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Challenges for the Implementation of commercial inoculum of arbuscular fungi in a commercial Callet vineyard (*Vitis vinifera* L.)

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Over the past 70 years, scientific literature has consistently illustrated the advantageous effects of arbuscular mycorrhiza fungi (AMF) on plant growth and stress tolerance. Recent reviews not only reaffirm these findings but also underscore the pivotal role of AMF in ensuring the sustainability of viticulture. In fact, various companies actively promote commercial inoculants based on AMF as biofertilizers or biostimulants for sustainable viticulture. However, despite the touted benefits of these products, the consistent effectiveness of AMF inoculants in real-world field conditions remains uncertain. Our study investigates the influence of a commercial AMF inoculant containing a mycorrhizal complex of *Rhizophagus irregularis* and *Funneliformis mosseae* on a five-year-old vineyard featuring a local grape cultivar (Callet) grafted onto a common rootstock (R110). We monitored the physiological well-being and productivity of inoculated vines compared to control counterparts. Additionally, we assessed the impact of inoculation on the root fungal community determined by NGS of roots DNA from ITS (fungi) regions using Illumina technology. We did not find a statistically significant increase in the photosynthetic rate of inoculated plants, although it did present significantly greater stomatal conductance. Moreover, there were not statistical differences on productivity or grape quality. There was a slight increase in root fungal Shannon diversity in the inoculated plants at beginning of summer but without generating statistically significant differences. Furthermore, the analysis of the fungal community of the roots, conducted through NMDS with the Bray-Curtis distance, showed no detectable changes in the fungal community after inoculation.

Numerous studies highlight the context-dependent nature of AMF inoculation's effects, making it challenging to predict outcomes in field conditions. Failures encountered in trials like ours contribute valuable information to the scientific literature, aiding in the determination of prerequisites for effective biofertilizer use in commercial agriculture. Ultimately, the effectiveness of AMF-based biofertilizers remains contingent on specific conditions, highlighting the need for additional research to ensure their consistent and reliable application.

Keywords: Arbuscular mycorrhiza fungi (AMF); Biofertilizer; Effectiveness; NGS (Next-Generation Sequencing); Root fungal community; Sustainability.

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