

predictive accuracy, and provide web-based supervision for low-cost deployment, although infrastructure cost, interoperability, and rural connectivity remain important implementation constraints (Tace et al., 2022; Miller et al., 2025).

8 Conclusions and Perspectives

Water and fertilizer management plays an important role in fruit yield formation of *Rubus chingii*. Appropriate irrigation and balanced nutrient supply can regulate photosynthesis, reproductive development, fruit set, fruit enlargement, and resource-use efficiency, thereby improving yield performance. Studies in fruit crops show that moderate water and fertilizer inputs generally achieve better production performance than excessive application, while balanced fertilization promotes photosynthetic capacity and assimilate supply, providing a physiological basis for stable fruit development. For *R. chingii*, rational water-fertilizer management is therefore a key strategy for achieving efficient and sustainable yield formation.

Water-fertilizer regulation also has great potential for improving fruit quality and medicinal value in *R. chingii*. By optimizing water supply and nutrient allocation, it can regulate sugar-acid balance, nutritional characteristics, and the accumulation of bioactive compounds such as flavonoids, phenolics, ellagic acid, and kaempferol-3-O-rutinoside. Moderate water regulation and balanced fertilization may promote the coordinated improvement of edible quality and medicinal quality, providing an effective approach for producing high-value raw materials for both food and traditional medicine applications.

Future *R. chingii* production should focus on developing precision water-fertilizer management systems based on cultivar characteristics, growth stages, environmental conditions, and intelligent monitoring technologies. Precision drip fertigation, sensor-based regulation, and data-driven models are promising approaches for improving water and nutrient use efficiency. Further studies should establish region-specific management thresholds, evaluate economic and ecological benefits, and integrate genotype selection, stage-based fertigation, biological inputs, and smart sensing technologies to achieve simultaneous improvements in yield, fruit quality, medicinal value, and sustainable production efficiency.

Conflict of Interest Disclosure

The author affirms that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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