

the stability of yield and also improve the consistency of fruit quality. This research aims to provide theoretical basis and technical reference for the efficient cultivation of Changshan Huyou, industrial upgrading, and its sustainable development in modern fruit industry.

2 Biological and Commercial Characteristics of Changshan Huyou

2.1 Morphological and physiological traits of Huyou

Changshan Huyou (*Citrus changshan-huyou*) is a unique citrus fruit tree in China, mainly produced in Changshan County, Zhejiang Province and other places. It is a local specialty variety formed by the natural hybridization of pomelos and other citrus fruits, and belongs to evergreen subtropical fruit trees (Figure 1). Changshan Huyou grows fast, has strong adaptability, and is also cold-resistant and easy to store. The fruits enter the expansion period from June to July and September, and are ripe and harvested in November (Gao et al., 2022). In terms of morphology, the leaves of Changshan Huyou are relatively thick. The fruits are mostly spherical or flattened spherical, with golden peel and pale yellow flesh. It has a high yield and good stress resistance (Miao et al., 2024). In addition, polyploid Changshan Huyou (such as tetraploid) has larger fruits, larger leaves and flower organs, strong pollen viability and ovule viability, which is suitable for hybrid breeding (Huang et al., 2025).



Figure 1 Field view of Changshan Huyou trees laden with mature fruits

2.2 Commercial quality indicators: fruit size, weight, peel thickness, juice content, flavor, and storage ability

The fruit of Changshan Huyou is generally medium to large-sized, with a single fruit weighing about 300 grams. The peel is relatively thick but easy to peel off. The flesh is juicy and has a unique flavor, with a hint of sweetness, sourness and a touch of bitterness. The fruit contains rich active substances, such as naringin, hesperidin and limonin (Zhang et al., 2012). The peel also contains a large amount of volatile oil, flavonoids, coumarins and terpenoids, etc., which bring special aroma and certain medicinal value (Gao et al., 2022; Huang et al., 2025). Changshan Huyou is suitable for storage and can be preserved for a long time at room temperature, which is convenient for long-distance transportation and market sales (Miao et al., 2024). Furthermore, it has a high content of antioxidant activity and functional components, and its nutritional and health care value is prominent (Zhang et al., 2012; Gao et al., 2022).

2.3 Current cultivation practices in major producing regions

Changshan Huyou is mainly cultivated in places such as Quzhou, Kecheng and Longyou in Zhejiang Province, and has a cultivation history of over a hundred years (Gao et al., 2022; Miao et al., 2024). The current mainstream planting methods include high-density cultivation, scientific pruning, reasonable fertilization and integrated pest and disease management, emphasizing ecological and green production (Zhong, 2004). Changshan Huyou has strong adaptability. After being introduced to Hunan and other places, it has performed well, with stable growth, good yield and flavor maintenance, few diseases and pests and easy control. It has high economic and ecological value (Tan et al., 2012). In recent years, with the development of deep processing and functional foods, the industrial chain of Changshan Huyou has been continuously extended, promoting the process of commercialization and branding (Gao et al., 2022; Miao et al., 2024).