vegetation can also support biological control through ground cover and hedgerows, as long as disruptive practices like broad-spectrum pesticides and intensive tillage are minimized.

Orchards managed under organic or biodynamic systems, including agroforestry systems, generally show better soil properties than conventional citrus orchards. These include improved chemical properties (higher pH, phosphorus, cation exchange capacity, and soil organic carbon), better physical structure (lower bulk density and improved porosity), and stronger biological activity (higher enzyme activity and soil fauna feeding) (Pilon et al., 2023). Agroforestry citrus systems can reach soil quality levels similar to forests aged 40-200 years. Rich herbaceous vegetation, especially species from the Fabaceae family, plays an important role by providing green manure and ecological services. In the future, high-density orchards can integrate agroforestry practices or diverse ground covers between rows to maintain soil structure, organic matter, and biodiversity.

Managing drip irrigation at about 70% of field capacity, combined with alginate oligosaccharide treatment, can improve yield, sugar content, sucrose levels, and the efficiency of potassium and water use (with potassium use efficiency increasing by up to 62%). It also improves root growth, soil aggregate stability, and increases available potassium and cation exchange capacity in the topsoil, while reducing deep leaching losses (Li et al., 2024). Low-input practices such as organic fertilization, field margin vegetation, and integrated pest management are practical and cost-effective ways to reduce environmental impact. However, better technical guidance and demonstration are still needed to promote their wider adoption.

Author Contributions

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Conflict of Interest Disclosure

The authors affirm 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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