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“Microorganisms for future agriculture"
Integrating soil microbial community context in plant response to mycorrhizal symbionts.

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ABSTRACT
We found that more beneficial mycorrhizal species to a host plant, in terms of phosphorus and nitrogen nutrition, did not coincide when in isolation and when interacting with a bacterial community, showing that plant growth response to mycorrhizal fungi is rhizospheric-associated bacterial community dependent.

INTRODUCTION
Arbuscular mycorrhizal fungi (AMF) are likely the most abundant plant mutualists, improving phosphorus and nitrogen plant nutrition in exchange of carbon. Each plant simultaneously associates with several species of AMF that vary in symbiont quality, that is, in the delivery of benefit they provide to the host plant (Klironomos et al., 2003), which could threaten the stability of mycorrhizal mutualisms. Recent research indicate that plants can favor more-beneficial against less-beneficial AMF symbionts (Bever et al., 2009; Kiers et al., 2011). Studies testing mycorrhizal symbiont quality have been conducted using plants and AMF in isolation, but plant response to mycorrhizal fungi may be biotic community context dependent (Hoeksema et al., 2010). In nature, plants interact with other symbiotic and associative soil microbial symbionts involved in plant nutrition, and these plant-AMF-microbe interactions may influence plant response to each AMF species. Here, we investigated whether the nutritional effects of different AMF species to the host plant (symbiont quality) are dependent on soil biotic community context, particularly on the presence of plant-growth promoting bacteria.

MATERIAL AND METHODS
Maize plants were inoculated with one of four AMF species, alone or together with a community of plant-growth promoting rhizobacteria involved in phosphorus and nitrogen plant nutrition; non-mycorrhizal control treatments were included. Plant growth, phosphorus and nitrogen content, nitrogen isotope rations ($\delta^{15}N$), and mycorrhizal colonization were assessed after two months of growth under greenhouse conditions.

RESULTS AND DISCUSSION
Mycorrhizal benefits in providing phosphorus and nitrogen to maize plants vary with AMF taxa, but variation in AMF identity effect was influenced by the presence of a rhizospheric bacterial community (Figure 1). For instance, AMF species conferring more nutritional benefits when inoculated alone, provided similar or lower benefits than other species when AMF were inoculated together with a bacterial community. Plant benefits from AMF relatively to non-mycorrhizal controls were generally highest in nitrogen rather than in phosphorus contents, and synergistic effects between AMF and rhizospheric bacteria depended on mycorrhizal species. Overall, shoot $\delta^{15}N$ signature of maize plants was influenced by AMF taxa.
Figure 1. Phosphorus and nitrogen content of maize plants inoculated with one from four AMF species, alone or together with a bacterial community of six PGPR.

This study indicates that the presence of a soil microbial community differentially influences symbiotic function of mycorrhizal fungal species to host plants, which can have important evolutionary and ecological implications for the stability of the mutualism between plants, and for the design of effective microbial consortia to be applied in agriculture.

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