‘Jin Dieyu’: A New Cultivar of Lotus with Large, Yellow-green, Duplicate-layered Flowers

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Lotus (*Nelumbo* Adans.) is one of the earliest angiosperms (Du et al., 2016) and comprises only two species, *Nelumbo nucifera* Gaertn. and *Nelumbo lutea* (Willd.) Pers., which are herbaceous aquatic perennials that are valued as ornamental plants, especially in landscaping. *Nelumbo nucifera* is largely distributed throughout Asia and Oceania, with the natural distribution center in China, whereas *N. lutea* is distributed in North America (Wang and Zhang, 2004; Zhang et al., 2011). In China, *N. nucifera* has been cultivated for ≈3000 years resulting in a diversity of floral forms that include single, semidouble, double, duplicate-layered, and thousand-petaled, and flower colors that include white, pink, and red because of the lack of a yellow genotype (Liu et al., 2017). *Nelumbo nucifera* contrasts with forms of *N. lutea* that are typically characterized by yellow, single flowers with fewer than 20 petals. The creation of interspecific hybrids between the two *Nelumbo* species has been a longstanding goal for plant breeders and, following several years of breeding from the female parent lotus, ‘Friendship Peony’, we have bred a duplicate-layered, yellow-flowered hybrid, named ‘Jin Dieyu’ (Figs. 1 and 2). Here, we describe the breeding process and characters of ‘Jin Dieyu’, and provide recommendations for its cultivation.

Origin

The female parent of ‘Jin Dieyu’ is ‘Friendship Peony’, which is the progeny of

and we subsequently propagated rhizomes from these plants, in a 120 × 100 cm pond in 2013 and 2014. We assessed the flowering characters of these ‘Jin Dieyu’ plants between 8:00 and 10:00 h on the second day of blooming, using standard descriptions of floral color (Royal Horticultural Society, 2015).

Description

‘Jin Dieyu’ is a large cultivar, with green, ball-like buds that gradually expand before opening into bowl-shaped flowers with more than 250 compactly arranged petals and fully-vesiculated carpels. The flowers are yellow-green, where the outer and inner petals differ in color and shape. The outer petals are broad and obovate, with yellow-green coloration and clear dorsal arteries and veins; the base, middle, and upper portions of the petals are Yellow-Green Royal Horticultural Society (RHS) 145C, RHS 144D, and RHS 144B, respectively. The obovate-lanceolate inner petals are relatively narrow and small, where the base and upper portions are Green-Yellow RHS 1B and RHS 1D, respectively. The stamens are relatively inconspicuous, because of their petaloid shape and green spotting on the surface. The flowering characteristics of *Nelumbo* ‘Jin Dieyu’

Fig. 1. Flower phenotype of *Nelumbo* ‘Jin Dieyu’ and its female parent ‘Friendship Peony’. (A) ‘Friendship Peony’; (B) ‘Jin Dieyu’.

Fig. 2. Horticultural traits of *Nelumbo* ‘Jin Dieyu’ plants. (A) flower bud; (B) flower bud before open; (C) flower, top side; (D) flower, lateral side; (E) structure of flowers, adaxial view; (F) structure of flowers, abaxial view; (G) seedpod, lateral side; (H) seedpod, top side.

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Table 1. Flower features of *Nelumbo* 'Jin Dieyu' and *Nelumbo* 'Friendship Peony'.^z

<i>Nelumbo</i> descriptor	<i>Nelumbo</i> 'Jin Dieyu'	<i>Nelumbo</i> 'Friendship Peony'
Flower bud	Green	Green-yellow
Flower color	Yellow-green	Yellow
Flower form	Double	Double
Flower shape	Bowl-shaped	Cup-shaped
Petal coloration	Petals of outer layers: base, yellow-green (RHS145C) Middle, yellow-green (RHS 144D) Upper, yellow-green (RHS 144B) Petals of inner layers: base, green-yellow (RHS 1B) Upper, green-yellow (RHS 1D)	Petals of outer layers: green-white (RHS157B) Petals of inner layers: base, yellow (RHS4C) Upper, green-yellow (RHS 1D)
Dorsal veins on petal	Clear	Clear
Color of dorsal vein	Green	Pale yellow-green
Stamens	Partially petaloid	Partially petaloid
Carpel	Vesiculated	Normal
Top surface of seedpod	Protruded	Flat

