Daylilies: Perfect Perennial or Insidious Invader?

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Introduction

Exotic plants have been shown to alter soil ecosystems. As the exotic plant becomes established, they cultivate specific microbial communities in their rhizosphere and develop distinctive soil properties that may negatively influence the growth of other plants[1].

Hemerocallis (daylily) is a burgeoning invasive species[2] but little information exists on how *Hemerocallis* could modify belowground processes.

The goals of this study were to: 1) examine the environmental correlates of *Hemerocallis*; 2) test the functioning of the *Hemerocallis* soil microbe community; and 3) use these data to assess the invasive potential of *Hemerocallis* .

Methods

Collection of Samples
Soil and root samples were collected from under *Hemerocallis* plants (the sphere of influence) and adjacent plants in the Chicago Botanic Garden (*n*=20).

Mycorrhizal root colonization
Percent root colonization was determined for the 20 *Hemerocallis* stands.

Environmental correlates
Comparison of fungal: bacterial ratio, extracellular enzymes of C and N cycling, levels of soil C, N and P under *vs* outside stands.

Functioning
Zea mays bioassay: root, shootbiomass, shoot N, and mycorrhizal root colonization measurements were collected.

Results

Mycorrhizal Root Colonization in *Hemerocallis*

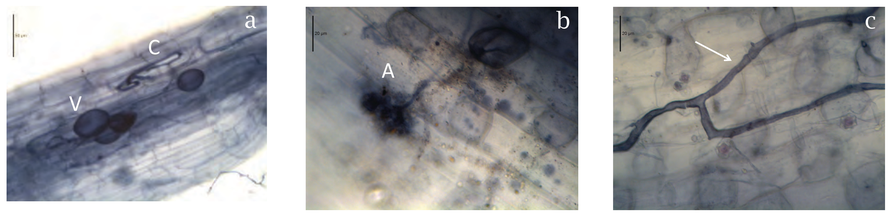

Figure 1: Mycorrhizal structures seen: (a) Coil (C), vesicles (V); (b) arbuscule (A); (c) hyphae.

Environmental Correlates of *Hemerocallis*

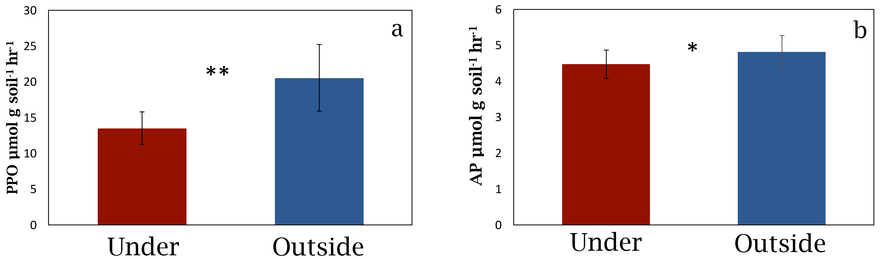

Figure 2: Mean activity of (a) phenol oxidase (PPO) and (b) acid phosphatase (AP) enzymes under and outside of *Hemerocallis* stands. **means differ significantly at p<0.05; *means differ significantly at p<0.10.

Hemerocallis Microbial Community Functioning

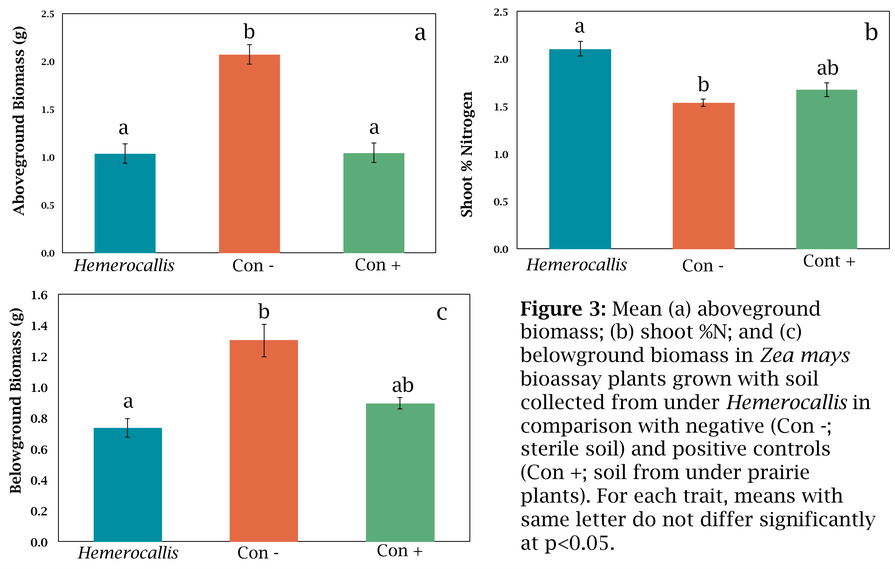

Figure 3: Mean (a) aboveground biomass; (b) shoot %N; and (c) belowground biomass in *Zea mays* bioassay plants grown with soil collected from under *Hemerocallis* in comparison with negative (Con -; sterile soil) and positive controls (Con +; soil from under prairie plants). For each trait, means with same letter do not differ significantly at p<0.05.

Results

Mycorrhizal root colonization. *Hemerocallis* roots were highly colonized by arbuscular mycorrhizal fungi (Fig. 1). On average, roots were primarily colonized by hyphae (50.5%) and vesicles (28.7%) with lower levels of colonization by coils (15.2%) and arbuscules (5.4%).

Environmental correlates. There was no significant difference in fungal: bacterial ratio, levels of soil C, N and P between soils under *versus* outside the *Hemerocallis* stand. Only the activity of two enzymes, phenol oxidase (PPO; Fig. 2a) and acid phosphatase (AP; Fig. 2b), differed with activity significantly higher outside *versus* under *Hemerocallis*.

Microbial community functioning. Plants grown with *Hemerocallis* rhizosphere soils had significantly reduced above- (Fig. 3a) and belowground biomass (Fig. 3c) and increased shoot %N (Fig. 3b) in comparison to the controls. There was no significant relationship between mycorrhizal root (hyphae, vesicles, coils, arbuscules) and above- and belowground biomass, or shoot %N. (p>0.05).

Conclusions

***Hemerocallis* has the potential to be an effective invader by modifying soil nutrient cycling and the growth of plants.**

The reduction in PPO and AP activity under *Hemerocallis* suggests that rhizosphere microbes produce lower levels of enzymes required to break down recalcitrant litter (PPO) and solubilize P (AP). These changes may disrupt soil C and P cycling.

Microbial communities associated with *Hemerocallis* also suppressed the growth of plants. Changes in mycorrhizal abundance do not appear to be part of the invasive process.

Future directions: Future studies on *Hemerocallis* should incorporate the use of DNA-based tools to determine if there has been a shift in the microbial community. Additionally, future studies should include larger samples sizes to further investigate established trends and encompass variations in the samples.

Citation

[1] Wolfe, B. E., & Klironomos, J. N. (2005). Breaking new ground: Soil communities and exotic plant invasion. *BioScience*, *55*(6), 477–487. http://doi.org/10.1641/0006-3568(2005)055[0477:BNGSCA]2.0.CO;2

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