‘Zijin Chuoying’: A Multicolored and Duplicate-layered Flowered Lotus Cultivar

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Lotus (*Nelumbo nucifera*) is one of the most popular ornamental flowers in Asia. There are two species of lotus: *N. nucifera* Gaertn. and *Nelumbo lutea* (Willd.) Pers (Savolainen and Chas, 2003). One major difference between the species is flower color. Usually, *N. nucifera* appears with white, pink, or red flowers (Zhang et al., 2011), whereas the flower of *N. lutea* is characterized by its yellow flowers. In China, lotus has a long cultivation history of more than 3000 years, and traditional cultivars were pigmented with red, pink, or white (Wang and Zhang, 1999; Zhang et al., 2011). The development of new color cultivars in lotus has always been a goal for breeders. In China, over 800 cultivars have been created, and the demand for new colors in lotus cultivars has increased steadily in recent years (Zhang et al., 2011). In addition, large-flowered lotus is popular in landscaping.

‘Zijin Chuoying’ is an attractive large-flowered lotus with multicolored and duplicate-layered flowers; broad outer petals with yellow-green coloration, red-purple petal tips, and clear dorsal veins; and narrow, small, erect inner petals with red or green spots. In replicated trials, ‘Zijin Chuoying’

has a similar growth habit to cultivar Zhufeng Cuiying in terms of cultivation environment, plant behavior, and flowering time. ‘Zijin Chuoying’ is suitable for planting in temperate zones, such as in Nanjing. The latitude of Nanjing is 31°14′ N to 32°37′ N, and the climate of Nanjing is similar to the regions in the eastern United States, such as Georgia. In Nanjing, the average temperature in January is 2 °C and its typical minimum temperatures is –5 to –8 °C; August is the hottest month in a year, and its average temperature is 28 °C. In cold zones, a greenhouse environment is required for lotus production.

Origin

‘Zijin Chuoying’ was selected in 2013 from the progeny of ‘Zhufeng Cuiying’ from natural seeds, which came from the opening

pollination. ‘Zhufeng Cuiying’ is a commercial cultivar that is almost white in color and popular for its excellent flowers (Fig. 1A). It is very hard to produce seeds from ‘Zhufeng Cuiying’ because the carpels are fully or partially vesiculated. In Sept. 2011, several ‘Zhufeng Cuiying’ seeds were found in a lotus seed pod; we collected the seeds from these plants. Next, we planted the seeds separately in containers in Mar. 2012. Individual plants with attractive flowers were selected in July 2012. We then propagated the rhizomes from these plants in pools in Apr. 2013. Superior individual plants with high flower production and high disease resistance were further selected in July 2013. The new cultivar Zijin Chuoying originated from these selected plants.

Description

The Royal Horticultural Society Color Chart is used for descriptions of floral color (Royal Horticultural Society, 2007). ‘Zijin Chuoying’ was grown in 100 × 80 cm pools, and the emergence of 2nd-day flowers was recorded at 8:00–10:00 AM.

The flower buds of ‘Zijin Chuoying’ vary in color from green to purple-red. ‘Zijin Chuoying’ has duplicate-layered, bowl-shaped flowers (Fig. 1B). In terms of petal color, the outer layers of the flower differ from the inner layers. In the outer layers, the base of the petal is yellow (RHS 4D), the middle portion is yellow-green (RHS 144C), and the upper portion is red-purple (RHS 59D), with clear dorsal veins; in the inner layers, the base of the petal is yellow (RHS 3C), the middle portion is yellow (RHS 4D), and the upper portion is red-purple (RHS 59D). The stamens are partially petaloid, with red or green spots on the surface. Carpel development is normal and leads to the production of seeds. The seed pod is bowl-like in shape, and the top surface of the seed pod is flat (Fig. 2; Table 1). Underground rhizomes are average expanded, and the shape of rhizome is long tubular.

