Osmanthus fragrans ‘Cai Ye Gui’, a Variegated Cultivar

Tingting Tong

Central South University of Forestry and Technology, 498 South Shaoshan Rd., Changsha, Hunan 410004, China; and Changsha Environmental Protection College, 10 Jingui Road, Changsha, Hunan 410004, China

Lili Shao

Hunan Biological and Electromechanical College, 2nd Yuanda Road, Changsha, Hunan 410618, China

Zhonghua Peng¹

Central South University of Forestry and Technology, 498 South Shaoshan Road, Changsha, Hunan 410004, China

Youping Sun¹

Department of Plants, Soils, and Climate, UT State University, 4820 Old Main Hill, Logan, UT 84322

Additional index words. cutting propagation, *O. fragrans* ‘Variegatus’, Oleaceae, sweet osmanthus

Osmanthus fragrans Lour., commonly known as sweet osmanthus, sweet olive, tea olive, and fragrant olive, is a species belonging to Oleaceae. It was originally named *Olea fragrans* Thunb. (Murray, 1784). Sweet osmanthus is native to Asia. It comes from the Himalayas through southern China, southern Japan, Southeast Asia and continues as far south as Cambodia and Thailand (Chang et al., 1996). Sweet osmanthus is an evergreen shrub or small tree that grows up to 3–12 m tall. Leaves are 7–15 cm long and 3–5 cm broad with an entire or serrulate margin. It produces strongly fragrant and small flower clusters in an assortment of white, pale yellow, yellow, or orange-yellow colors in late summer and autumn. The purple-black drupe fruit is 10–15 mm long and matures in spring.

The flowers of sweet osmanthus have long been used for traditional Chinese medicine as an herbal tea remedy, in Chinese cuisine as osmanthus-scented jam, and in northern India as an insect repellent (Royal Botanic Gardens, Kew, 2017; Zhou, 2008). Elsewhere in the world, it is cultivated as an ornamental plant for its deliciously fragrant flowers in gardens in Asia, Europe, and North America. Several taxa with various flower colors have been selected for garden use. In Japan, *O. fragrans* var. *thunbergii* produces gold-orange flowers (Makino, 1927). A variety with red-orange flowers is named *O. fragrans*

var. *aurantiaeus* (Makino, 1902) or *O. auran-tiacus* (Nakai and Koidzumi, 1922). *Osmanthus fragrans* var. *ginnokusei* (silver osmanthus) is a white-blossoming subspecies, whereas *O. fragrans* var. *kinmokusei* (gold osmanthus) is a subspecies producing orange flowers (Chang et al., 1996; Huxley, 1992). More than 200 sweet osmanthus cultivars are named in China, e.g., *O. fragrans* ‘Yinbi Shuanghui’, ‘Qiannan Guifei’, ‘Huaan Tianxiang’, ‘Meiyuan Bai’, and ‘Zhuye Yin’ (Xiang, 2008; Xiang et al., 2014; Zang et al., 2014).

In this paper, a new cultivar named *O. fragrans* ‘Cai Ye Gui’ (syn. *O. fragrans* ‘Variegatus’) is described and being released for germplasm purposes. It is a selection from *O. fragrans* seedlings with variegated foliage. It was discovered by Mr. Jianxiong Yi, the owner of Yuntian Nursery (Zhuzhou, Hunan, China), and has been licensed to Jiangsu Ao-Yang Ecological Agriculture and Forestry Ltd. (Suzhou, Jiangsu, China).

Origin

Osmanthus fragrans ‘Cai Ye Gui’ was derived from wild-collected seeds (≈4000 kg) purchased in 1999 from retail nurseries in the southern China provinces of Guangxi, Hunan, Hubei, and Jiangxi. These seeds were put into wet sand for cold stratification at 4 °C for 4 months. Stratified seeds were then sown into field plots with regular red soil in Yuntian Nursery, Zhuzhou, Hunan (27°59′45″N, 113°11′13″E, elevation 67 m). The type of the red soil is Orthic Acrisols (Ao) based on the soil map of China (Zhang, 1990). Of hundreds and thousands of regular dark green seedlings, a seedling with variegated foliage stood out (Fig. 1A). This seedling was discovered by Mr. Jianxiong Yi, the owner of

Yuntian Nursery, and propagated via grafting on *O. fragrans* rootstock. The resulting plants were cultivated and observed for field performance in Zhuzhou, Hunan for 9 years. *Osmanthus fragrans* ‘Cai Ye Gui’ (syn. *O. fragrans* ‘Variegatus’) was named and is being released based on variegated foliage and stable field performance.

