'Longhua' *Lonicera*

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The genus of *Lonicera* L., commonly referred to as honeysuckle, has ≈ 180 species of deciduous or evergreen, bushy, candent, twining, or creeping shrubs distributed in Asia, Europe, and North America (Huxley, 1992). Dried flowers and buds of honeysuckles are known as "Jinyinhua" in Chinese or flos *Lonicerae*, which is one of the most popular herbs of traditional Chinese medicine (Shang et al., 2011). Flos *Lonicerae* contains a series of compounds including essential oils, organic acids, flavones, saponins, and iridoids (Lee et al., 1998; Palacios et al., 2002). Because of the variation among species and even cultivars in the chemical compounds, the Chinese Pharmacopoeia (Committee for the Pharmacopoeia of PR China, 2010) has used the content of 5-*O*-caffeoyl-quinic acid or chlorogenic acid (CGA) as the indicator compound for the evaluation of the quality of flos *Lonicerae* (Shang et al., 2011). CGA has been reported to suppress *N*-nitrosating reactions and inhibit hepatic glucose 6-phosphatase, which is a significant factor in the abnormal diabetic state (Arion et al., 1997; Yang et al., 2004). CGA also has strong antiviral activity against adeno-associated 3 and 7 viruses, coxsackie B3 and B5 viruses, and respiratory syncytia virus (Hu et al., 2001).

As a result of the increasing recognition of its pharmaceutical value, there have been increasing activities in the selection and production of honeysuckle plants with high CGA content in China (Wang et al., 2004, 2009; Yuan et al., 2012). *Lonicera macranthoides* Hands.-Mazz. is a species native to China

(Xu and Wang, 1988) and has been found to contain CGA concentrations up to 4.5% compared with commonly used *L. japonica* L. with a range from 2.2% to 2.5% (Zhou and Tong, 2003). Wang et al. (2004) isolated three naturally occurring mutants: 'Jinculei', 'Yinculei', and 'Baiyun' of *L. macranthoides* from Hunan Province, China, which had CGA contents of 5.92%, 5.83%, and 6.97%, respectively, compared with 4.33% in their parental plants. Here we report 'Longhua', another selection from *Lonicera macranthoides*.

Origin

Lonicera macranthoides is mainly distributed in Hunan, Guizhou, Guangxi, and Sichuan Provinces in China. The plant seldom produces seeds in its natural habitat, and plants are propagated through cutting or grafting. A mutant plant with abundant large flowers that never opened was discovered in Longhui County, Hunan Province in 2005. The plant was propagated by cutting and grafting in 2006 and evaluated for five years. The mutant was stable over the last six years and named 'Longhua' in accordance with the International Code of Nomenclature for Cultivated Plants (Brickell et al., 2009). A specimen of the cultivar has been deposited at the Experimental Station in Longhui County as a cultivar standard.

Description

'Longhua' is a shrub with a dome-shaped crown (Fig. 1A). Plant height is over 1.5 m and canopy diameter of 4 to 5 m. Leaves are simple, opposite, ovate to oblong with a round base and acuminate apex. The upper leaf surface is azure green, whereas the underside is yellowish green. The mean length of mature leaves is ≈ 11.2 cm with a width of ≈ 5.4 cm.

The young alabastrum is green and clustered axillarily or at the terminal (Fig. 1B).

The corolla is tubular; as it becomes mature, the upper tube expands much more than the base portion. Mature corollas are clavate, curved slightly, indehiscent, and yellowish white. The mean length of a mature flower is ≈ 5.94 cm, apex diameter is ≈ 3.20 mm, and base diameter is ≈ 1.54 mm. A branch can bear up to seven clusters of flowers in axillary or in terminal spikes. Mean flower numbers are more than 20 in each cluster arranged in cymes or racemes. The calyx is green without woolly hair in the tube. The flowers never open and plants have not been seen bearing any berries.

Culture and Performance

Propagation of 'Longhua' is primarily through grafting and cutting. In vitro culture has not been well established. Both the parental *L. macranthoides* and *L. japonica* have been used as rootstocks for grafting. Grafted plants can flower in the second year if the rootstocks have a height over 50 cm. Cuttings can be either single eye or multiple eyes and should be made from plants less than three years old. Rooted cuttings can grow up to 1.5 m in three years and plants then flower. 'Longhua' is highly adaptable to different soil types with pH ranging from 5.5 to 7.5 and is able to grow in mountainous areas, hilly countries, or plains. Plants should be transplanted 2.1 m apart (≈ 2250 plant per hectare) and fertilized with 0.15 kg of N-P₂O₅-K₂O and 0.1 kg of magnesium annually. Application of composted organic fertilizers at 2 kg per plant is highly recommended each spring after pruning.

Lonicera 'Longhua' in Hunan Province sprout in late February with a temperature above 10 °C. The first flower appears in middle May; flowering peak time is early July. The fresh weight per 1000 flowers is 151 g. To determine flower yield and CGA content of 'Longhua', two field trials were conducted in different locations of Longhui County, Hunan Province. Grafted 'Longhua' was compared with parental *L. macranthoides* as well as previously selected cultivars Jinculei, Yinculei, and Baiyun that were also graft-propagated at the same time as 'Longhua'. Flower sizes, flower yield, and CGA contents were determined; data were analyzed by analysis of variance (SAS GLM; SAS Institute, Cary, NC), and mean separations were performed using Fisher's protected least significant differences at the 5% level. Results showed that 'Longhua' had a mean flower length of 5.94 cm and flower apex diameter of 3.20 cm, which were significantly greater than the other tested cultivars (Table 1). Flowers harvested from the third year of plants were 1.55 kg per plant based on dry weight, which was higher than the parental plants and 'Yinculei', comparable to 'Jinculei' and 'Baiyun' (Table 1). Thus, a hectare of 'Longhua' could produce ≈ 3488 kg of dry flowers annually. The CGA content in dry flowers was 7.25%; this was significantly greater than the other tested cultivars with the exception of 'Baiyun'.

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Fig. 1. *Lonicera macranthoides* 'Longhua' were grown in Longhui County, Hunan Province, China, with abundant flowers (A); as a mutant, the flowers of this cultivar never opened (B).

Availability

Limited numbers of rooted cuttings of *Lonicera* 'Longhua' are available for research purposes, which can be obtained from Xiaoming Wang, the Hunan Key Laboratory for Breeding of Clonally Propagated Forest Trees.

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Table 1. Flower characteristics, yield, and chlorogenic acid content of parental *Lonicera macranthoides* and cultivars of Longhua, Jincuilai, Yincuilai, and Baiyun selected from this species.^z

Cultivar	Flower length (cm)	Flower apex diam (mm)	Flower base diam (mm)	Flower open or closed	Flower yield	
					in dry wt (kg/plant)	Chlorogenic acid content (%)
Parental plant	3.93 b ^y	2.41 b	1.40 ab	Open	0.65 c	4.33 c
Longhua	5.94 a	3.20 a	1.54 a	Closed	1.55 a	7.25 a
Jincuilai	4.00 b	2.50 b	1.30 b	Closed	1.50 a	5.92 b
Yincuilai	4.20 b	2.50 b	1.50 a	Closed	1.16 b	5.83 b
Baiyun	3.90 b	2.50 b	1.60 a	Partially open	1.77 a	6.97 a

^zMeasurements were taken from the three-year-old plants, and the data were the mean of 10 plants per cultivar.

^yDifferent letters within a column represent significant difference at $P \leq 0.05$ by Fisher's protected least significant difference test.

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