute apex, and crenate margins. Leaves are 7.3 ± 0.3 cm long, 6.4 ± 0.2 cm wide, and 0.03 ± 0.01 cm thick. The primary vein is yellow–white, whereas the lateral veins are yellow–green. The petioles are dark red and 3.0 ± 0.3 cm long, with three to four medium sized, round nectaries.

In Zhengzhou, the apricot cultivars Zao Jinyan and Mei Xiang begin pushing leaf buds in late March, and leaves begin to expand in early April. The leaves begin to fall in early November, and defoliation ends in mid-November.

Flower. The pistils of most ‘Zao Jinyan’ and ‘Mei Xiang’ flowers are equal in height to or taller than the stamens, and the proportion of complete flowers is greater than 65%. The upper part of the ‘Zao Jinyan’ petal is white and the lower part is red, whereas the

entire ‘Mei Xiang’ petal is pure white. Both cultivars have full, hypertrophic floral buds. The self-pollination rates of the ‘Zao Jinyan’ and ‘Mei Xiang’ apricots have been observed to be very low. Therefore, these cultivars are believed to be self-incompatible. In Zhengzhou, the floral buds of both cultivars break in early March, and the full bloom dates for ‘Zao Jinyan’ and ‘Mei Xiang’ are ≈ 15 March and 20 March, respectively. The flowering period of both cultivars is 7–10 d.

Fruit. The fruit development period for the ‘Zao Jinyan’ apricot is ≈ 49 –55 d, and the fruit reach maturity in early to middle May. The fruit shape is near globose, and the fruit surface is clean (Fig. 2). The average weight of the ‘Zao Jinyan’ fruit is 59.6 ± 4.8 g, and the maximum weight is 105.2 g (Table 1). The average vertical diameter, transverse diameter, and lateral diameter of the fruit are 4.8 ± 0.4 cm, 5.0 ± 0.3 cm, and 5.1 ± 0.3 cm, respectively. The ground color of the

mature fruit is golden yellow, without any overcolor. The moderately thick peel can be easily separated from the mesocarp and is covered with short pubescence. The fruit flesh is yellow, thick, and delicate in texture, with a low fiber content. The edible rate can reach 96.5%. ‘Zao Jinyan’ fruits are valuable because they have abundant juice, strong sweetness, and an intense fruity aroma. In these fruits, the SSC is $15.6\% \pm 0.5\%$, the total soluble sugar content is $8.16\% \pm 0.22\%$, the reducing sugar content is $3.00\% \pm 0.09\%$, the total acid content is 4.9 ± 1.1 mg/mL, the pectin content is $1.33\% \pm 0.11\%$, and the vitamin C content is 9.65 ± 1.0 mg·100 g⁻¹. The ‘Zao Jinyan’ apricot is a freestone cultivar. The stone is oblong, and the average dry stone weight is $\approx 1.6 \pm 0.2$ g. The vertical diameter, transverse diameter, and lateral diameter of the stone are 1.9 ± 0.2 cm, 1.5 ± 0.2 cm, and 0.8 ± 0.1 cm, respectively. The kernel has a bitter flavor, and the average dry weight is 0.4 ± 0.1 g. The shelf life of ‘Zao Jinyan’ fruit at room temperature is 7–10 d.

The ‘Mei Xiang’ apricot ripens in early June, and the fruit development period is ≈ 70 –80 d. The fruit is nearly globose and brightly colored (Fig. 3). The ‘Mei Xiang’ apricot is relatively large, with an average weight of 97.0 ± 9.3 g and a maximum weight of 142.1 g (Table 1). The vertical diameter, transverse diameter, and lateral diameter of the fruit are 5.3 ± 0.3 cm, 5.5 ± 0.4 cm, and 5.6 ± 0.4 cm, respectively. The ground color of the ‘Mei Xiang’ fruit is orange–yellow, and the fruit is covered with red patches on the side exposed to the sun. The fruit blush percentage is estimated to be 30% to 50%. The peel is moderately thick, easily separated from the mesocarp, and covered with dense short pubescence. The flesh is golden yellow, with a soft and delicate texture, and has a very low fiber content. The edible rate is $\approx 95.2\%$. The flavor of the ‘Mei Xiang’ apricot is initially tart and then sweet, with a strong fruity aroma and plentiful juice. The SSC is $14.6\% \pm 0.4\%$, the total soluble sugar content is $7.19\% \pm 0.16\%$, the reducing sugar content is $2.91\% \pm 0.08\%$, the total acid content is 9.9 ± 1.2 mg/mL, the pectin content is $1.31\% \pm 0.14\%$, and the vitamin C content is 10.9 ± 0.9

Fig. 2. Fruits of the apricot cultivar Zao Jinyan.