Description and Performance

Osmanthus fragrans ‘Cai Ye Gui’ is an evergreen shrub or small tree that has a moderate-sized, rounded form and reaches up to 5 m tall and 2.5 m wide over 17 years in Yuntian, Zhuzhou, Hunan. Leaves are 7.4–10 cm long by 2.6–3.5 cm wide and elliptic to elliptic-lanceolate with acuminate apex, cuneate or broadly cuneate base, and serrulate leaf margin. A unique characteristic of this selection is its variegated leaves. All references to color numbers are from the Royal Horticultural Society and Flower Council of Holland (2001). Leaf color is growth-stage dependent (Fig. 1B). The middle part of new leaves is carmine (59B) or dark magenta (79A). The color at the edge of the adaxial and abaxial surfaces of new leaves is lavender blush (73A and 73B, respectively). Mature leaves are light yellow (11D) mixed with green (134A) in the central part, whereas turn light yellow (11D) at the edge of the adaxial and abaxial surfaces.

Starting from 2012, a systematic field trial was conducted to observe the field performance of this new cultivar over three consecutive years. *Osmanthus fragrans* ‘Cai Ye Gui’ plants propagated from stem cuttings were grown in raised beds under 30% shade-cloth with well-drained regular red soil Ao. The dark green seedlings from the aforementioned sources were used as the comparison. Plant height, leaf length, and leaf width were measured on three plants of each type. The relative chlorophyll content [Soil and Plant Analyzer Development (SPAD) reading] of 10 leaves each plant was recorded at the edge of the leaf blade along the distal half using a handheld chlorophyll meter (measured as the optical density; Minolta Camera Co., Osaka, Japan). Analysis of variance was performed using JMP (Version 12, SAS Institute, Inc., Cary, NC). Means separation between *O. fragrans* ‘Cai Ye Gui’ and *O. fragrans* was conducted using the Student’s *t* test at $\alpha = 0.05$. *Osmanthus fragrans* ‘Cai Ye Gui’ were constantly shorter than *O. fragrans* dark green seedlings over three consecutive years of observations (Table 1). The leaf of *O. fragrans* ‘Cai Ye Gui’ was also smaller than that of *O. fragrans* dark green seedlings. This result indicates that *O. fragrans* ‘Cai Ye Gui’ has the potential of being produced into a compact form with smaller leaves. Compared with *O. fragrans* dark green seedlings, leaf index (length/width) of *O. fragrans* ‘Cai Ye Gui’ was reduced at the first year of observation, but did not change at the second and third year. Obviously, SPAD reading of *O. fragrans* ‘Cai Ye Gui’ was less than that of *O. fragrans* dark green seedlings.

Received for publication 7 Dec. 2017. Accepted for publication 4 Feb. 2018.

¹Corresponding authors. E-mail: 345492902@qq.com or youping.sun@usu.edu.

This is an open access article distributed under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Culture and Use

Like other *O. fragrans* cultivars, *O. fragrans* ‘Cai Ye Gui’ is a heliophilous species. It prefers moist, well-drained fertile soil in full sun or partial shade. The average daily light integral ranged from 15.2 to 38.4 mol·m⁻²·d⁻¹ in a closest weather station in Changsha, Hunan (Sun et al., 2015). *Osmanthus fragrans* ‘Cai Ye Gui’ grow well at ambient temperature ranging from 15 to 28 °C. It is a cold hardy cultivar that can survive at a temperature of -12 °C (USDA cold hardiness zone 7a). Once established, *O. fragrans* ‘Cai Ye Gui’ shows similar drought tolerance to the species. No major insect and pest problems have been observed. It is suitable for landscape use as a single specimen, an evergreen screen, or a foundation plant and mass planting.