^zDescriptions of color are based on comparison with RHS Color Chart.Table 2. Plant characteristics of *Nelumbo* 'Jin Dieyu' and *Nelumbo* 'Friendship Peony' grown in open field during summer of 2015 and 2016 in Nanjing, China.

Cultivar	Leaf blade size		Plant ht	Flower size (diam)	Petal number	Outer petal size	
	Length	Width			Total number of petals	Length (cm)	Width (cm)
July 2015							
'Jin Dieyu'	45.00 ± 2.31 a ^z	39.33 ± 3.53 a	125.67 ± 4.06 a	24.67 ± 2.60 a	265.33 ± 4.10 a	12.30 ± 0.89 a	8.93 ± 0.64 a
'Friendship Peony'	32.67 ± 3.18 b	28.67 ± 2.96 b	82.67 ± 12.47 b	17.00 ± 1.53 b	198.00 ± 20.43 b	9.77 ± 0.85 b	4.70 ± 0.32 b
July 2016							
'Jin Dieyu'	48.17 ± 1.69 a	39.83 ± 1.01 a	114.00 ± 2.89 a	24.43 ± 2.60 a	275.00 ± 10.97 a	12.63 ± 0.70 a	9.17 ± 0.60 a
'Friendship Peony'	29.73 ± 3.47 b	26.77 ± 3.79 b	80.00 ± 9.07 b	15.57 ± 1.62 b	209.00 ± 18.03 b	8.67 ± 0.63 b	3.87 ± 0.38 b

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

and *Nelumbo* 'Friendship Peony' are presented in Table 1.

Performance

In 2015 and 2016, the performance of newly planted 'Jin Dieyu' and parent 'Friendship Peony' was evaluated in field trials at Nanjing Yileen lotus garden. Rhizomes of 'Jin Dieyu' were separated and planted in the ponds in early April and by mid-April, floating leaves were visible. Standing leaves were growing vigorously in May and then flowering occurred between July and September.

Lotus rhizomes with at least one terminal bud were used as a measure of reproduction and in mid-July. Plant height, number of petals, and sizes of leaf, flower, and outer petals were recorded from five plants for each cultivar. Duncan's multiple range test was used to test for differences in the measures of plant performance between 'Jin Dieyu' and 'Friendship Peony' ($P < 0.05$) in each year.

Overall, we found that 'Jin Dieyu' maintained stability of major ornamental traits and had a similar growth habit to *N. lutea*. 'Jin Dieyu' was larger than its female parent,

being 34 and 43 cm higher than 'Friendship Peony' in 2015 and 2016, respectively, and the mean leaf blade length and width were about 15 and 9 cm larger, respectively (Table 2). Flowers were also larger in 'Jin Dieyu' than 'Friendship Peony', where they were about 7 cm in diameter larger, and there were an additional 50 petals in 'Jin Dieyu' in both years (Table 2). The mean length and width of the outer petals of 'Jin Dieyu' was 2.5 cm and about 4 cm longer in 2015 and about 4 and 5 cm in 2016, respectively (Table 2). Seed production in 'Jin Dieyu' was low, because of its petaloid stamens and vesiculated carpels; however, rate of seed set in 'Friendship Peony' was 55% owing to normal stamen and carpel development.

In October, the leaves started to yellow and the plants entered the withering phase. It was necessary to maintain sufficient water for rhizome growth, and the rhizomes remained in the ponds overwinter, before being separated for cultivation the following spring.

Recommendation

We suggest that although 'Jin Dieyu' could be successfully cultivated in warm and sunny temperate regions, the production

of 'Jin Dieyu' in colder climates would require greenhouse protection.

Availability

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

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