

‘Jinyu’ and ‘Jinhe’: Two New High-quality, Very Early-ripening Apricot (*Prunus armeniaca* L.) Cultivars from China

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Apricot (*Prunus armeniaca* L.) is one of the important fruit trees originating from China, and it is highly appreciated by consumers because of its early ripening, gorgeous colors, and nutritional content (Zhang and Zhang, 2003). Apricot cultivation area and yield in China rank first in the world. In 2016, the total cultivation area of apricots grown for the fresh market and processed in China reached 360,000 hm², with a yield of 2,700,000 t (Sun et al., 2019). In recent years, the apricot cultivation area and yield have shown a steady growth trend in Hebei Province, the second-largest apricot-growing area in China. The fresh apricot-growing area in Hebei Province was 63,000 hm² and the yield was 289,000 t in 2015 (Wu et al., 2018a). Historically, the main apricot cultivars grown in Hebei have been mostly local cultivars, with a large proportion of medium- and late-ripening cultivars and a small proportion of high-quality early-ripening cultivars. Driven by the consumer market, the earlier the apricot ripens, the greater the commodity value. Therefore, it is common practice to pick the fruit early, yet the fruit quality can decline, which restricts the development of the apricot industry.

To provide high-quality fruit to the commercial market, very early-ripening apricots with high yield, good fruit quality, strong disease resistance, and wide adaptability can be obtained through cultivar improvement. Indeed, many programs have focused on the

breeding of very early-ripening apricot, resulting in the successful release of new apricot cultivars such as ‘Zaojinyan’ from the Zhengzhou Fruit Research Institute and ‘Chunhua’ from the Shandong Institute of Pomology in China (Huang et al., 2019; Yuan et al., 2019). However, the ecological regions across China vary considerably, and each cultivar has its own adaptability; thus, these cultivars still cannot fully meet the market demand. Currently, very early-ripening apricot cultivars suitable for cultivation in Hebei Province are still lacking. Therefore, the Shijiazhuang Fruit Research Institute at the Hebei Academy of Agriculture and Forestry Sciences (SFRI-HAAFS; Shijiazhuang, Hebei Province, China) established a cross-breeding program with the aim of obtaining high-yielding, high-quality, very early-ripening apricot cultivars. The collection and evaluation of apricot germplasm resources began in 1981. Currently, SFRI-HAAFS has conserved genetic resources of 120 significant apricot cultivars.

The botanical and biological characteristics of the apricot cultivars, including their ripening time, productivity, fruit shape, skin color, flesh color, fruit weight, flesh adherence to the stone, aroma, total soluble solids content, titratable acidity, reducing sugar content, and protein content, have been determined by comprehensive and systematic analyses of the available genetic resources at SFRI-HAAFS (Chai and Zhao, 2002). Many cultivars are selected as parents, such as ‘Zihe’ and ‘Ganyu’ (Chai and Zhao, 2002), ‘Xinshiji’ (Chen et al., 2001), and ‘Luotuo-huang’ and ‘Chuanzhong’ (Liu et al., 2012). We found that when early-ripening apricot cultivars were used as the female parent, they were more likely to transfer the early-ripening trait to their offspring (Wu et al., 2018b). However, the seeds of very early-ripening apricot are unable to germinate by means of winter sand storage. To solve this problem, we proposed two seed treatment methods: 1) soaking fresh seed kernels in gibberellin and 2) sand storage of fresh seeds (Zhao and Liu, 2013). The work of cross-breeding with very early-ripening apricot cultivars as the female parent began in

2006. Currently, SFRI-HAAFS has more than 10,000 hybrid apricot seedlings under evaluation.

‘Jinyu’ and ‘Jinhe’ are two new very early-ripening apricot hybrids developed by the Plum and Apricot Laboratory of SFRI-HAAFS. They were released in Hebei in 2015 and 2017, respectively. ‘Jinyu’ has high fresh-fruit quality with a sweet taste and a high vitamin C content. ‘Jinhe’ ripens earlier than other very early-ripening cultivars grown in Shijiazhuang, and it has large fruit with good appearance and high flesh quality. The cultivation of these two cultivars has been demonstrated and promoted in the main apricot-producing areas in Hebei, and their high productivity has been recognized. ‘Jinyu’ and ‘Jinhe’ produce apricot fruit that can be supplied to the market earlier, especially in the south-central part of North China and other similar ecological regions. The release of these two cultivars in the future is expected to increase the choice of apricot cultivars available for the major production areas in China.

