

pollination conditions. Fruit set in loquat depends on the normal sequence of pollen deposition, pollen germination, pollen tube growth, and ovary viability, so any climatic disturbance during bloom can reduce the conversion of flowers into retained fruit. Field studies under Mediterranean conditions further show that minimum temperature significantly affects initial and final fruit set, while humidity and precipitation during bloom can suppress blossoming and reduce fruit retention.

Yield formation in loquat therefore depends not simply on flower abundance, but on the interaction among genotype, flowering traits, fruit set efficiency, and the proportion of fruit that remain to harvest. Considerable cultivar variation has been reported: in one multi-year trial, 'Gold Nugget' showed the highest mean initial fruit set, final fruit set, and productivity among four cultivars grown in the same environment. Rootstock effects also contribute to yield components, because the number of flower buds per cluster, flower number, and final fruit set differed significantly among quince rootstocks, with Quince-C producing higher values for these reproductive traits (Akkuş and Polat, 2021). At the developmental level, loquat fruit growth is not uniform across stages; pulp thickens steadily, whereas rapid early fruit enlargement before the Z02 stage is closely associated with strong seed expansion, indicating that final yield and fruit size are shaped early in fruit development (Lin et al., 2025).

2.2 Fruit load and nutrient allocation

In loquat, fruit load directly alters the internal distribution of assimilates because fruit acts as a dominant sink during development (Assefa and Debella, 2020). Experimental work with field-grown loquat trees showed that as fruit develops, photosynthate translocation to the roots declines markedly, especially from the period when fruit reaches about 50% of final size until the onset of color change. During this same period, carbohydrate concentrations in roots are reduced and root development is strongly inhibited, indicating that actively growing fruit competes effectively with belowground organs for available carbon. This pattern is especially important in loquat because fruit growth occurs in winter, when non-shoot growth is also active, so competition between reproductive and vegetative sinks becomes unusually direct (Reig et al., 2013).

The broader source-sink literature supports this interpretation and helps explain why excessive crop load often reduces both fruit quality and tree vigor. When sink demand is too low, leaves accumulate non-structural carbohydrates and photosynthesis becomes feedback-limited, as shown in low-crop-load apple trees (Yang et al., 2021). When sink demand is high, however, carbon export to fruit is favored at the expense of vegetative growth, and fruit-bearing citrus trees show reduced shoot growth because developing fruits accumulate carbon that would otherwise support new flushes. Loquat appears to follow the same general rule, but with an added hormonal component: heavy fruit load is associated with increased ABA, reduced IAA in roots, and depressed root respiration, showing that crop load regulates not only carbon partitioning but also growth through coordinated metabolic and hormonal signals (Figure 1).

2.3 Theoretical basis and technical principles

The theoretical basis of fruit thinning in loquat is the regulation of the source-sink balance so that the remaining fruits receive more assimilates, mineral nutrients, and growth-promoting capacity per fruit (Assefa and Debella, 2020). This principle is especially relevant in loquat because fruit size is a major production constraint, and both domestication studies and functional analyses indicate that sugar metabolism, hormone signaling, and fruit size-related genes are central to fruit development. At the cellular level, fruit weight in loquat is more strongly associated with cell size than with cell number, which means that reducing competition among fruit can theoretically favor enlargement through enhanced cell expansion rather than only through increased cell division. This framework is consistent with molecular evidence that brassinosteroid-related regulation, including EjbZR1-mediated repression of cell enlargement pathways, contributes to final fruit size formation.

Technically, fruit thinning is an exercise in crop-load optimization rather than simple fruit removal, because excessive retention depresses fruit size and quality while excessive thinning can sacrifice yield or destabilize postharvest performance (Sidhu et al., 2022). Studies across fruit crops show that earlier thinning generally produces better outcomes for fruit size, soluble solids, and return bloom than later thinning, supporting the principle that competition should be reduced before the most critical stages of sink establishment and fruit