Table 1. Economically important traits of ‘Zao Jinyan’ and ‘Mei Xiang’ fruits compared with those of other apricot cultivars.

Cultivar	Ripening date	Avg fruit wt (g)	Fruit shape	Soluble solids content (°Brix)	Total soluble sugar content (%)	Reducing sugar content (%)	Titrateable acid content (mg/mL)	Vitamin C content (mg·100 g ⁻¹)	Pectin content (%)	Chilling requirement (h)
Zao Jinyan	4–10 May	59.6 ± 4.8^a	Near globose	15.6 ± 0.5	8.16 ± 0.22	3.00 ± 0.09	4.9 ± 1.1	9.65 ± 1.0	1.33 ± 0.11	580–610
Mei Xiang	1–10 June	97.0 ± 9.3	Near globose	14.6 ± 0.4	7.19 ± 0.16	2.91 ± 0.09	8.9 ± 1.2	10.9 ± 1.1	1.31 ± 0.15	600–640
Zao Shu	3–10 May	49.1 ± 3.3	Heart-shaped	14.8 ± 0.4	7.37 ± 0.21	2.89 ± 0.11	6.2 ± 0.9	10.7 ± 1.4	1.22 ± 0.11	550–600
Yang Shao	10–20 June	86.9 ± 6.7	Ovate	15.3 ± 0.2	8.29 ± 0.24	3.39 ± 0.07	10.3 ± 1.1	11.7 ± 0.9	1.40 ± 0.13	600–640
You Xi	20–30 June	107.0 ± 8.0	Oblong, globose	15.8 ± 0.3	8.09 ± 0.34	3.23 ± 0.14	9.5 ± 1.2	11.3 ± 1.1	1.25 ± 0.12	610–650
Sungold	20–30 May	58.6 ± 5.1	Near globose	13.1 ± 0.3	7.02 ± 0.25	2.91 ± 0.12	11.1 ± 0.8	8.22 ± 0.7	1.21 ± 0.09	610–650
Katy	3–12 June	95.5 ± 6.3	Oblong, globose	12.7 ± 0.4	6.82 ± 0.15	2.71 ± 0.11	10.4 ± 0.9	7.73 ± 1.0	1.26 ± 0.14	690–730

^aData were obtained from three replicates, and each replicate comprised nine uniform fruits from three different trees. Data are expressed as mean $\pm$ SD.

Fig. 3. Fruits of the apricot cultivar Mei Xiang.

mg/100 g⁻¹. The ‘Mei Xiang’ apricot is a freestone cultivar. The stone is ovate, and the stone surface is coarse with deep ridges. The average dry stone weight is $\approx 2.0 \pm 0.2$ g. The vertical diameter, transverse diameter, and lateral diameter of the stone are 2.8 ± 0.3 cm, 2.0 ± 0.2 cm, and 1.2 ± 0.2 cm, respectively. The kernel has a sweet flavor and an average dry weight of 0.5 ± 0.2 g. The shelf life of the fruit at room temperature is 5–7 d.

Growth and fruiting habit. In Zhengzhou, 10-year-old ‘Zao Jinyan’ and ‘Mei Xiang’ trees are 3.4–3.8 m high, with canopy diameters of 3.3–3.6 m and trunk circumferences of 65–80 cm. The mean length and diameter of the annual shoots are $\approx 54.0 \pm 6.0$ cm and 0.8 ± 0.2 cm, respectively. The fruits of the two cultivars are primarily produced on bouquet spurs and short fruiting branches. Grafted ‘Zao Jinyan’ and ‘Mei Xiang’ apricot seedlings flower beginning in the second year, and the high-yield period begins the fourth year after planting. The average yield of a 5-year-old tree

is nearly 40 kg of fruit, and the fruit yield during the full fruiting period is estimated to be 33,600 kg per hectare at a density of 3×4 m.

