

and 13 differential metabolites in peel and pulp tissues, respectively. Changes in peel metabolism were mainly associated with enhanced amino acid biosynthesis, whereas pulp tissues showed increased accumulation of glycoside-related metabolites. The study suggested that potassium alleviates fruit cracking by coordinating peel mechanical strength with metabolic changes in internal and external tissues, thereby reducing the imbalance between pulp expansion and peel extension during fruit development.

5.3 Potassium optimization for different citrus quality targets

Potassium regulates citrus quality formation mainly through the coordinated regulation of multiple processes, including fruit growth, carbohydrate metabolism, organic acid balance, and peel development (Figure 2). For high-sugar citrus production, current evidence supports an appropriate and timely potassium supply rather than pursuing the maximum potassium application rate. For example, Chen et al. (2026) reported that in semi-arid regions of southwestern China, increasing fertilizer input during stage III enhanced soluble sugar and vitamin C accumulation, while reducing irrigation and increasing fertilizer levels during stage IV also promoted the accumulation of sugars and vitamin C. Since commercial citrus maturity largely depends on the ratio of soluble solids to acidity and juice percentage, potassium management aimed at improving sweetness should consider both cultivar characteristics and environmental conditions (Lado et al., 2018; Jiao et al., 2023).

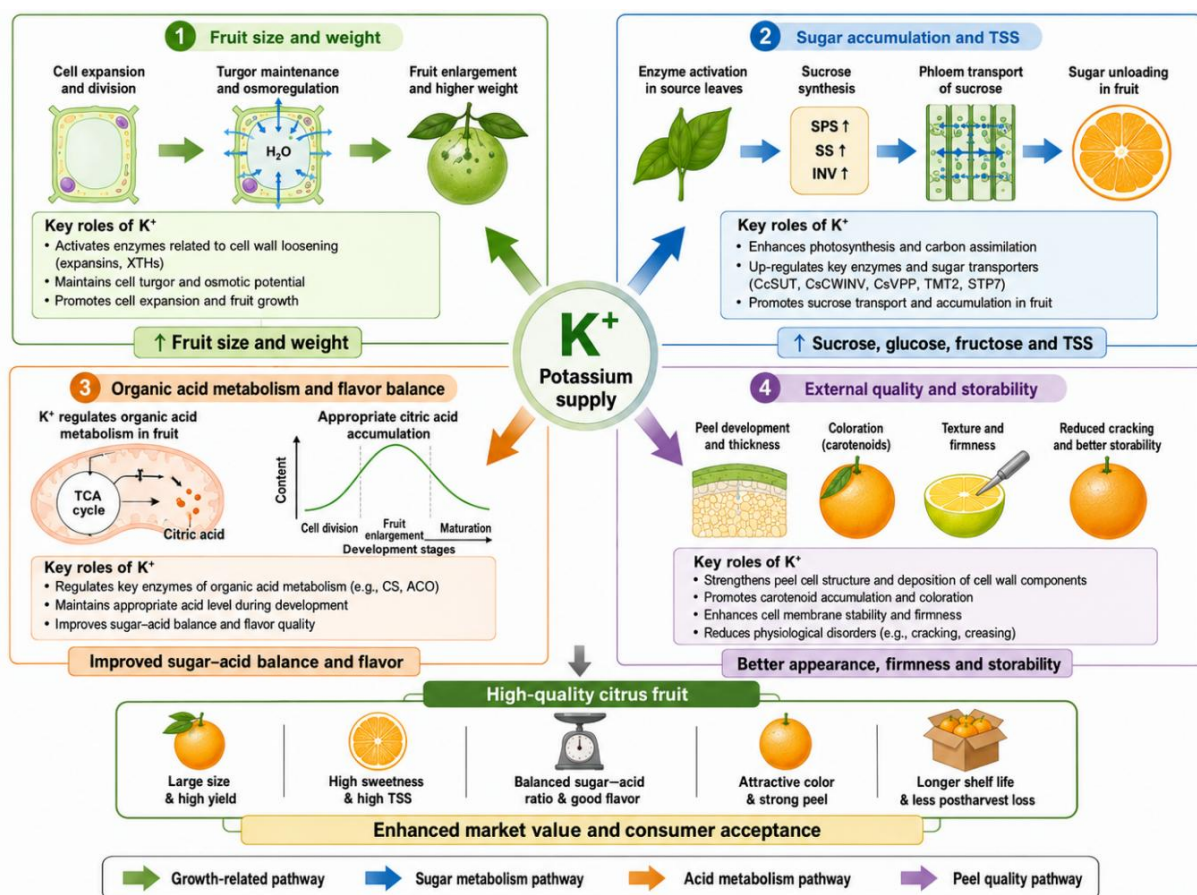


Figure 2 Integrated model of potassium regulation of citrus fruit quality formation

Image caption: The figure summarizes the multi-pathway regulation of citrus fruit quality formation by potassium supply. Adequate potassium availability promotes cell expansion and fruit enlargement, thereby increasing fruit size and weight. Potassium enhances carbon assimilation in source leaves, sucrose synthesis, phloem transport, and sugar unloading processes, resulting in greater accumulation of sucrose, glucose, and fructose and improved total soluble solids content. Meanwhile, potassium regulates organic acid metabolism to optimize sugar-acid balance and flavor development. Potassium also contributes to peel development, coloration, tissue stability, and reduction of physiological disorders such as fruit cracking, ultimately improving commercial value and storage performance of citrus fruits