Origin

‘Jinyu’ resulted from a cross of ‘Yuzhou-hong’ as the female parent and ‘Sungold’ as the male parent in 2005 (Fig. 1). ‘Yuzhou-hong’ is a very early-ripening apricot cultivar from China. The fruit is ovoid, with an average weight of 38.6 ± 4.9 g and a maximum weight of 70.0 g. The skin is bright orange with red spots on the surface, and the flesh is orange with a soluble solids content of 11.6% ± 1.2%. ‘Yuzhou-hong’ is a freestone cultivar with bitter kernels. The fruit has a flesh hardness of 2.7 ± 0.3 kg·cm⁻². Because the fruit can be stored for 5 to 7 d at room temperature and can withstand storage and transport, this cultivar is referred to as “long-legged apricot” by local fruit farmers. ‘Sungold’ is an early-ripening cultivar from America that is highly productive and amenable to long-term storage. Consequently, ‘Sungold’ has been widely planted in China. The fruit is nearly round, with an average weight of 59.6 ± 0.6 g and a maximum weight of 83.0 g. The skin is orange with a smooth surface. The flesh is orange, fine in texture, and tough. The flesh contains little fiber, with a high juice content and no aroma. The soluble solids content of the fruit is 14.0% ± 0.8%. The kernels are bitter. The fruit can be eaten either fresh or processed.

‘Jinhe’ resulted from a cross made in 2008 between the apricot cultivars ‘Zihe’ (female parent) and ‘Xinshiji’ (male parent; Fig. 1). ‘Zihe’ is a traditional apricot cultivar from China. The fruit is oblate with a concave apex. The average weight of single fruit is 46.8 ± 7.5 g and the maximum fruit weight is 60.0 g. The ground color of the fruit skin is green–yellow, with small fruit dot size and no pubescence. The fruit flesh is orange, juicy, and sweet, with a soluble solids content of 14.2% ± 0.6%. The flesh is freestone with no browning or softening near the stone. The fresh stone weight is 1.13 ± 0.04 g, and the

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fruit edible rate is $97.3\% \pm 0.2\%$. The kernel is bitter. The flesh hardness is $0.9 \pm 0.3 \text{ kg}\cdot\text{cm}^{-2}$ and the fruit can be stored for ≈ 3 to 5 d at room temperature. ‘Xinshiji’ is a cultivar obtained by crossing ‘Erhuacao’ (female parent) with ‘Honghebao’ (male parent) at the Shandong Agricultural University (Tai’an, Shandong Province, China). The fruit has an elongated, circular shape, with an average weight of $71.5 \pm 7.7 \text{ g}$ and a maximum weight of 160.5 g. The sutures are deep and distinct, and the flesh slices are asymmetrical. The ground color is orange-red, with pink patches on the side exposed to the sun. The flesh is orange with coarse fiber, a high juice content, and a sour taste. The soluble solids content is $13.0\% \pm 0.6\%$. The flesh is cling stone. The stone is large, with a fresh weight of $3.22 \pm 0.05 \text{ g}$, and the fruit edible rate is $94.5\% \pm 0.4\%$. The kernel is bitter. The fruit has a flesh hardness of $2.0 \pm 0.3 \text{ kg}\cdot\text{cm}^{-2}$ and can be stored for ≈ 3 to 5 d at room temperature.