Cultivation techniques. The internodes of ‘Zao Jinyan’ and ‘Mei Xiang’ are relatively short, which allows rational high-density planting ($2-3 \times 3-4$ m) in newly built orchards to generate early, plentiful yields. The recommended planting time is from the end of defoliation until the soil freezes in the fall, or from the time soil thaws to the beginning of bud burst in the spring. Suitable pollinizers, such as ‘Katy’ and ‘Sungold’ apricots, are required at a ratio of one pollinizer to four to eight cultivars.

The recommended tree structures for ‘Zao Jinyan’ and ‘Mei Xiang’ are open center, stratified leader, ‘Y’, or free spindle. Proper tree training will reduce the number of skeleton branches, ensuring sufficient air circulation and light penetration. This will facilitate management, harvest, and regeneration.

Flowering branches that are weak or too long should be pruned before flowering. The

first fruit thinning should be performed 20 d after flowering. At this time, fruit that are not well-developed or that are crowded should be removed. A second fruit thinning should be performed 15 d later; only one fruit should be retained per 8- to 10-cm branch segment. Proper fruit thinning will ensure high stable yields in subsequent years.

Intercropping, weeding, and mulching are suggested during the growth periods of ‘Zao Jinyan’ and ‘Mei Xiang’. After autumn harvest, organic fertilizer and compound fertilizer should be applied to each tree using pit or furrow application techniques. After 1–2 years of growth, ≈ 5000 kg organic fertilizer per 666.7 m² should be applied. At the end of autumn, each fully productive tree should receive 25–50 kg organic fertilizer (e.g., composted chicken manure, cattle manure, and pig manure) plus 0.5–1.0 kg diammonium phosphate, potassium chloride, or potassium sulfate. Fully productive trees typically should be top-dressed twice per year using quick-acting fertilizer, once before flowering and once before fruit expansion.

Field observations indicated that ‘Zao Jinyan’ and ‘Mei Xiang’ apricots were resistant to stressors, diseases, and pests. However, management techniques should be prophylactically applied in orchards.

In conclusion, ‘Zao Jinyan’ and ‘Mei Xiang’ apricots are early-maturing cultivars with excellent fruit quality. Both cultivars are stable, high-yield producers; therefore, they are strong competitors in the early summer fruit market. These cultivars are believed to be suitable for Henan and neighboring provinces.

Availability

‘Zao Jinyan’ and ‘Mei Xiang’ are the property of the ZFRI-CAAS. They have been approved by the Approval Committee for Improved Varieties of Forest Tree of Henan Province (no. Henan S-SV-AV-007-2010; no. Henan S-SV-AV-016-2013). A limited quantity of bud wood is available on request for trial and research purposes as well as commercial propagation.

Literature Cited

- Chen, X.S., W.W. Guo, J. Xu, P.H. Cong, L.R. Wang, C.H. Liu, X.G. Li, S.J. Wu, Y.X. Yao, and X.L. Chen. 2015. Genetic improvement and promotion of fruit quality of main fruit trees. *Scientia Agricultura Sinica* 48(17):3524–3540.
- Huang, Z.Y., L.H. Xia, Y.B. Feng, J.T. Hui, S.R. Qiao, and Y.L. Chen. 2018. ‘Meishuo’: An early-maturing apricot cultivar with large fruit from ZFRI-CAAS. *HortScience* 53:1907–1908.
- Liu, N. and W.S. Liu. 2006. Descriptors and data standard for apricot (*Armeniaca* Mill.). China Agricultural Press, Beijing.
- Wang, L.R., G.R. Zhu, W.C. Fang, and Q.Y. Zuo. 2003. Estimating models of the chilling requirement for peach. *Acta Horticulturae Sinica* 30(4):379–383.
- Zhao, X.P., X.L. Wu, X.C. Zhang, L.Y. Yuan, H.X. Zhang, Q.Z. Cui, and L.Y. Li. 2016. Breeding of early maturity new apricot line ‘Z08-7-34’. *Journal of Hebei Agricultural Sciences* 20(2):77–78, 104.