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Biological solutions in sugarcane with mycorrhizal fungi, rhizobacteria and phosphorus enhancing root growth and hydric resilience

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Sugarcane (*Saccharum* sp.) cultivation shows a high dependence on phosphate fertilisers, increasing costs and compromising system sustainability. In this context, the use of soil microorganisms, such as arbuscular mycorrhizal fungi (AMF) and plant growth-promoting rhizobacteria, emerges as an alternative to enhance phosphorus use efficiency and improve plant performance. This study evaluated the effect of inoculation with AMF (*Rhizophagus clarus* – RC) and rhizobacteria (B), either alone or in consortium (RC+B), on sugarcane growth and root development. The experiment was conducted under greenhouse conditions using the RB867515 variety, under three phosphorus levels (0, 30 and 90 mg kg^{-1}). Root biomass and microbial community structure were assessed at 30 and 90 days after inoculation (DAI) through root dry mass determination and bacterial metabarcoding (16S v3–v4). The results showed that the RC+B consortium promoted greater root biomass, with increases exceeding 70% compared with single treatments, indicating greater carbon allocation to the root system. This favours soil exploration and enhances water and nutrient uptake. Z-score analysis revealed a positive association between plant growth, soil biological activity and physiological performance, particularly under moderate phosphorus conditions. At 30 DAI, RC showed *Leifsonia* and *Sinomonas*; RC+B was characterised by *Azospirillum*, *Sphingobium* and *Rhodoplanes*; B was associated with *Devosia* and *Hyphomicrobium*; and the control with *Bradyrhizobium* and *Pedomicrobium*. At 90 DAI, a reduction in discriminant taxa was observed, indicating community reorganisation. It is concluded that RC+B is an efficient strategy to optimise phosphorus use, promote root growth and modulate soil microbiota, contributing to the development of sugarcane plants.

KEYWORDS: Bioinoculants, phosphorus use efficiency, rhizosphere, soil biological activity

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