From the cross ‘Yuzhouhong’ \times ‘Sungold’, 485 hybrid seeds were initially harvested. Of these, 205 seedlings germinated successfully and survived transplantation in 2006. The seedlings began to bear fruit in 2008. From the cross ‘Zihe’ \times ‘Xinshiji’, 419 hybrid seeds were initially harvested. Of these, 240 seedlings germinated successfully and survived transplantation in 2009. The seedlings began to bear fruit in 2012. All plants were grown using conventional management and pest control techniques. The primary agronomic traits of the fruit and trees

were determined according to the standards described by Liu and Liu (2006). Among the descendants of the two crosses, hybrids 2005YJ-134 (‘Yuzhouhong’ \times ‘Sungold’) and Z08-7-34 (‘Zihe’ \times ‘Xinshiji’) exhibited the best performance. These two hybrids were selected as the most advanced accessions. The evaluation of hybrids 2005YJ-134 and Z08-7-34 was conducted using top-grafting tests from 2013 to 2015 and 2014 to 2017, respectively. The following the botanical and biological characteristics were examined in the tests: date of full blooming, date of open leaf, date of harvest maturity, date of defoliation, internode length, taper, leaf length, leaf width, self-pollination rate, fruit-set rate, fruit development, fruit size, fruit shape, soluble solids content, ground color, cover color, flesh color, titratable acid content, flavor, flesh firmness, edible rate, vitamin C content, low-chilling requirement, productivity, and so on. After 3 to 4 years of continuous observation, the agronomic traits of the two hybrids were excellent and stable. Finally, in 2015 and 2017, accessions 2005YJ-134 and Z08-7-34 were approved by the Approval Committee for Improved Varieties of Forest Tree of Hebei Province. Accession 2005YJ-134 was named ‘Jinyu’ and accession Z08-7-34 was named ‘Jinhe’.

Description

Tree characteristics

Trees. Trees of ‘Jinyu’ have a high growth potential, a crown with a round head shape,

and a semicircular canopy with a semiopen growth habit. The trunk of mature trees is purplish brown, and the perennial branches are brown. The annual branches are strong and oblique, with a smooth surface. The annual branches have a medium density, and they are brownish red on the sunny side and yellowish brown on the back. The lenticels are transverse and small. The length-to-diameter ratio of the annual branches is 182:1.24, and the average panel length is $2.20 \pm 0.33 \text{ cm}$. The vegetative growth of ‘Jinyu’ continues for $\approx 220 \text{ d}$ per year (Table 1).

‘Jinhe’ trees also have a high growth potential, a crown with a round head shape, and a semicircular canopy with a semiopen growth habit. The trunk of mature trees is coarse, and the bark is split longitudinally with a yellowish brown surface color. The perennial branches are greenish brown. The annual branches have a moderately rough surface and are oblique. The sunny side of the annual branches is tawny and smooth. The lenticels are circular and dense, and of medium size. The internode length is $2.27 \pm 0.29 \text{ cm}$, and the taper is 0.74 ± 0.03 . The vegetative growth period of ‘Jinhe’ is $\approx 220 \text{ d}$ per year (Table 1).

Leaves. The leaves of ‘Jinyu’ are broadly rounded, thick, dark green, glossy, and smooth. The angle of the blade tip is acute; the leaf base is heart shaped. The leaf margin is neat and serrated whereas the leaf blade undulates. The average length and width of the leaves are $(8.5 \pm 0.6) \times (8.0 \pm 1.1) \text{ cm}$ (Table 1). The main veins are light green. The petiole has an average length of 3.1 cm and is purplish red. The average number of nectaries in the petiole is two to three.

The leaves of ‘Jinhe’ are circular and smooth. Mature leaves are green; younger leaves are reddish brown. The angle of the blade tip is acute; the leaf base is round. The leaf margin is coarsely serrated; the leaf blade is slightly rolled up. The average length and width of the leaves are $(11.1 \pm 0.9) \times (9.1 \pm 0.9) \text{ cm}$ (Table 1). The main veins are light green. The average length of the petiole is 3.7 cm and is purplish red. There are three to four nectaries on the petiole on average.

In Shijiazhuang, the apricot cultivars Jinyu and Jinhe begin pushing leaf buds in late March to the beginning of April, and leaves begin to expand in early April. The