Propagation

Softwood and semihardwood cuttings are suitable for the propagation of *O. fragrans* ‘Cai Ye Gui’. The best time for collecting softwood and semihardwood cuttings is in June to early July and in September to early October, respectively. In July 2013, softwood cuttings were collected from the top outer canopy of healthy *O. fragrans* ‘Cai Ye Gui’ plants grown in Yuantian, Zhuzhou, Hunan. The subterminal cuttings, 7–10 cm long with two to four nodes, were collected from one to two nodes basipetal from the meristems. All cuttings were stripped off the bottom leaves leaving only two top leaves. The bottom of the cuttings was trimmed into a horseshoe shape, and the top of the cuttings was sealed with wax. The cuttings were then soaked for 4 h at a depth of 2–3 cm in solutions with different concentrations (0, 50, 75, 100, or 125 mg·L⁻¹) of 1-naphthaleneacetic acid (NAA). ABT1 talc powder [a.i. 30% indole-3-acetic acid (IAA) and 20% NAA; Shanghai Horticulture Ltd., Shanghai, China] were also compared. Three replications of 30 cuttings each were prepared for each treatment.

All cuttings were then inserted 3–5 cm deep in well-drained regular red soil (Ao, pH: 5.5–7.0) in raised beds (1.3–1.5 m wide) (Fig. 1C). Raised beds were treated with 0.125% of carbendazim 50% wettable powder (a.i. carbendazim, 50% w/w; Kenvos Biotech Co., Ltd., Hangzhou, Zhejiang, China) 3 d before the cuttings were inserted. Low tunnels with polyethylene plastic were made to cover the raised beds to maintain humidity the first 2 weeks and then removed for the remainder of the experiment. After 40 d, the number of cuttings with roots, number of roots per cutting, or the length of all roots were recorded. Data analysis was performed as described previously. Means separation among hormone treatments or between *O. fragrans* ‘Cai Ye Gui’ and *O. fragrans* was conducted using the Tukey’s honestly significant difference multiple comparison or Student’s *t* test at $\alpha = 0.05$, respectively. NAA significantly promoted the rooting of *O. fragrans* ‘Cai Ye Gui’ with the highest

Fig. 1. Variegated foliage of *Osmanthus fragrans* ‘Cai Ye Gui’ (A), leaves of *O. fragrans* ‘Cai Ye Gui’ (top) and *O. fragrans* (bottom) with a newly developed leaf on the left and a mature leaf on the right (B), 2-year-old *O. fragrans* ‘Cai Ye Gui’ plants from softwood cutting propagation in a field (C), semihardwood cuttings of *O. fragrans* ‘Cai Ye Gui’ in containers (D), and a representative cutting treated with 1,500 mg·L⁻¹ 1-naphthaleneacetic acid formed roots after 60 d (E).

Table 1. Growth, leaf size, and relative chlorophyll content [Soil and Plant Analyzer Development (SPAD) reading] of *Osmanthus fragrans* and *O. fragrans* ‘Cai Ye Gui’ plants grown in field plots for three consecutive years. Three plants *O. fragrans* ‘Cai Ye Gui’ propagated from stem cuttings and three *O. fragrans* seedlings were chosen for this observation.

Yr	Plant	Ht (cm)	Leaf			SPAD
			Length (L) (mm)	Width (W) (mm)	L/W	
1	<i>O. fragrans</i>	86 a ^z	77.9 a	33.2 ba	2.3 a	54.1 a
	<i>O. fragrans</i> ‘Cai Ye Gui’	44 b	49.8 b	25.7 b	1.9 b	29.0 b
2	<i>O. fragrans</i>	113 a	85.2 a	36.3 a	2.4 a	57.5 a
	<i>O. fragrans</i> ‘Cai Ye Gui’	77 b	58.8 b	26.9 b	2.2 a	38.9 b
3	<i>O. fragrans</i>	137 a	92.9 a	44.0 a	2.1 a	54.7 a
	<i>O. fragrans</i> ‘Cai Ye Gui’	104 b	67.2 b	32.8 b	2.1 a	44.7 b

^zMeans with same lowercase letters within a year and dependent variable are not significantly different by the Student’s *t* test at $\alpha = 0.05$.

