

‘Dai Long’ Crabapple

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Ornamental crabapples are woody plants of the *Malus* in the Rosaceae family and are popular for the high ornamental value of their leaves, flowers, and fruit (Fiala, 1994; Qian et al., 2006). In China, the culture of ornamental crabapple exhibits profound social, cultural, artistic, and scientific connotations, and ancient literati have not hesitated to designate the ornamental crabapple as the “imperial concubine of flower” (Guo et al., 2019). The poet Jia Dan in the Tang Dynasty called it “immortal in flowers” in the *Florilegium*, which is an ancient book of poetry about flowers (Zhou et al., 2018).

These plants have a long history of cultivation in China and are widely used in landscaping (Guan, 2008). However, the selection and breeding of good ornamental crabapple cultivars in China have lagged behind such efforts in North America and Europe. Landscape applications are mostly limited to traditional cultivars, such as *M. micromalus*, *M. halliana*, and *M. hupehensis*. The independent breeding of new cultivars started late; therefore, the plants were domesticated from the introduction of European and North American ornamental crabapple cultivars (Dixon et al., 2015). Genealogical analyses have indicated that the main parents were *M. baccata*, *M. pumila*, *M. prunifolia*, *M. sieboldii*, and *M. sieversii*; all of these species comprise original germplasm resources in China (Gao et al., 2007; Schuster and Büttner, 1995). After their introduction, the cultivars exhibited many defects, including florescences that were too concentrated, a single tree habit type, and vulnerability to pests and diseases. Phenotypic diversity has an important role in plant breeding and selection (Endress, 2011; Zhou et al., 2020). Such diversity results in an extremely high degree of variation in the morphology, structure, and function of plants; these traits are the products of long-term natural selection and serve as important foundations for germplasm innovations (Kumari et al., 2016; Muzher et al., 2007; Ulukan, 2009). Therefore, it is highly significant to breed new cultivars with novel flower characteristics.

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Recently, Shandong Agricultural University in Shandong, China, has been actively breeding new cultivars of crabapple and selected some excellent lines of ornamental crabapple. Currently, we have created a large population of seedlings, selected excellent

strains that are good for landscaping, conducted preliminary grafting studies, and investigated the adaptability and stability of these lines. Dai Long is a new cultivar with unique flower characteristics that was bred by the Ornamental Crabapple Program of Shandong Agricultural University. This cultivar has garnered much attention because of its uniquely shaped petals and its advantage of having fruit that does not drop during the winter. The study of this unique cultivar is highly significant for landscape planting and the enrichment of ornamental crabapple germplasm resources.

Origin

In Fall 2015, we collected more than 2000 seeds of *M. baccata* in Northeast China. We buried them under moist sand at 1 to 10 °C



Fig. 1. Comparison of the foliage and flower characteristics of *Malus* ‘Dolgo’ (right) and ‘Dai Long’ (left).



Fig. 2. Different stages of the flower characteristics of *Malus* ‘Dai Long’.

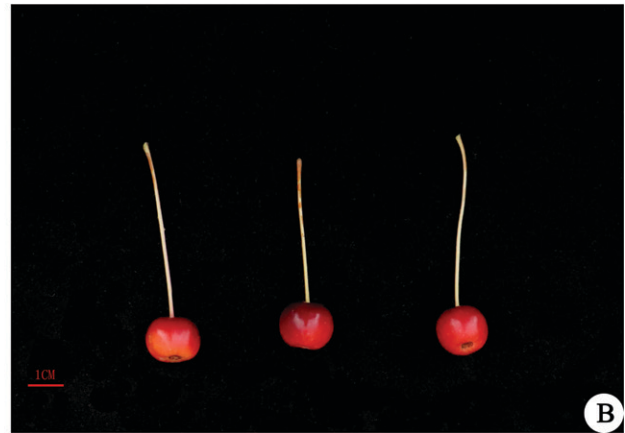


Fig. 3. Phenotypic characteristics of fruits of *Malus* 'Dai Long'.

because the seeds require stratification. Then, we sowed them in the field of the Fruit Tree Root Laboratory of the College of Horticulture Science and Engineering at Shandong Agricultural University in Spring 2016 (Tai'an, Shandong Province, China, lat. 36°05' N, long. 117°03' E, altitude of 153 m above sea level). The climate is temperate monsoon. In 2018, after the seedlings flowered and bore fruit, an individual plant with unique flower characteristics was observed and selected for further evaluation. It was designated 'Dai Long'. 'Dai' means Mount Tai in Chinese, and 'Long' means that the flowers of the plant are shaped like the claw of a dragon. We grafted this cultivar to rootstocks of *M. hupehensis* seedlings from 2018 to 2021. Then, we conducted a series of studies of its successive biological characteristics. We compared the morphology with that of *M. 'Dolgo'* as the control (Table 1). The results showed that the plants grew stably and every individual retained its unique flowering features. In addition, there were no serious diseases and pests, such as apple scab, apple rust, and apple aphids, thus adding to the high ornamental value of this cultivar.

