

Future research should place greater emphasis on the mechanisms underlying soil-microbe-root interactions and integrate approaches such as metagenomics and metabolomics to clarify how organic fertilizers regulate nutrient cycling and the rhizosphere microenvironment. At the same time, precision organic nutrient management systems should be developed by jointly considering organic fertilizer quality, mineralization rate, irrigation, ground-cover management, cultivar-specific nutrient requirements, and local climatic conditions. Integrating soil and plant diagnostics with real-time monitoring and data-driven decision-making tools will further support dynamic fertilization and the sustainable management of vineyards.

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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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