A New Late-ripening Chinese Chestnut Cultivar, Jianding Youli

Cancan Zhu, Liu Liu, Min Wang, Yuqiang Zhao, and Yu Chen

Institute of Botany, Jiangsu Province and Chinese Academy of Sciences, Nanjing 210014, China

Xiaomei Lu

Changzhou Guomei Agricultural Technology Corporation Limited, Changzhou, 213000, China

Guomin Geng¹

Institute of Botany, Jiangsu Province and Chinese Academy of Sciences, Nanjing 210014, China

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A new Chinese chestnut cultivar, Jianding Youli (*Castanea mollissima* Blume), was released from native chestnut trees in China by Institute of Botany, Jiangsu Province, and Chinese Academy of Sciences in 2017. This cultivar was preliminary selected from a natural seedling tree in Shandong Province in 1963. Then, the advanced and regional yield trials for evaluation were carried out from 1975 to 2016. Jianding Youli is a late-ripening cultivar with an optimal ripening date in late September. It has good nut quality for eating raw and processing, and it is especially suitable for sugar-frying processing. The average nut weight is 10.8 g. It is easily identified by the acute tip on the blossom of nuts and reddish-brown, glossy shell. It also has been found to be resistant to chestnut blight disease and the chestnut weevil. This gives it suitable features for storage. It has high yield potential, and the average yield of an 8-year old ‘Jianding Youli’ was 8.8 kg per tree.

Origin

The first general survey of Chinese chestnut resources was carried out from 1961 to 1963. Jianding Youli (*Castanea mollissima* Blume) cultivar was selected in 1963 from indigenous individual located at Tancheng County, Shandong Province, People’s Republic of China (lat. 34°38′1.07″N, long. 118°11′1.18″E, elevation 67 m). This area is situated in the warm temperate zone of China, belonging to the warm temperate zone monsoon climate. The type of the soil

is brown soil. Trees of this cultivar are vigorous and produce abundant heavy fruits uniformly throughout the fruiting season. This cultivar is easy to identified by the acute tip on the blossom and reddish-brown, glossy nutshell. Finally, this cultivar also shows resistance to chestnut blight disease and the chestnut weevil.

Description and Performance

Using scion grafting, more than 60 Chinese chestnut cultivars including ‘Jianding Youli’ (*Castanea mollissima* Blume) were tested for propagation in the experimental nursery in Institute of Botany, Jiangsu Province, and Chinese Academy of Sciences in 1975. The first selection was conducted from 1975 to 1985. From 1990 to 2016, the regional adaptation and advanced trails for examination of each individual tree’s characteristics and productivity were initiated in the Chinese Chestnut experimental nursery of Institute of Botany, Jiangsu Province and Chinese Academy of Sciences, Nanjing, China (lat. 32°03′20.79″N, long. 118°49′53.377″E, elevation 48 m). This area has a north subtropical humid monsoon climate and the landform here is mainly low mountains and gentle hills. The cultivar Jiujiazhong (*C. mollissima*) was used as a standard for comparison. Native to China, this cultivar has good yields, large fruit, and has been generally cultivated in Yangtze Plain of China.

We evaluated the new Jianding Youli cultivar and the reference cultivar Jiujiazhong for bursting time of leaf bud and leaf characteristics, flowering, fructification characteristics, harvesting time, yield, morphological nut characteristics, and nut traits on 10 grafted trees (2 years after grafting, seedlings as rootstocks) according to guidelines for the conduct of tests for distinctness, uniformity, and stability in chestnuts (*Castanea mollissima* Blume) (LY/T 1851-2009, UPOV TG/124/3, UPOV 2017). The contents of soluble sugar, starch, soluble protein, crude fat, and vitamin C of the nuts also

were investigated using plant biochemical methods. The values provided are the averages of 3 years of data collection, 2011 to 2014.

For bursting time of leaf bud and leaf characteristics, ‘Jianding Youli’ bursts into leaf bud around 10 Apr., and it is observed to be 1/2 or partially 2/5 in phyllotaxis. Leaves are needle-shaped elliptic to oval. ‘Jianding Youli’ has a dentate incision shape of the leaf margin, a cordate shape of the leaf blade base, leaf length to leaf width ratio of 2.75, and a leaf length to petiole length ratio of 14 (Table 1).