Description

'Dai Long' has unique petals and white, flat flowers. It most closely resembles *M. 'Dolgo'*. We used *M. 'Dolgo'* as the standard for comparison (Fig. 1). *Malus 'Dolgo'* is characterized by large fruit and short petal stalks, whereas 'Dai Long' has small fruit and slender, long petal stalks. In addition, the two cultivars have distinctive tree habits. *Malus 'Dolgo'* grows upright and 'Dai Long' spreads (Table 2).

Tree. 'Dai Long' exhibits medium vigor and an upright, spreading growth habit. The branches of 1-year-old plants are purple-brown (RHS-166A), and the mature branches are brown (RHS-199C) (Royal Horticultural Society, 2007). The trees have a strong ability to branch, but there are few short branches. The tree grew to 2.1 to 2.4 m over the course of 3 years.

Leaf. The expanded leaves are green, 6.9 to 7.6 cm long, and 4.1 to 4.4 cm wide; the petioles are 2.4 to 3.5 cm long. The shape is broadly elliptical. There are no leaf lobes,

and the leaf margins are crenate. The upper sides of leaves are not very glossy and lack coloring from anthocyanins.

Flowers. The blooming time (10% open flowers) of 'Dai Long' is late March in Tai'an, Shandong. It has an umbellate inflorescence, and each is composed of four to eight flowers. The unopened flowers (balloon stage) are dark pink (RHS-61C). The flowers are single and have a flat shape and medium diameter (4.3–4.6 cm); the petals are flattened in the horizontal position. Each flower has five petals. The pistils are light green, the anthers are yellow, and the filaments are white. The petals are broad, elliptical, and clearly free because of the slender, long petal stalks, whereas the marginal zone has a fold and the veins are not prominent (Fig. 2). The petals in the marginal zone of the inner side are light pink (RHS-56A). The middle zone of the inner side and basal zone of the inner side are both white (RHS-N999D), and the outer side is pink (RHS-64D).

Fruit. 'Dai Long' sets a large number of fruit (Fig. 3). The fruits are obloid and relatively

small. Their vertical diameter is ≈ 1.1 to ≈ 1.3 cm, and the transverse diameter is ≈ 1.3 to ≈ 1.5 cm. The predominant color is dark purple-red (RHS-53A), with a strongly expressed glossy exocarp. The fruit pulp is light yellow-orange (RHS-19B), and the calyx is abscised, with long stalks that are 3.8 to 4.5 cm long. The fruits remain on the tree for a long time, and some can persist until the tree blooms the following year.

Cultivation and pest management. 'Dai Long' is suitable for cultivation in north, east, and northwest China and other areas that are suitable for planting apples. The cultivar prefers thick loam, moist soil, and good drainage; a soil pH of 6 to 7.5 is ideal. The plant is primarily propagated by grafting using *M. hupehensis* seedlings as the rootstock. Healthy and plump buds are collected from mature branches of the current year as scions in autumn (August to September). The plastic wrappers should be removed and the rootstock should be pruned during the following spring. After germination, the rootstock sprouts should be removed three to four times to ensure the growth of buds that are grafted. Regular prun-

Table 1. Comparison of flower traits of *Malus* 'Dai Long' and *M. 'Dolgo'*.

Petal color	<i>M. 'Dai Long'</i>	<i>M. 'Dolgo'</i>
Inner side, marginal zone	Light pink (RHS-56A)	White (RHS-N999D)
Inner side, middle zone	White (RHS-N999D)	White (RHS-N999D)
Inner side, basal zone	White (RHS-N999D)	White (RHS-N999D)
Outer side	Pink (RHS-64D)	White (RHS-N999D)

Table 2. Comparison of the physiological characteristics of *Malus* 'Dai Long' and *M. 'Dolgo'*.

Characteristic	<i>M. 'Dai Long'</i>	<i>M. 'Dolgo'</i>
Growth vigor	Medium	Medium
Growth habit	Upright	Spherical
Shoot color	Purple-brown (RHS-166A)	Dark green (RHS-144A)
Unopened flower (balloon stage) color	Dark pink (RHS-61C)	Light pink (RHS-65B)
Flower shape	Flat	shallow cup
Petal shape (excluding petal stalks)	Broad and elliptic	Ovate
Fruit shape	Obloid	Ovoid
Fruit size	Small	Large
Fruit color	Dark purple-red (RHS-53A)	Red (RHS-45A)
Fruit persistence	Long	Medium
Fruit skin glossiness	Strongly expressed	Weakly expressed
Time of the beginning of flowering (10% open flowers)	Early	Early

ing that keeps the branches short is critical to ensure flowering the next year. Our observations indicated that this cultivar has few incidents of pests and diseases. However, it may be necessary to control aphids in the spring by spraying pesticides. The planting of alternate host plants for rust, such as *Juniperus sabina*, should be avoided near the planting area to reduce the incidence of this debilitating disease. Other management techniques are those used for ordinary ornamental trees.

Availability

Malus 'Dai Long' is available from Zhen-dong Nursery (Tai'an, Shandong, China). Please direct all inquiries to Duoqiao Zhang (e-mail: 1170345630@qq.com).

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