percentage of 90.2% at a concentration of 100 mg·L⁻¹, which was an increase of 64% compared with the control (distilled water) (Table 2). No significant difference in the rooting was observed between *O. fragrans* and *O. fragrans* ‘Cai Ye Gui’. When NAA and ABT1 were compared, the percentage of cuttings with roots was 90.2% and 78.8% for *O. fragrans* ‘Cai Ye Gui’ treated with NAA at 100 mg·L⁻¹ or with ABT1 talc powder, respectively (Table 3). The rooting percentage of *O. fragrans* ‘Cai Ye Gui’ was similar to that of *O. fragrans* when NAA or ABT1 was used. In addition, there were no differences between *O. fragrans* and *O. fragrans* ‘Cai Ye Gui’ in terms of the number of roots per cutting and the length of the longest root. These results indicated that ABT1 was a less effective rooting agent than NAA for the propagation of *O. fragrans* ‘Cai Ye Gui’ via softwood cutting.

Table 2. Cutting propagation of *Osmanthus fragrans* and *O. fragrans* ‘Cai Ye Gui’ at different concentrations of 1-naphthaleneacetic acid (NAA). Thirty cuttings of each of three replications were prepared, soaked for 4 h at a depth of 2–3 cm in solutions at different NAA concentrations, and inserted 3–5 cm deep in well-drained regular red soil in raised beds. Data were collected at 40 d after treatment.

NAA (mg·L ⁻¹)	Rooting (%) ^z	
	<i>O. fragrans</i>	<i>O. fragrans</i> ‘Cai Ye Gui’
0	27.9 ± 2.1 ^z e ^y	26.1 ± 2.3 d
50	48.2 ± 3.4 d	47.3 ± 3.6 c
75	61.8 ± 4.5 c	62.3 ± 4.2 b
100	91.7 ± 5.7 a	90.2 ± 5.5 a
125	78.2 ± 6.3 b	71.4 ± 6.2 b

^zMean ± SE.

^yMeans with same lowercase letters within a column are not significantly different by the Tukey’s honestly significant difference multiple comparison at $\alpha = 0.05$.

Table 3. Cutting propagation of *Osmanthus fragrans* and *O. fragrans* 'Cai Ye Gui' using 1-naphthaleneacetic acid (NAA) at a concentration of 100 mg·L⁻¹ and ABT1 talc powder [a.i. 30% indole-3-acetic acid (IAA) and 20% NAA]. Thirty cuttings of each of the three replications were prepared, treated with NAA solution or ABT1 talc powder, and inserted 3–5 cm deep in well-drained regular red soil in raised beds. Data were collected at 40 d after treatment.

	Rooting hormone	Species or cultivar	
		<i>O. fragrans</i>	<i>O. fragrans</i> 'Cai Ye Gui'
Rooting (%)	NAA	91.7 ± 5.7 ^a	90.2 ± 5.5 a
	ABT1	84.6 ± 4.2 a	78.8 ± 4.5 b
Number of roots	NAA	3.50 ± 0.32 a	4.22 ± 0.45 a
	ABT1	2.60 ± 0.48 b	1.57 ± 0.45 b
Length of the longest of root (cm)	NAA	2.07 ± 0.30 b	2.07 ± 0.58 a
	ABT1	2.23 ± 0.39 a	2.63 ± 0.39 a

^aMean ± SE.

^bMeans with same lowercase letters within a column and dependent variable are not significantly different by Student's *t* test at $\alpha = 0.05$.

