‘Xiahong’: An Ornamental Purple-leaf Plum Cultivar

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Purple-leaf plum [*Prunus cerasifera* Ehrhar f. *atropurpurea* (Jacq.) Rehd.], a member of the Rosaceae family, is widely cultivated in North America, Europe, and Asia (Szekely and Dagmar, 2011). All purple-leaf and red-leaf plum cultivars are produced by bud mutations of green-leaf plum leaves. The young leaves are vividly red during the whole growth period of this tree, and the old leaves are purplish red. The use of these buds results in the synthesis of a large amount of anthocyanin, which causes the leaves to appear purple or red (Gu et al., 2015). Purple-leaf plum, an ornamental plant with luxuriant leaves, is usually planted in parks or gardens (Jiang et al., 2006). In recent years, in-depth studies of the mechanism by which the color is produced and the anthocyanin from purple-leaf plum has been extracted have been conducted (Liu et al., 2019; Piccolo et al., 2020; Vangelisti et al., 2020).

Origin

Our research team began to introduce and breed different cultivars of plum in 2002, with the goal of producing new cultivars of the purple-leaf plum. The Purple-leaf Plum Resource Nursery was established to use the directional selection method of bud transformation. Bud selection is a type of somatic mutation that occurs in the meristematic cells of the bud. However, until the mutant bud germinates and grows into a branch, significant morphological differences from the original variety can easily be observed. Therefore, the bud transformation always changes by one branch. In our project, the selection and breeding of new cultivars of purple-leaf plum strictly followed the process of pre-selection, primary selection, second selection, and final selection. During the first step of pre-selection, we conducted a field survey in the nursery. Outstanding single seedlings or branches were then

marked and numbered individually as pre-selected trees during the whole plum growing season. During the period of primary selection, the pre-selected trees with marked numbers were systematically investigated and evaluated for 3 years, and preselected trees that had excellent and stable characteristics were selected as primary superior plants. These superior plants were used to conduct multipoint (multiple location) observations. The process of both the second and final selection involved a comprehensive evaluation of the parent plant materials, vegetatively propagated plants, and multipoint tests for more than 10 years. The project team finally identified the excellent purple-leaf plum ‘L0630’ from the bud transformation of Chinese purple-leaf plum and found it to be a cultivar that is worth popularizing. ‘L0630’ was officially designated ‘Xiahong’ in 2013, and it was released by the Jiangsu Yanjiang Institute of Agricultural Sciences (Nantong, Jiangsu, China) in 2014. Currently, ‘Xiahong’ is widely used in landscape architecture in southeastern China.

Description

The ornamental characteristics of ‘Xiahong’ are leaves that are large and intensively red (FAN2-59A). Although the mature leaves of most other purple-leaf plum cultivars turn green (FAN3-135C) in the summer, only the central part of ‘Xiahong’ leaves fade and turn bluish purple (FAN2-N92A) (Li et al., 2007; Zhang et al., 2013). However, the rest of the leaves remain purple (FAN2-N77A). In addition, ‘Xiahong’ has one unique characteristic. It retains an excellent condition of new budbreak and extension of young leaves in the summer, whereas other cultivars are affected by hot temperatures to varying degrees. ‘Xiahong’ also has a late deciduous period. The leaves of ‘Xiahong’ usually fall ≈ 17 to 24 d later than those of other purple-leaf plum cultivars during the initial deciduous leaf stage. The final deciduous stage occurs ≈ 28 d later (Li et al., 2013). ‘Xiahong’ has a long period during which its leaves are red. Its growth period is ≈ 270 d, and the red leaf period is more than 250 d in Nantong, Jiangsu, China (lat. $32^{\circ}8'N$, long. $120^{\circ}37'E$).

Foliage. The foliage is red or purple, papery, elliptical, ovate or obovate (8.7–9.6 cm long, 4.8–5.3 cm wide, leaf area of 31.3–34.7 cm^2 , with a length-to-width ratio of 1.8), has a

short petiole (0.6–1.2 cm), and has a serrated margin. The mature leaves are purple with a bright red back, a wedge at the base, thick serrations at the margin, and dark purple petioles. New leaves are always formed during the growing period, and only a few of the mature leaves turn green during the summer. The young leaf surface exhibits a showy red appearance compared with other purple-leaf plum cultivars, thus giving this tree a special ornamental value in the summer (Fig. 1A).

Flower. Each cluster has one to five white (FAN4-N155B) or light pink (FAN4-NN155D) flowers. The flowers are small (diameter, 2.0–2.5 cm), with five petals and purple sheaths, 25 to 30 stamens, and a 0.6- to 1.6-cm bluish violet flower stalk (Fig. 1B). Flowering begins (10% open flowers) in the middle of March, and it ends in early December in Jiangsu, China.