Performance

Plant performance for ‘Zijin Chuoying’ was evaluated at the Institute of Botany,

Fig. 1. Flowers phenotype of *Nelumbo* ‘Zijin Chuoying’ and its female parent ‘Zhufeng Cuiying’. (A) ‘Zhufeng Cuiying’; (B) ‘Zijin Chuoying’.

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Fig. 2. Horticultural traits of *Nelumbo* 'Zijin Chuoying' plants. (A) flower bud; (B) leaves; (C) flower, top side; (D) flower, lateral side; (E) structure of flowers, adaxial view; (F) structure of flowers, abaxial view; (G) seedpod, top side; (H) seedpod, lateral side.

Table 1. Flower features of *Nelumbo* 'Zijin Chuoying' from the female parent, *Nelumbo* 'Zhufeng Cuiying'.

<i>Nelumbo</i> descriptor	<i>Nelumbo</i> 'Zhufeng Cuiying'	<i>Nelumbo</i> 'Zijin Chuoying'
Flower bud	Green	Multicolored: green and purple red
Flower color	Nearly white	Multicolored
Flower form	Duplicate layered	Duplicate layered
Flower shape	Bowl shaped	Bowl shaped
Petal coloration ²	Base yellow 8A, middle and upper yellow 1D	Petals of outer layers: base, yellow 4D; middle, yellow-green 144C; upper, red-purple 59D Petals of inner layers: base, yellow 3C; middle, yellow 4D; upper, red-purple 59D
Dorsal veins on petal	Unclear	Clear
Color of dorsal vein	—	Red
Stamens	Partially petaloid	Partially petaloid
Carpel	Partially vesiculated	Normal
Top surface of seed pod	Protruded	Flat

²Descriptions of color are based on comparison with RHS Color Chart.

Jiangsu Province and Chinese Academy of Sciences, in 2014 and 2015, respectively. Plants were grown in 100 × 80 cm pools. In readiness for cultivation, the silt was prepared and added to the pools. Field plots were organized with five replications. About 4 months after planting, leaf size, plant height, flower size, petal size, and number of flowers were measured on five randomly chosen plants (Table 2). Statistical analysis was performed using Duncan's multiple range tests ($P < 0.05$).

To reproduce 'Zijin Chuoying', lotus rhizomes with at least one terminal bud were used. In mid-April of 2014 and 2015, the lotus rhizomes were planted in the soil, with the ends without the terminal buds exposed. Next, the pools were irrigated with water to a depth of 15–20 cm. About 15 d later, the floating leaves were visible on the surface of the water. In early May, the standing leaves had emerged from the water. The first flower bud appeared in mid-June, and flowering peaked in July and August. In September,

the rate of flowering slowed considerably, and the leaves started to turn yellow with the onset of the plant-withering period. Nevertheless, it remains important to keep sufficient water in the pool to allow for continued growth of the lotus rhizomes. The rhizomes can be preserved in the pool during the overwintering period.

'Zijin Chuoying' plants were relatively larger than its female parent 'Zhufeng Cuiying'. In 2014, 'Zijin Chuoying' plants were 26 cm taller than 'Zhufeng Cuiying' plants, whereas in 2015 'Zijin Chuoying' plants were 24 cm higher. In terms of leaf blade size, 'Zijin Chuoying' had larger leaves than its female parent. In 2014, both the leaf length and leaf width of 'Zijin Chuoying' were more than twice the size of its female parent. In 2015, both the leaf length and leaf width of 'Zijin Chuoying' were over 20 cm larger than those of its female parent. However, for lotus breeders, more attention is focused on flower-related traits. In terms of flower size, 'Zijin Chuoying' had bigger flowers. In both 2014 and 2015, the average flower diameter of 'Zijin Chuoying' was about 6 cm larger than that of its female parent. Moreover, 'Zijin Chuoying' had up to 88 petals—about 11–12 slices more than in its female parent. In addition, 'Zijin Chuoying' had relatively

Table 2. Plant characteristics of *Nelumbo* 'Zijin Chuoying' from the female parent *Nelumbo* 'Zhufeng Cuiying' grown in open field during Summer of 2014 and 2015 in Nanjing, China.

