A Field of Dreams:
Could corn enhance the recovery of the AMF community during restoration?

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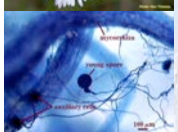
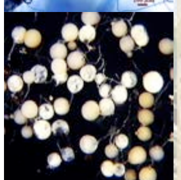
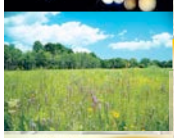




Abstract

Our study tested the ability of corn and mulch treatments to promote AMF diversity in a prairie restoration following the removal of an invasion of *Rhamnus catharticus* (buckthorn). Increasing the AMF diversity can restore the native flora. We evaluated AMF root colonization and species richness, as well as soil factors in five communities: buck thorn invaded prairie, standard tallgrass prairie restoration, restoration plus mulch, restoration using corn plants, and the Shaw Prairie. The Shaw Prairie served as the 'ideal' to which these treatments were expected to achieve. Our results indicate that mulch treatments had a positive effect on AMF diversity and soil factors during restoration while the corn treatment was relatively ineffective. Despite the corn treatment's lack of success in establishing AMF diversity, it does not rule out its effectiveness in the future. Perhaps, there was insufficient time allotted for the prairie to reap the benefits of its potential positive effects on AMF diversity.

Introduction

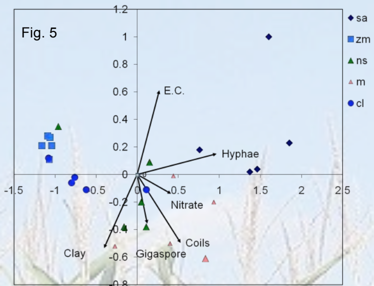
Ecosystems worldwide are threatened by invasive species. In tall grass prairies, Buckthorn (*Rhamnus cathartica*) can alter soil conditions and increase soil N to levels unsuitable for native flora, most of which rely on Arbuscular Mycorrhizal Fungi (AMF) for growth and survival. Recent studies, however, indicate that mulching may be an effective treatment in lowering soil N. Mulch establishes a C layer that hosts a variety of microbial communities that, in turn, may consume the excess N and potentially return the soil back to a healthy condition. Another unconventional- but hopeful- treatment is to plant corn. Corn is excellent at acquiring N, and is host to a wide variety of AMF. These traits have the potential to be an excellent stimulus to initiate AMF diversity during restoration.

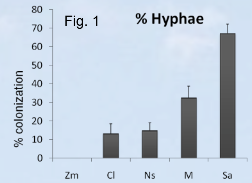
Materials and Methods

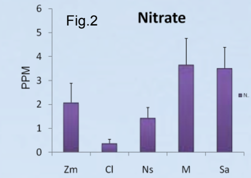
1. Sampling: we sampled *Aster* roots from Shaw Prairie (Lake Forest, IL), and *Aster* in Mulch and Ns, *Rhamnus cathartica* roots in Control treatments, and *Zea mays* roots in Corn treatment at the restoration site (Mettawa, IL).
2. Roots were stained with Trypan Blue and assessed for AMF colonization by microscopy.
3. Soil texture, EC, pH, ammonia, and nitrate analyses were performed using standard methods.
4. DNA was extracted from root samples using FastDNA® kit, purified with Wizard® PCR DNA purification system, and amplified using nested PCR: first with ITS4 and ITS1F primers, and then with AMF-specific primers, ACAU1660, ARCH 1330, LETC 1670, GIGA 5.8R, GLOM 5.8R, GLOM 1310.
5. Amplicons were then used in RFLP reactions with *HinfI* and *DpnII* endonucleases. RFLP fragment patterns were compared against a database of known AMF taxa to generate identities.

