Sapindus Cultivar ‘Yue Shuo Bodhi’

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Sapindus mukorossi Gaertn. (*S. mukorossi*) is a deciduous tree of the *Sapindus* L. (*Sapindus*) in the *Sapindaceae* Juss. family, which is widely distributed in warm temperate to tropical regions in Asia, especially China and Southeast Asian countries. Because of the high yield of its seed oil (26.15% to 44.69%) (Liu et al., 2017; Sun et al., 2017), it is suitable for biodiesel production according to American Society for Testing and Materials (ASTM) D6751 and European Standards (EN) 14214 (Chakraborty and Baruah, 2013; Sun et al., 2019). Crude extracts from the fruit pericarps of *S. mukorossi* are rich in triterpenoid saponins (4.14% to 27.04%) and sesquiterpenoids (Liu et al., 2019; Liu et al., 2017), which exhibit excellent surface activity as well as antibacterial, elution, pharmacological, and physiological effects (Xu et al., 2018). Saponin serves as an efficient natural

surfactant in commercial soaps, shampoos, and cosmetic cleansers (Muntaha and Khan, 2015), and the root, bark, and fruit are used in traditional Chinese medicine. Therefore, *S. mukorossi* are widely cultivated as important biodiesel, biomedical, biochemical, and multifunctional feedstock species (Liu et al., 2017, 2019; Sun et al., 2016) in China. *S. mukorossi* has a long history of cultivation in China and its forestry has developed rapidly in recent years. As of 2016, *S. mukorossi* plantations covered nearly 26,000 ha in south China (e.g., Fujian, Zhejiang, and Guizhou provinces) (Gao et al., 2016). However, yields fluctuate widely because of the lack of improved varieties and limitations of the technical cultivation system (Liu et al., 2017). The *Sapindus* research team of Beijing Forestry University have investigated, collected, and evaluated the elite germplasm resources of *Sapindus* since 2014 and established the *Sapindus* germplasm resource nursery in Jianning county to perform the breeding of *Sapindus* (Liu et al., 2019; Wang et al., 2020). ‘Yue Shuo Bodhi’ was released as a new *S. mukorossi* cultivar in China on 21 Dec. 2020. This new cultivar, which has a fruit weight of 4.45 ± 0.10 g, relatively large size, high yield, and excellent fruit traits, has been widely planted in the Fujian province. This study aimed to introduce a high-quality *S. mukorossi* cultivar and help *S. mukorossi* growers recognize this new cultivar that can be

recommended as a candidate for different breeding programs.

Origin

‘Yue Shuo Bodhi’ is a clone of elite germplasm with high yield and high quality that comes from Meilinghe Forest Farm, Guanyu Town, Deqing City, Guangdong Province in China. Field investigation, collection, and evaluation of *Sapindus* germplasms worldwide were undertaken from 2014 to 2020, in 16 provinces in the south of China that represent the natural distribution of *Sapindus*. In Jianning County, Sanming City, Fujian Province, China (lat. $27^{\circ}06'N$, long. $117^{\circ}25'E$), where the average temperature is $17.4^{\circ}C$, the maximum temperature is $36.8^{\circ}C$ (July), the minimum temperature is $4.3^{\circ}C$ (January), and average relative humidity is 83.9%, using grafting, 117 kinds of *Sapindus* clones were conserved in a *Sapindus* germplasm nursery (Wang et al., 2020). We have performed clonal testing since 2014. Through years of continuous observation and statistics of the agronomic traits of this variety, we found that it consistently exhibited the characteristics of high yield, relatively large size, and short fruit infructescence. The agro-morphological traits were measured as described by Sun et al. (2016) and Liu et al. (2019). Thirty mature fruits were randomly picked from each clone to analyze the agro-morphological traits.

Description

We aimed to provide data regarding this new *S. mukorossi* cultivar. Our study was certified by the Protection of New Varieties of plants (CNPVP), National Forestry and Grassland Administration in China (21 Dec. 2020) (date of request, 18 Dec. 2018; certification no., 20200312).