Cultivar	Leaf blade size		Plant Ht (cm)	Flower size Diam (cm)	Petal number Total number of petals	Outer petal size	
	Length (cm)	Width (cm)				Length (cm)	Width (cm)
July 2014							
Zijin Chuoying	52.67 ± 5.03 a ^z	41.63 ± 6.94 a	67.33 ± 5.68 a	27.00 ± 1.83 a	88.00 ± 2.16 a	12.70 ± 0.73 a	7.02 ± 0.17 a
Zhufeng Cuiying	26.25 ± 3.50 b	18.00 ± 1.83 b	40.50 ± 2.64 b	21.00 ± 1.82 b	77.25 ± 2.06 b	10.05 ± 0.42 b	3.87 ± 0.30 b
July 2015							
Zijin Chuoying	51.5 ± 5.20 a	43.67 ± 7.09 a	66.00 ± 4.69 a	27.00 ± 1.00 a	88.00 ± 3.61 a	13.13 ± 0.61 a	7.03 ± 0.55 a
Zhufeng Cuiying	28.00 ± 3.00 b	19.00 ± 1.00 b	41.67 ± 3.21 b	21.67 ± 1.15 b	76.00 ± 2.00 b	10.00 ± 0.08 b	3.97 ± 0.15 b

²Different letters indicate significant differences among the treatments according to Duncan's multiple range test ($P < 0.05$).

Fig. 3. *Nelumbo* 'Zijin Chuoying' plants (about 4 months old) grown in the pools in full sun. Lotus root was planted in Apr. 2014 (the photo was taken in Aug. 2014).

large petals, especially in terms of the outer petals. In 2014 and 2015, the length of the outer petals of 'Zijin Chuoying' was about 13 cm, which was ≈ 3 cm longer than that of its female parent; similarly, the width of the outer petals of 'Zijin Chuoying' was 3 cm longer than that of its female parent (Table 2).

The landscape performance of 'Zijin Chuoying' was assessed in pools used for evaluating horticultural characteristics. 'Zijin Chuoying' is suited to growing in pools under full sun in hot summer. In July and August of 2014 and 2015, the highest daily average temperature in Nanjing was 30 to 31 °C, the extreme maximum temperature was 36 to 40 °C, and the minimum temperature was 24 to 25 °C. 'Zijin Chuoying' began to blossom in late June in 2014 and 2015. In July and August, the flowers of 'Zijin Chuoying' entered into flourishing florescence. Notably, the flowers were taller than their associated standing leaves. Each plant produced 12–16 flowers, on average, in the pools (100 × 80 cm) (Fig. 3). 'Zijin Chuoying' is a hardy cultivar whose rhizomes were able to tolerate freezing temperature. Moreover, no lesions were found on its leaves when evaluating its landscape performance. In terms of plant reproduction, the lotus rhizomes of 'Zijin Chuoying' in the pools could be separated and planted in the next spring.

Recommendation

'Zijin Chuoying' performed well in replicated pools in Nanjing and in other places with similar climates. Overall, 'Zijin Chuoying' is an attractive lotus, with multicolored

and duplicate-layered flowers. The ornamental characters were found to be comparable to, or better than, the commercial cultivar Zhufeng Cuiying. 'Zijin Chuoying' is suitable for growing in pools. Although evaluations of 'Zhufeng Cuiying' were performed in temperate regions, experienced growers should be encouraged to plant 'Zijin Chuoying' under greenhouse conditions in cold zones.

Availability

Those interested in 'Zijin Chuoying' should contact the corresponding author, Dongrui Yao, at the Institute of Botany, Jiangsu Province and Chinese Academy of Sciences.

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