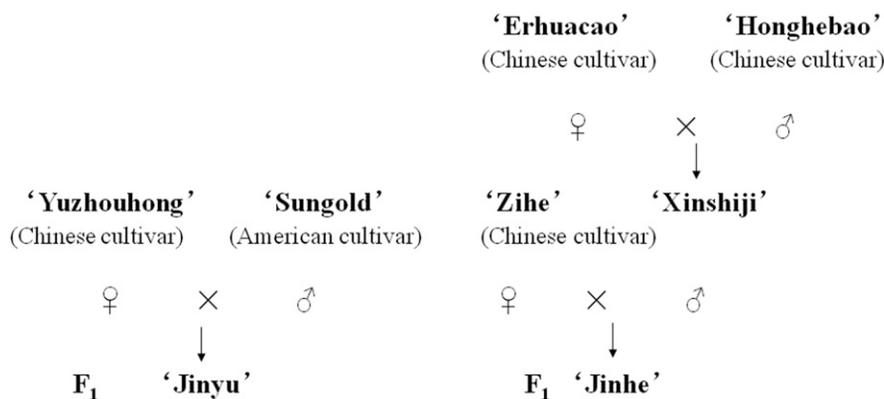


Fig. 1. Pedigrees of the new very early-ripening apricot cultivars Jinyu and Jinhe.

Table 1. Description of apricot trees of the new cultivars Jinyu and Jinhe, their parents’ cultivars, and the reference cultivars under experimental conditions in Shijiazhuang, 2015 to 2017.

Cultivar	Full blooming date	Open leaf date	Harvest maturity date	Defoliation date	Internode		Leaf length (cm)	Leaf width (cm)	Complete flowers (%)	Rate of fruit set (%)
					length (cm)	Taper				
Jinyu	23 Mar.	3 Apr.	20 May	2 Nov.	$2.3 \pm 0.2 \text{ ab}$	$0.59 \pm 0.02 \text{ a}$	$8.5 \pm 0.6 \text{ a}$	$8.0 \pm 1.1 \text{ ab}$	$85.1 \pm 12.3 \text{ cd}$	$68.3 \pm 8.4 \text{ d}$
Jinhe	24 Mar.	1 Apr.	18 May	30 Oct.	$2.2 \pm 0.5 \text{ ab}$	$0.74 \pm 0.03 \text{ b}$	$11.1 \pm 0.9 \text{ b}$	$9.1 \pm 0.9 \text{ b}$	$43.5 \pm 6.8 \text{ b}$	$36.1 \pm 4.2 \text{ b}$
Yuzhouhong	23 Mar.	1 Apr.	20 May	1 Nov.	$1.9 \pm 0.4 \text{ a}$	$0.61 \pm 0.03 \text{ a}$	$9.5 \pm 0.9 \text{ ab}$	$7.0 \pm 0.9 \text{ a}$	$77.3 \pm 7.9 \text{ c}$	$55.0 \pm 3.6 \text{ c}$
Sungold	23 Mar.	2 Apr.	1 June	5 Nov.	$2.2 \pm 0.1 \text{ ab}$	$0.56 \pm 0.06 \text{ a}$	$8.2 \pm 0.8 \text{ a}$	$7.8 \pm 1.0 \text{ ab}$	$91.2 \pm 11.1 \text{ d}$	$85.0 \pm 6.9 \text{ e}$
Zihe	25 Mar.	3 Apr.	22 May	3 Nov.	$1.8 \pm 0.4 \text{ a}$	$0.78 \pm 0.09 \text{ b}$	$9.8 \pm 1.1 \text{ ab}$	$7.9 \pm 0.8 \text{ ab}$	$70.2 \pm 9.8 \text{ c}$	$48.3 \pm 3.3 \text{ c}$
Xinshiji	23 Mar.	1 Apr.	26 May	30 Oct.	$2.5 \pm 0.6 \text{ bc}$	$0.54 \pm 0.06 \text{ a}$	$11.7 \pm 0.9 \text{ b}$	$8.0 \pm 0.9 \text{ ab}$	$48.9 \pm 7.5 \text{ b}$	$36.4 \pm 4.1 \text{ b}$
Luotuojuang	23 Mar.	3 Apr.	22 May	1 Nov.	$2.8 \pm 0.5 \text{ c}$	$0.63 \pm 0.05 \text{ a}$	$10.0 \pm 0.9 \text{ ab}$	$7.9 \pm 1.2 \text{ ab}$	$21.4 \pm 3.3 \text{ a}$	$12.6 \pm 1.9 \text{ a}$

Data are the means \pm SD. Different lowercase letters in each column indicate a significant difference between cultivars at the 0.05 level by Duncan’s multiple range test.