The cultivar shows a semierect tree shape (Fig. 1). The diameter of the tree trunk (after first growing season, below first branch) is large, and the bearing mother branches are short and thick, with the length of internodes of current season’s lateral is 1.5 cm. Also, the densities of lenticels on the laterals are dense. The dormant bud of the cultivar is reddish brown in color with hairs. This cultivar was observed to have tolerance to chestnut blight disease and the chestnut weevil (data not shown).

The pistillate flowering period is from 29 May to 15 June with a full bloom from 6 June to 11 June. The staminate flowering period of ‘Jianding Youli’ is from 2 June to 20 June with a full bloom from 8 June to 15 June (Table 2). The male catkin is of medium length, and the type of catkins is longistaminate, based on the International Union for the Protection of New Varieties of Plants guidelines.

Jianding Youli is an early-ripening, high-yield cultivar. It has high sprouting power. Fruiting ability of the bearing mother branches on this cultivar is well developed. The bearing branches of juvenile tree easily produce branchlets and are tolerant to pruning (Table 3). The average plant yield of 2-year-old grafted seedlings was 0.55 kg of nuts, and the highest yield of 3-year-old grafted trees was 12.3 kg.

‘Jianding Youli’ has short, dense burs. The fruit is transverse broad ellipsoid in shape with an acute tip (Fig. 2). The shell is reddish-brown, glossy, and easy to peel. This variety produced larger nuts than other varieties, with the nut height to nut width ratio of 1.08 ± 0.03 , a hilum length to nut width ratio of 1.15 ± 0.06 , 0.0% polyembryonic nuts, 0.13% pericarp splitting, and weak degree of penetration of the seedcoat into the kernel (Table 4). We predict that this cultivar has great potential future product value for processing use because it is monoembryonic, has lower pericarp splitting, and has a low percentage of penetration of the seedcoat into the kernel.

The average single nut weight is 10.8 g and the nut kernel rate is 49.2%. The kernel is fine, glutinous, and sweet, with soluble sugar content of 20.56%, starch content of 39%, starch gelatinization temperature of 57.2 °C, and the soluble solid content of 16.2% after harvesting (Table 5). This chestnut cultivar is suitable for roasting and stir-frying.

The cultivar Jianding Youli did not show obvious symptoms of weevil and *Dichrocis punctiferalis* Guenée infestation. In 2016,

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¹Corresponding author. E-mail: 13951970164@163.com.

Table 1. Time of leaf bud burst and leaf characteristics of 'Jianding Youli' and 'Jiujiazhong'.

Cultivars	Bursting time of leaf bud	Phyllotaxis	Cross section of leaf	Incisions of leaf margin	Shape of base of leaf blade	Leaf length/leaf width	Leaf length/petiole length
UPOV number	8	5	15	22	21	17	25
Jianding Youli	10 Apr.	1/2, 2/5	Straight	Dentate	Cordate	2.8 ± 0.23 b	14 ± 1.61 b
Jiujiazhong	13 Apr.	1/2, 2/5	Slightly concave	Dentate	Obtuse	2.2 ± 0.87 a	11 ± 2.55 a

Means ± SD done by *t* test (Duncan's multiple range test) at *P* = 0.05 on 10 plants per cultivar (n = 20); similar letters within a column indicate no significant differences.

UPOV = International Union for the Protection of New Varieties of Plants.

Table 2. Flowering period of 'Jianding Youli' and 'Jiujiazhong'.

Cultivars	Staminate flower					Pistillate flower			
	Flowering beginning	Full bloom beginning	Full bloom end	Flowering end	Length of unisexual catkin	Flowering beginning	Full bloom beginning	Full bloom end	Flowering end
UPOV number	11				9	12			
Jianding Youli	2 June	8 June	15 June	20 June	Medium	29 May	6 June	11 June	15 June
Jiujiazhong	1 June	10 June	16 June	19 June	Short	30 May	5 June	10 June	16 June

UPOV = International Union for the Protection of New Varieties of Plants.

Table 3. Flowering and fructification characteristics of 'Jianding Youli' and 'Jiujiazhong'.

Cultivar	No. of pistillate flowers per bearing branchy	No. of bearing branch per bearing mother branch	No. of burs per bearing branch	Seed-setting rate (%)	Empty shell rate (%)
Jianding Youli	1.25 ± 0.42 a	2.12 ± 0.82 a	2.82 ± 0.06 ab	89.68 ± 10.32 b	2.08 ± 0.38 a
Jiujiazhong	1.77 ± 0.38 b	2.51 ± 0.32 b	2.77 ± 0.20 a	82.58 ± 5.53 a	2.43 ± 0.41 b

Means ± SD done by *t* test (Duncan's multiple range test) at *P* = 0.05 on 10 plants per cultivar (n = 20); similar letters within a column indicate no significant difference.

