responses are irreversible and slow to show results, and are also influenced by environmental conditions and labor constraints, optimization is difficult. In the absence of systematic pruning models tailored to the growth habits and phenological characteristics of loquat, many orchards commonly show problems such as overly tall canopies, crowded branches, and poor internal structure. These conditions lead to insufficient light inside the canopy, outward movement of fruiting zones, and reduced overall production efficiency. In high-density planting systems or aging orchards, these issues become more severe, increasing the difficulty of pruning and harvesting, raising labor costs, and potentially aggravating physiological disorders and postharvest losses. In addition, pruning needs to be coordinated with practices such as flower and fruit thinning, regulated deficit irrigation, nutrient management, and pollination management, which further increases management complexity (Ahmad et al., 2021).

Given the high economic importance of fruit size, earliness, and eating quality in the loquat market, it is necessary to conduct systematic research on pruning systems. Agronomic practices such as flower and fruit thinning, canopy optimization, and new pruning methods can significantly regulate fruit load, cell division, and the light microenvironment, thereby affecting fruit size, sweetness, appearance quality, and overall production efficiency. At present, systematic comparative studies on different pruning systems in terms of yield, key quality indicators (such as fruit weight, soluble solids, titratable acidity, and color), and operational feasibility are still limited. This study evaluates the effects of different pruning systems on canopy structure, fruiting characteristics, and physicochemical properties of fruits through field experiments, aiming to provide a theoretical basis for the optimized design and scientific management of loquat orchards.

2 Growth Characteristics of Loquat Related to Pruning

2.1 Growth habit and canopy structure of loquat trees

Loquat (*Eriobotrya japonica* Lindl.) is an evergreen fruit tree with strong vigor, and its growth habit and canopy structure largely determine how it responds to pruning. Under natural conditions, loquat trees tend to grow tall with vigorous vegetative growth. Without training and pruning, the canopy becomes too high, and the inner canopy is very dense, causing fruiting sites to shift toward the outer canopy. In this situation, flowers and fruits on the exposed outer layer are more likely to suffer from frost damage and sunburn, while the shaded inner canopy receives insufficient light, resulting in lower yield and poorer fruit quality. Loquat usually shows weak lateral branching ability, with long fruiting shoots and mainly terminal flower buds. This limits the number and uniform distribution of fruiting sites within a given canopy volume, making its productivity relatively lower compared with other pome fruit trees (Li et al., 2025). Differences among cultivars in shoot length, leaf–branch angle, and lateral branch number are closely related to hormone signaling pathways such as abscisic acid and strigolactones.

2.2 Flowering and fruiting characteristics

Loquat shows a unique flowering and fruiting pattern within the Rosaceae family. After a juvenile phase of about 4~6 years, the plant enters the adult reproductive stage, during which flower bud differentiation and flowering occur in autumn and winter, while fruit development continues throughout winter and fruits mature from early to mid-spring (Peng et al., 2022). The extended standardized BBCH scale divides its growth process into 7 main stages and 31 secondary stages, covering bud, leaf and shoot development, inflorescence formation, flowering, fruit development, and fruit ripening. There are significant differences among cultivars in phenological traits, including the onset and duration of flowering, the time from full bloom to maturity, and harvest time. Under Mediterranean or subtropical climates, some genotypes mature in early April, while others mature in late April or even later (Kaur, 2018; Kizil and Durgac, 2023). Loquat has large panicle inflorescences with many flowers and a naturally high fruit set rate. To obtain fruits that meet commercial size standards, thinning of flowers or fruits is usually required. Reducing the number of flower buds per inflorescence can increase fruit set, fruit size, and sweetness of the remaining fruits, mainly by reducing competition among sinks and improving the source–sink relationship of the tree. Flowering and fruit set are also affected by canopy orientation; under field conditions, the south side of the canopy usually shows higher flowering and final fruit set rates (Polat, 2015). Flowering time and floral initiation are regulated by at least two FT homologous genes (*EjFT1* and *EjFT2*), which respond to photoperiod and gibberellin signals; meanwhile, RAV transcription factors can delay flowering and extend the juvenile phase (Jiang et al., 2025).