

nutrients (Wei et al., 2021). Across fruit crops, thinning is regarded as a core management practice because natural fruit drop alone rarely achieves the balance between yield quantity and market quality required in commercial orchards. Broad reviews of thinning research show that its principal effects arise through crop-load adjustment, with fruit size generally increasing as thinning intensity increases, although the response is modified by factors such as wood age, flower quality, within-cluster competition, canopy position, and the timing and method of thinning. Thinning can improve a first group of commercially decisive quality traits-including size, colour, firmness, and sugar-acid characteristics-but excessive reduction in crop load can create trade-offs with total yield and must therefore be optimized for local market goals rather than maximized indiscriminately. Experimental evidence from other fruit trees supports this general pattern. In peach, repeated fruit thinning during early development improved individual fruit weight, yield, internal and external quality, and leaf resource-use efficiency, while late thinning was less effective (Zhang et al., 2024). In pear, hand thinning increased fruit weight, diameter, height, and soluble solids, and although immediate yield could decline, thinning helped stabilize production over years and increased the proportion of marketable fruit. In loquat specifically, thinning has been studied at both flower and fruit stages. Earlier work showed that fruit thinning increased fruit growth and sugar accumulation, but also raised the incidence of purple spot, indicating that quality improvement can be accompanied by physiological risks. More recent studies confirm that loquat thinning is an essential management practice because the species tends toward heavy fruiting, and reducing competition among reproductive sinks can produce larger, sweeter, and more uniform fruit with better consumer appeal (Nordi et al., 2025). Flower-bud thinning at full bloom in the cultivar ‘Precoce de Itaquera’ improved overall fruit quality when four buds per cluster were retained, whereas keeping more buds increased cluster weight and total yield, clearly demonstrating the central agronomic trade-off between fruit quality and crop quantity in loquat production.

Against this background, studying the effects of fruit thinning on loquat yield and quality is important both scientifically and practically. From a physiological perspective, thinning provides a tractable way to modify source-sink relations, fruit set, and subsequent fruit enlargement, and loquat research increasingly links these orchard-level responses to developmental processes such as early cell division and shoot vigor. From a production perspective, growers urgently need management protocols that improve the performance of existing cultivars, because breeding alone has not solved the combined problems of small fruit, low yield, and inconsistent quality. Thinning is also relevant to orchard profitability because larger, higher-value fruit generally obtain better prices, even when hand thinning increases labor costs, and because proper crop-load regulation can support more regular cropping and better return bloom in subsequent seasons. Nevertheless, the benefits of thinning in loquat cannot be separated from important constraints. Responses vary with cultivar, site, climate, and thinning timing or intensity, and improvements in sugar accumulation or rapid fruit growth may increase susceptibility to disorders such as purple spot, while postharvest perishability remains a major bottleneck for market expansion. Future research should therefore move beyond asking whether thinning works and focus instead on how to optimize stage, intensity, and method for specific cultivars and environments; how thinning interacts with pruning, nutrition, and preharvest sprays; and how quality gains in the orchard translate into storability, disorder resistance, and supply-chain performance. Additional opportunities lie in improving the utilization of removed unripe fruit, since thinned fruits contain recoverable bioactive compounds and their revalorization could offset management costs while reducing orchard waste. Overall, fruit thinning appears to be a key tool for reconciling yield regulation with market-oriented quality improvement in loquat, and systematic evaluation of its effects is essential for developing more efficient, sustainable, and profitable loquat cultivation systems.

2 Fruit Development Characteristics of Loquat and Theoretical Basis of Fruit Thinning Regulation

2.1 Flowering, fruit set characteristics and yield components of loquat

Loquat has a distinctive reproductive calendar among rosaceous fruit trees, with flower bud formation beginning in summer, blooming occurring in autumn to early winter, and fruit ripening taking place in spring or early summer. This phenology exposes flowering and early fruit set to low temperature, rain, wind, and reduced pollinator activity, which makes the fruit-setting process especially sensitive to orchard environment and