Table 4. Harvesting time, yield, and morphological nut characteristics of 'Jianding Youli' and 'Jiujiazhong'.

Cultivars	Optimal harvest time	Yield (kg/tree)	Nut shape	Nut ht/nut width	Hilum length/nut width	Percent of Polyembryonic nuts ² (%)	Percent with the pericarp split ² (%)	Penetration of the seedcoat into kernel	Degree of penetration of the seedcoat into kernel
UPOV number			31			27		29	30
Jianding Youli	September 28	7.46 ± 1.05 a ²	Transverse broad ellipsoid with acute tip	1.08 ± 0.03 b ²	1.15 ± 0.06 b ²	0.0 a ²	0.13 ± 0.007 a ²	Present	Weak
Jiujiazhong	September 19	8.33 ± 0.84 b	Transverse ellipsoid	0.82 ± 0.05 a	0.97 ± 0.11 a	2.5 ± 0.73 b	0.22 ± 0.005 b	Present	Medium

²Measured during the third and the fourth week of September.

²Measured 8 years old for yield; Means ± SD done by *t* test (Duncan's multiple range test) at *P* = 0.05 on 10 plants per cultivar (n = 20); similar letters within a column indicate no significant difference.

UPOV = International Union for the Protection of New Varieties of Plants.

the observation results showed that the percentage of nuts damaged by insects was 8.2%, much lower than that of the Jiujiazhong cultivar (Table 6).

Notes and Spreading Prospects in Cultivation

'Jiandang Youli' is a high-quality chestnut suitable for roasting, especially in the south of China. This cultivar has early-bearing, high-yielding characteristics, and good storage tolerance. It can be planted in the north and south areas of Jiangsu Province in China. It grows rapidly and has strong adaptability. It is also an excellent ecological greening tree species. Because 'Jianding Youli' is a cultivar bearing heavy fruiting in young trees, this cultivar could show large nuts and annual fructification. This cultivar does demand proper pruning and fertilizer control to maintain tree vigor continuously (Kim et al., 2008).

On the basis of the origin and experimental ecological conditions, this cultivar prefers a warm and humid climate and is more suitable for extensive cultivation that uses few inputs of labor and fertilizers.

Fig. 1. 'Jiujiazhong' (left) and 'Jianding Youli' (right) trees in late September.

Availability

On 10 March, 2017, the Chinese chestnut cultivar Jianding Youli was granted cultivar protection by the Forest Variety Approval Committee of Jiangsu Forestry Bureau with a certificate no. SU-S-SV-CM-014-2017. Nurseries interested in a propagating program may contact the Institute of Botany, Jiangsu Province and Chinese Academy of Sciences, Nanjing, China or 13951970164@163.com.

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Fig. 2. Nut size and nut shape (upper row: 'Jiujiazhong', lower row: 'Jianding Youli').

Table 5. Nut traits of 'Jianding Youli' and 'Jiujiazhong'.

Cultivars	Nut wt (g)	Moisture content (%)	Soluble sugar content (%)	Starch content (%)	Starch gelatinization temp (°C)	Crude protein content (%)	Crude fat content (%)
Jianding Youli	10.8 ± 0.85 a	48.6 ± 1.23 b	20.56 ± 1.08 b	39 ± 1.47 a	57.2 ± 1.03 a	6.92 ± 1.25 a	1.8 ± 0.96 a
Jiujiazhong	13.1 ± 0.92 b	45.8 ± 1.79 a	15.76 ± 1.43 a	45.7 ± 1.09 b	59.0 ± 0.87 ab	7.22 ± 1.08 b	2.0 ± 1.27 b

Means ± SD done by *t* test (Duncan's multiple range test) at *P* = 0.05 on 10 plants per cultivar (n = 20); similar letters within a column indicate no significant difference.

Table 6. Nut infestation rate of 'Jianding Youli' and 'Jiujiazhong'.

Cultivars	Total number of nuts	Number of insect-damaged fruit	Percentage of insect-damaged fruit (%)
Jianding Youli	146	12	8.2
Jiujiazhong	163	58	35.5