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ORIGINAL PAPER

Arbuscular mycorrhizal root colonization and soil P availability are positively related to agrodiversity in Mexican maize polycultures

Simoneta Negrete-Yankelevich · Ignacio Eduardo Maldonado-Mendoza · Jesús Omar Lázaro-Castellanos · Wendy Sangabriel-Conde · Juan Carlos Martínez-Álvarez

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Abstract In Los Tuxtlas, Mexico, the local Popoluca people maintain the traditional management of their maize agroecosystems. However, it is not known whether the loss of agrodiversity over recent decades has affected mycorrhizal populations, nutrient availability, and crop productivity. This study utilized linear mixed effect models to analyze the relationship between agrodiversity (three, six, and greater than or equal to eight cultivated species) and (a) arbuscular mycorrhizal fungi (AMF) inoculum potential, measured as the most probable number (MPN) of propagules and colonization level, (b) nutrient availability, and (c) aboveground maize productivity. We also investigated the relationship between soil nutrient content and inoculum potential. Soil samples were taken before planting, and during flowering, in the 2009 maize cycle. We found that AMF colonization level of maize roots and P availability increased with planted species richness, but that this effect only occurred at the flowering sampling date. Plots with a higher MPN of propagules presented increased C and NO_3^- contents and lower C/N ratio than those with lower MPN of propagules, regardless of agrodiversity. Soils that produced the highest maize root colonization level also featured high P availability and N content. We conclude that decreased agrodiversity in these traditional systems does not significantly affect the soil MPN of propagules, but may have a negative impact on the ability of the mycorrhizal community to colonize maize roots, as well as reducing the availability of P, which is often the most limiting nutrient in tropical soils.

Keywords Most probable number of propagules · *Milpas* · Limiting phosphate · Inoculum potential · Plant richness

S. Negrete-Yankelevich · J. O. Lázaro-Castellanos · W. Sangabriel-Conde
Red de Ecología Funcional, Instituto de Ecología A. C., Xalapa, Mexico

I. E. Maldonado-Mendoza · J. C. Martínez-Álvarez
Departamento de Biotecnología Agrícola, Instituto Politécnico Nacional. CIIDIR-Sinaloa, Sinaloa, Mexico

S. Negrete-Yankelevich (✉)
Red de Ecología Funcional, Instituto de Ecología A. C., Carretera Antigua a Coatepec No. 351, El Haya, Xalapa 91070 Veracruz, Mexico
e-mail: simoneta.negrete@inecol.edu.mx

Introduction

Arbuscular mycorrhizal fungi (AMF) form mutualistic associations with about 90 % of terrestrial plant species (Smith and Smith 2012), contributing to the nutrition of these plants. Arbuscular mycorrhizal fungi hyphae extend from the roots and facilitate access to immobile nutrients (Miyasaka and Habte 2001) and inorganic N (Govindarajulu et al. 2005), reducing fertilizer requirements (Shukla et al. 2012). The benefits of AMF for plants include increased growth, chlorophyll, and leaf P content and tolerance to pathogens and pollution (Sudová and Vosátka 2007; Shukla et al. 2012).

The best known role of AMF is to increase the P uptake of plants (Smith and Smith 2012). Root colonization by mycorrhiza, and their contribution to plant P acquisition, are often inversely correlated with soil P availability (Jakobsen et al. 2005; Shukla et al. 2012). In P-limited soils, plants may even depend completely on the mycorrhizal pathway for