From Forest Nursery Notes Winter 2013

121. © Effects of resident soil fungi and land use history outweigh those of commercial mycorrhizal inocula: testing a restoration strategy in unsterilized soil.
Paluch, E. C., Thomsen, M. A., and Volk, T. J. Restoration Ecology online. 2012.

Restoration Ecology
THE JOURNAL OF THE SOCIETY FOR ECOLOGICAL RESTORATION INTERNATIONAL

RESEARCH ARTICLE

Effects of Resident Soil Fungi and Land Use History Outweigh Those of Commercial Mycorrhizal Inocula: Testing a Restoration Strategy in Unsterilized Soil

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Abstract

Arbuscular mycorrhizal fungi (AMF) have numerous effects on temperate grassland ecosystems, but prairie restorations are frequently located in sites with depauperate AMF communities. In this greenhouse study, four native species (*Schizachyrium scoparium, Elymus canadensis*, *Monarda punctata*, and *Aster ericoides*) and an invasive grass *(Bromus inermis)* were grown in unsterilized field soils and treated with two types of commercial AMF inoculum. Inocula were applied at one and two times the manufacturers' suggested rate. Soil was collected from a meadow enrolled in the Conservation Reserve Program (CRP), and from an active agricultural field. Inoculum addition had no effect on biomass or percent colonization by AMF for any grass species, regardless of soil type. Inoculum type significantly affected *Aster* biomass and percent colonization, although pairwise comparisons of treated individuals and controls were not significant. The overall lack of effectiveness of the commercial inocula may reflect the small number of propagules added, even when used at twice the recommended rate. Higher rates of fungal colonization in all three grasses and increased biomass in the native grasses were observed in individuals grown in the CRP soil. Plants were also colonized by dark septate endophytic fungi; for *Schizachyrium*, endophyte colonization was significantly greater in tilled than CRP soil. Our results indicate that an existing soil fungal community promotes colonization by AMF more than the addition of commercial inocula, and that soil characteristics associated with land use history significantly affect the growth of native species in a restoration setting.

Key words: arbuscular mycorrhizal fungi, dark septate endophytes, little bluestem, sand prairie, smooth brome.

Introduction

Temperate grasslands are globally endangered ecosystems (Henwood 2010). It is estimated that one hundredth of one percent of the original North American tallgrass prairie remains today (Neely & Heister 1987), driving widespread interest in prairie restoration. The ultimate goal of prairie restoration is an ecosystem that resembles natural grassland in terms of structure and function (Kline 1997). In natural grasslands, that structure and function are maintained by forces that work together like pieces in a jigsaw puzzle. Most restoration techniques focus on the establishment and performance of plant species, with less attention paid to other members of the community. Thus, one piece of the restoration "puzzle" that is often overlooked is the role played by symbiotic soil fungi.

Dark septate endophytes (DSE) and arbuscular mycorrhizal fungi (AMF) are root-inhabiting fungi common in prairie plants. DSE (Phylum Ascomycota) are non-pathogenic and found in a wide variety of plant hosts and habitats (Jumpponen & Trappe 1998, Newsham 2011). A recent meta-analysis concluded that DSE benefit host plants provided with organic forms of nitrogen, but the ecological significance of DSE remains poorly understood (Newsham 2011). In contrast, many studies have demonstrated the effects of AMF (Phylum Glomeromycota) on individual plants, including increased nutrient uptake, improved water relations, and protection from root pathogens (Smith & Read 1997). In grasslands, the individual-level effects of AMF colonization affect community characteristics, including competition, diversity, and productivity (Van der Heijden et al. 1998; Wilson & Hartnett 1998; Vogelsang et al. 2006; Collins & Foster 2009). Since modern agricultural practices such as plowing, disking, and the application of pesticides may decrease or eradicate AMF populations (Helgason et al. 1998), there is interest in including AMF in prairie restorations (Camill et al. 2004). However, the relative need for such additions in tilled soils versus other types of restoration sites is unknown. The fact that many invasive plants are known to benefit from colonization by resident AMF further complicates decision-making about augmenting the fungal community in restoration sites (Rowe et al. 2007).

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doi: 10.1111/j.1526-100X.2012.00894.x