Fruit. The fruits are dark red (FAN2-59A), ovoid, and relatively small (diameter, ≈ 2.2 cm) (Fig. 1C and D). The fruit is apricot red with tight flesh, less juice, and a relatively acidic taste. Locals eat the fruit with sugar after they have been stored in the refrigerator. However, the edible value of fruit remains to be developed further, and the antimicrobial applications of total polyphenols and flavones extracted from its fruit merit further study.

Cultivation. This cultivar is cold-resistant, which renders it suitable for planting in USDA Cold Hardiness Zones 4 through 10. Cuttings from this cultivar have poor adventitious root formation, a low rate of survival, and a slow growth rate during propagation. Therefore, tissue culture is a more effective way to propagate them (Zenna, 2020). Preliminary experiments suggest the application of the following tissue culture propagation techniques. Shoots with buds of ‘Xiahong’ that grew healthily in May and June should be selected. Then, the leaves should be removed and washed under tap water. The stems should be cut 2 to 3 cm with buds. The stem segments should be soaked in a solution of 0.1% $HgCl_2$ for 10 min, washed three to four times with sterile water, and inoculated on the starter medium. The culture medium used was MS (Murashige and Skoog media) + naphthalene acetic acid (NAA) 0.1 mg/L + butyl acrylate (BA) 0.8 mg/L. The culture temperature was $25 \pm 2^{\circ}C$. The light time was 12 h/d. The light intensity was 1500 to 2000 Lux. Then, buds were inoculated on 1/2 MS + 6-BA 0.5 mg/L as proliferation media, and 15 buds were planted in each triangular flask. The buds were grown in the flask for 30 d. Approximately 2.5 cm of strong shoots with three or four expanded leaves were cut from the fascicle buds under aseptic conditions and transferred to 1/2 MS + indole butyric acid (IBA) 0.3 mg/L rooting medium. The roots grew to ≈ 2 cm after 35 d (Carmona-Martin and Petri, 2020; Xia et al., 2011). Then, ‘Xiahong’ was moved to a container before its transfer to the field.

Transplantation typically occurs in the autumn, and the row spacing should be more than 2.0 m $\times$ 2.0 m. Nitrogen fertilizer (N:P:K = 6:3:1) was primarily applied from March to April, and broadcast or watered

Received for publication 23 Aug. 2021. Accepted for publication 19 Sept. 2021.

Published online 14 December 2021.

This project was supported by Jiangsu Forestry Science and Technology Innovation and Promotion Project (LYKJ-Nantong [2021]1) and Nantong Basic Science Research Project (JC2021136). Y.L. is the corresponding author. E-mail: lyglyj90@sohu.com.

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Fig. 1. Phenotypic characteristics of the foliage (A; 16 Apr. 2021), flower (B; 15 Mar. 2020), and fruit (C and D; 20 June 2020) of 'Xiahong' purple-leaf plum. All the photographs were obtained at the Jiangsu Yanjiang Institute of Agricultural Sciences (Nantong, Jiangsu, China).

once every 7 to 10 d. From May to August, decomposed organic fertilizer is primarily applied, and water should simultaneously be used to keep the soil moist. In the case of drought in the summer and autumn, irrigation should be used as required to promote moist soil in the field and to ensure bright leaves.

Disease and pest management. Good management consists of moderating dense planting, pruning reasonably, maintaining ventilation and light, strengthening the management of fertilizer and water, reasonable thinning in the summer, removing dead leaves, branches, and diseased leaves, removing insects, and using artificial methods to reduce the base of diseases and insects. Common diseases include leaf spot, foxiness shot hole, gummosis, and powdery mildew. Spraying the surface of the leaves at 1000× dilutions of 70% thiophanate-methyl (Jinlong, Jiangsu, China) can

effectively prevent these diseases. The main pests, which are aphids, can be controlled by spraying the surfaces of the leaves with 10% cypermethrin emulsifiable concentrates (Xingpai, Shandong, China) at 2000× dilution or 50% Pimiricarb wettable powder (Kesheng, Jiangsu, China) at 2000× dilution. The chemicals used for pest control and disease control should be rotated frequently to avoid the long-term use of the same pesticide, which can lead to resistance and affect the ability to control these organisms.

Availability

'Xiahong' is available through Leisure Agriculture Research Laboratory of Jiangsu Yanjiang Institute of Agricultural Sciences (<http://yj.jaas.ac.cn/show-481-22-1.html>).

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