On 8 Sept. 2017, terminal semihardwood cuttings of *O. fragrans* 'Cai Ye Gui' were collected and handled the same way as mentioned previously. The cuttings were then treated with a quick dip in solutions with 1,500 mg·L⁻¹ of NAA or indole-3-butyric acid (IBA). All cuttings were inserted in blow molded pots (6.5 cm in diameter, 6.5 cm high) containing regular red soil (Ao) (Fig. 1D). Three replications with 120 cuttings each were prepared for each treatment. After 60 d, the number of cuttings with roots, number of roots per cutting, and the length of all roots were recorded and analyzed as above. No significant difference ($P > 0.05$) was observed for semihardwood cuttings treated with NAA or IBA. The rooting percentage of semihardwood cuttings treated with 1,500 mg·L⁻¹ IBA and NAA was 86.4% ± 3.2% and 81.1% ± 4.7%, respectively. The cuttings treated with 1,500 mg·L⁻¹ IBA produced 8.3 ± 0.9 roots per cutting with an average root length of 3.5 ± 0.2 cm, whereas those with 1,500 mg·L⁻¹ NAA regenerated 7.9 ± 0.6 roots per cutting with an averaged root length of 3.4 ± 0.2 cm (Fig. 1E). These results indicated that semihardwood cuttings

of *O. fragrans* 'Cai Ye Gui' can be treated with either NAA or IBA at a concentration of 1,500 mg·L⁻¹ without significant difference.

Availability

Osmanthus fragrans 'Cai Ye Gui' was discovered among seedlings germinated from seeds collected from southern China by Mr. Jianxiong Yi, the owner of Yuntian Nursery (Zhuzhou, Hunan). On 31 Dec. 2009, the plant variety protection right for this newly discovered cultivar was granted by the State Forestry Administration of the People's Republic of China (Beijing, China) with a certificate no. 2009028. The plant variety rights of *O. fragrans* 'Cai Ye Gui' has been nonexclusively authorized to Jiangsu Ao-Yang Ecological Agriculture and Forestry Ltd. (Suzhou, Jiangsu). Since then, over 50 million plants have been propagated via stem cuttings for the Chinese green industry. Information about plant material, licensing, and propagation agreements can be obtained from the Yuntian Nursery (Zhuzhou, Hunan) or Jiangsu Ao-Yang Ecological Agriculture and Forestry Ltd. (Suzhou, Jiangsu).

Literature Cited

- Chang, M., L. Qiu, and P.S. Green. 1996. Oleaceae: *Osmanthus*, p. 272–319. In: Z. Wu, P.H. Raven, and D. Hong (eds.). *Flora of China*, vol. 15. Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis, MO.
- Huxley, A. 1992. *New RHS dictionary of gardening*. Macmillan, London, UK.
- Makino, T. 1902. *Osmanthus fragrans* var. *aurantiacus*. Bot. Mag. Tokyo 16:32.
- Makino, T. 1927. *Osmanthus fragrans* var. *thunbergii*. Shokubutsu Kenkyu Zasshi 4:4.
- Murray, J.A. 1784. *Systema vegetabilium*. 14th ed. p. 57.
- Nakai, T. and G. Koidzumi. 1922. *Osmanthus aurantiacus* (Makino) Nakai. Trees Shrubs Japan 265.
- Royal Botanic Gardens, Kew. 2017. Science, plants of the world online: *Osmanthus fragrans* Lour. Kew Gardens, Richmond, UK. 3 Dec. 2017. <<http://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:610878-1>>.
- Royal Horticultural Society and Flower Council of Holland. 2001. *RHS Colour Chart*, London, UK.
- Sun, Y., Y. Sun, Z. Sun, Q. Liu, P. Li, and C. Li. 2015. Mapping monthly distribution of daily light integrals across China. *Hunan For. Sci. Technol.* 42(4):43–47.
- Xiang, M., Y. Duan, and Q. Xiang. 2014. Annual report ICRCO: Establishment of a new group-*Osmanthus fragrans* colour group. *J. Nanjing For. Univ.* 38(1):cover page 2–3.
- Xiang, Q. 2008. An illustrated monograph of the sweet osmanthus cultivars in China. Zhejiang Science and Technology Press, Hangzhou, Zhejiang, China.
- Zang, D., M. Sun, B. Dong, Q. Xiang, and Y. Liu. 2014. Annual report ICRCO: Three new cultivars of *Osmanthus fragrans* from east China. *J. Nanjing For. Univ.* 38(4):cover page 2–3.
- Zhang, F. 1990. *Soil map of the People's Republic of China*. State Land Administration, Beijing, China.
- Zhou, S. 2008. Flower herbal tea used for treatment of menopathies. *J. Tradit. Chin. Med.* 28(3): 202–204.