

Water-nutrient interactions also shape soluble solids, firmness, and appearance quality. In deficit-irrigated orchards, fruits often show higher soluble solids and improved sugar:acid balance compared with fully irrigated trees, as seen in semi-arid China where 75% ETc produced fruit with more soluble solids, vitamin C, firmer texture, and better color than 100% ETc (Zhou et al., 2017). In arid Tunisia, sustained deficit irrigation and partial root-zone drying increased dry-matter content, firmness (by 13%-15.5%), soluble solids (up to 14.3 °Brix), glucose, phenolic compounds, and mineral nutrients, enhancing nutritional and commercial value (Toumi et al., 2022).

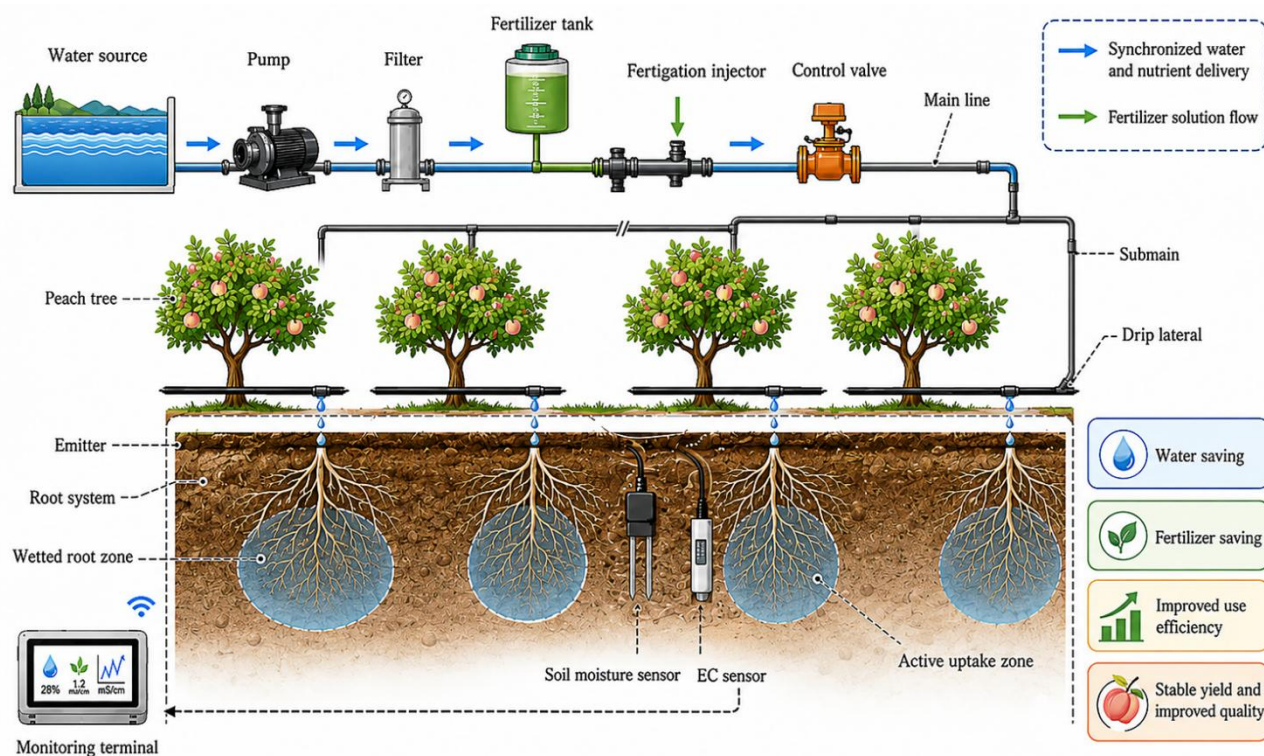


Figure 2 Drip fertigation system for integrated water and nutrient delivery

Potassium supply interacts with water regime: foliar K applied under full and deficit irrigation increased fruit size and soluble solids, with the highest soluble solids observed in potassium-sprayed trees under deficit conditions (100F+DI) (Dbara et al., 2018). In a fertilized, drip-irrigated sandy orchard, macronutrient applications increased fruit length, diameter, firmness, total soluble solids, and total sugars compared with unfertilized trees, confirming that adequate nutrition under efficient irrigation enhances both physical and internal quality attributes (Ali et al., 2019b).

6 Orchard Management Practices Supporting Nutrition and Irrigation

6.1 Soil management and organic amendments

Organic amendments can support fertilizer and water efficiency in peach orchards by improving soil structure, nutrient supply, and moisture buffering. In young orchards, annual applications of food-waste compost at 2× rate (≈20 t/ha pre-plant, then 10 t/ha annually) increased soil organic matter, phosphorus, and sodium in replant soils, improved soil moisture during the growing season, and produced larger trees and higher early yields than the unfertilized control, while allowing 80%-100% reduction of spring synthetic NPK inputs (Lawrence and Melgar, 2023). In bearing orchards, surface application of mixed compost (5-10 t/ha/yr) increased soil organic C and total N, reduced bulk density and water-filled pore space, and slightly improved fruit quality without significantly changing yield, indicating benefits for soil physical properties and carbon storage (Bruno et al., 2025).