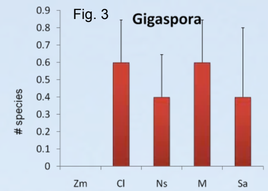
AMF Diversity

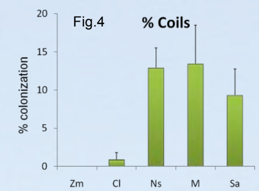
Family	Genus	Cl	Ns	M	Zm	Sa
Gigasporaceae	*Gigaspora*	2	2	3	0	1
	Scutellospora	2	0	1	1	1
Acaulosporaceae	*Acaulospora*	3	4	3	2	4
Archaeosporaceae	*Archaeospora*	2	2	2	2	1
Enterophosporaceae	*Enterophospora*	0	0	0	1	1
Glomaceae	*Glomus*	7	7	4	7	6
Paraglomaceae	*Paraglomus*	2	1	2	1	1
	Species richness	18	16	15	14	15
	Number of 'weedy' AMF species	5	5	5	5	2











Zm- Corn treatment
Cl- Control: untreated Buckthorn invaded prairie
Ns- Standard Buckthorn clearing treatment
M- Mulch treatment
Sa- Shaw Prairie

Hypotheses

We hypothesize that: 1) corn treatment will improve AMF diversity, and 2) Corn and Mulch will promote the return of an AMF community similar to a natural, high quality prairie.

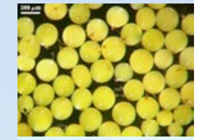
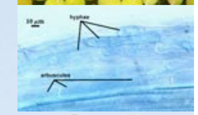
Synthesis

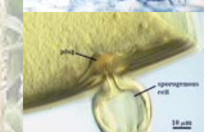
Our results refute the first hypothesis, i.e., planting does not promote AMF diversity. Out of five different treatments, corn had the lowest species richness (14 AMF species). In addition, hyphae (Fig.1) and coils (Fig. 4) were not detected in corn roots, indicating no apparent progression towards either mutualistic associations or native prairie conditions, in this case the Shaw Prairie. The corn roots also lacked *Gigaspora*, a genus of AMF that NMDS (Fig. 5) designated as a significant factor in achieving restoration success (Fig. 3; Table: AMF Diversity). Further, corn was associated with high soil NO_3 levels, which is not desirable (Fig. 2). We concluded that corn treatments would not benefit a prairie restoration.

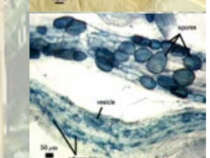
In contrast, it appears the mulch treatment could be beneficial. Thus, we accept the second hypothesis that mulch might promote the development of an AMF community similar to one in a natural high quality prairie (Shaw; Fig 5; Fig. 1-4, Table: AMF Diversity). Although mulch did not seem to produce an AMF community quite as diverse as the Shaw Prairie, patterns of root colonization by hyphae (Fig. 1) and coils (Fig. 4) along with soil NO_3 levels (Fig. 2) indicate that this treatment might promote nearly ideal conditions.

The AMF community is a dynamic component in restoration success. Studies show that AMF species tend to associate with particular plants (Eom et al. 2000), and AMF species richness correlates with plant species richness (Van der Heijden et al. 1998). As a result, the decreases in AMF species richness we observed may limit the regeneration of ecosystems that are contaminated with invasive plants. Further, there are particular AMF species that can be considered less mutualistic or "weedy", e.g., *Glomus intraradices* and *Glomus leptotichum* (Egerton-Warburton et al. 2007). These weedy species typically consume carbon and do not provide any nutritional benefit to the plant and, as a result, they can negatively affect restoration. Interestingly, in this study, all the restoration treatments contained significantly more weedy AMF species than a normal prairie environment (Table: AMF Diversity).

This study probed some of the components involved in restoring an ecosystem from the perspective of promoting the AMF community. We found that mulch was successful, and, on the other hand , observed corn's lack of success. However, we sampled in the second year of restoration using corn, and the corn plants were small. Perhaps, in the future- and after several years of corn cropping- corn might make a positive impact on restoration practices.



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