Biological characteristics. ‘Yue Shuo Bodhi’ has been identified since the date of bud burst (1–3 Mar.). The florescence is 25 ± 1 d (May–June). The fruit development period is 130 ± 8 d (June–October). The fruit matures in late October, and the defoliation stage occurs relatively late (December) (Fig. 1).

Tree and leaf characteristics. ‘Yue Shuo Bodhi’ is a deciduous tree with an umbrella crown. Plant growth habits include a spreading cultivar with trees 3 to 4 m high and 5 to 6 m wide that show vigorous growth and high rooting ability. The annual shoot length varies between 41 and 59 cm, and shoot width is less than 14 mm. The winter buds are grayish brown and ovoid, and the outside is smooth and glabrous. Leaves are even-pinnately compound, opposite or subopposite, with six to eight pairs of leaflets. Leaflets are strip-lanceolate, tip acuminate, base cuneate, and slightly asymmetric, with an entire leaf margin. Mature leaflets are dark green, smooth on both sides, and glabrous. The inflorescence is terminal and actinomorphic. There are five petals that are light yellow and oval. The infructescence is short, the fruit is densely distributed, and the posture of the fructescence is erect or suberect.

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Fig. 1. Phenology of 'Yue shuo Bodhi'. (A) Leaf extension stage in March. (B) Inflorescence emergence stage in April. (C) Flowering stage in May and June. (D) Primary bearing period in June. (E) Fruit expanding stage in July. (F) Fruit expanding stage in August. (G) Fruit expanding stage in September. (H) Full bearing period in October. (I) Frutescence in November.

Fig. 2. 'Yue shuo Bodhi' (top) and local cultivated *Sapindus* (bottom) fruit.

Fruit characteristics. Fruit yield and the quality of high-value products are crucial to the *Sapindus* industry. The fruit color of 'Yue Shuo Bodhi' is yellow, the shape of the fruit is nearly spherical, and the fruit is large (Fig. 2). The fruit horizontal, vertical, and lateral diameters are 25.25, 22.12, and 20.23 mm, respectively. The 100-fruit weight and 100-fruit pericarp weight are 454.0 ± 10.22 and 279.72 ± 5.19 g, respectively, which are 164% and 171% heavier than those of the local cultivated *Sapindus* fruits. Pericarp thickness and pericarp saponin content are important traits that indicate the production capacity of saponin. The pericarp thickness and pericarp saponin content of 'Yue Shuo Bodhi' are 2.15 ± 0.36 mm and $13.76 \pm 0.67\%$, respectively. The seed is spherical and black, with horizontal, vertical, and lateral

diameters of 14.40, 15.15, and 12.32 mm, respectively. The 100-seed weight is 172.86 ± 4.39 g, which is 153% heavier than that of the local cultivated *Sapindus*. The 100-seed kernel weight and seed kernel oil content are important traits that indicate the production capacity of oil. The 100-seed kernel weight and seed kernel oil content of 'Yue Shuo Bodhi' are 2.15 ± 0.36 mm and $34.50 \pm 0.91\%$, respectively. 'Yue Shuo Bodhi' can blossom, yielding fruit within 1 to 2 years after grafting. The yield per plant of the 5- to 6-year-old grafted seedlings is 5 to 10 kg. This plant shows strong high-yield habits during successive years.

Culture

Based on the clonal test and raw material forest cultivation, 'Yue Shuo Bodhi' is

productive and performs well. This variety is a strong, light-loving, deep-rooted, drought-tolerant tree species, but it is not resistant to excessive humidity. It is suitable for cultivation in fertile, well-drained, acidic or slightly alkaline sandy soil. It is suggested to popularize and cultivate in subtropical areas such as Fujian Province and Guangdong Province. The cultivar produces larger fruit with good fruit quality that is consumed extensively, especially by biochemistry and biodiesel companies.

Availability

'Yue Shuo Bodhi' is protected by the China protection of new varieties of plants (CNPVP; registration number 20200312). Propagating materials are available at the *Sapindus* germplasm resources nursery in Jianning County, Sanming City, Fujian Province.

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