

Feature Review

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Nutritional and Irrigation Strategies for High-Yield Peach Production

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Abstract The peach industry is currently facing pressure to stabilize yield, improve quality, save water and fertilizer, reduce costs, and increase efficiency. Water and mineral nutrient management has therefore become a key factor affecting high-yield and high-quality peach cultivation. This study analyzes peach water requirements, nitrogen, phosphorus, and potassium supply, deficit irrigation, and coordinated water-fertilizer regulation. The results show that appropriate nitrogen supply, balanced phosphorus and potassium ratios, and supplementation with micronutrients such as calcium, boron, and zinc can promote flowering, fruit set, fruit enlargement, and quality formation. Measures such as drip irrigation, integrated water and fertilizer management, regulated deficit irrigation, and partial root-zone drying can improve water use efficiency, enhance soluble solids, firmness, sugar-acid ratio, and mineral nutrient content, while reducing fertilizer loss and environmental risks. The study indicates that high-yield peach cultivation should be precisely regulated according to tree demand, soil nutrient supply, and phenological stages. Establishing an integrated water and fertilizer management system that combines water saving, fertilizer saving, high yield, superior quality, and ecological safety is of great significance for promoting the green and sustainable development of the peach industry.

Keywords Peach tree; High-yield cultivation; Integrated water and fertilizer management; Drip irrigation; Fruit quality

1 Introduction

Peach is one of the most important temperate fruit trees in the world and occupies a prominent position in global temperate fruit production, ranking second only to apple in terms of cultivation area and yield (Kumar and Kaur, 2021; Manganaris et al., 2022). In countries such as Spain, Tunisia, Egypt, the United States, and Ethiopia, large-scale commercial peach production has been established, providing important support for farmers' income and rural economies (Iglesias and Echeverría, 2022; Toumi et al., 2022). Peach trees enter the fruiting stage relatively early and have high yield potential per unit area. Under proper management, they can generate favorable economic returns, which has made them highly valued by growers for a long time (Kumar and Kaur, 2021). However, in recent years, affected by rising labor costs, declining grower profits, and intensified market competition in some major production areas, the peach industry has faced the dual pressure of stabilizing yield and improving quality while reducing costs and increasing efficiency (Manganaris et al., 2022). Consumers' requirements for fruit size, firmness, flavor, color, and nutritional quality are also increasing. Unstable fruit quality can directly affect peach consumption and the profitability of the industry (Anthony and Minas, 2021; Manganaris et al., 2022).

In high-yield peach cultivation, water and mineral nutrition are key factors affecting tree growth, fruit set, fruit enlargement, and quality formation. Insufficient nitrogen supply can weaken root growth, flower bud quality, and nutrient absorption capacity, thereby affecting yield. In contrast, excessive nitrogen application may lead to excessive vegetative growth, reduced fruit quality, increased disease risk, and nutrient loss (Nava et al., 2022). Phosphorus and potassium are associated with flowering and fruit set, sugar transport, fruit weight formation, and stress resistance. Therefore, an appropriate nitrogen, phosphorus, and potassium ratio is an important basis for achieving high yield and superior quality in peach production (Zayan et al., 2016; Dbara et al., 2018). Field studies have shown that appropriate fertilization at key stages such as budbreak, flowering, and fruit development