The Effects of Wild (Native) Mycorrhizae Compared to Commercial Mycorrhizae Inoculants on Cool-season Grasses (*Bromus inermis* and *Elymus canadensis*)

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Introduction/Background

- Mycorrhizal fungi form symbiotic relationships with host plants, typically increasing nutrient and water uptake of the host, increasing host plant growth, and protecting host plants from root pathogens and herbivores (5).
- Arbuscular mycorrhiza (AM) is the most abundant type of mycorrhizal fungi available for association with plants (3), although, ectomycorrhiza (ECM) can also influence host plants that associate with it.
- Based on previous studies (1,6) it is known that, unlike warm-season grasses, cool-season grasses are not obligate mycrotrophs and do not show significantly increased biomass or root colonization when associated with mycorrhizae.
- Cooler temperatures are shown to have an effect on metabolic activity of AM and spore germination of the fungi (1).
- *Bromus inermis* (smooth bromegrass) and *Elymus canadensis* (Canada wild ryegrass) are two common cool-season grasses from various parts of the world—Europe and Canada, respectively.
- As shown to be true in previous studies (2), sympatric and allopatric environments can influence the response of the host plant to the mycorrhizae present in the soil.
- AM fungal communities colonize and function most effectively in their native soils (4).
- Due to the symbiotic relationship between mycorrhizae and host plants, many commercial forms of mycorrhizal fungi have been introduced to the market.

Research Question/Hypothesis

How do commercial mycorrhizae inoculants (Plant Success Endo- and Ecto-Mycorrhizae) compare with wild (native) mycorrhizae in terms of their effect on cool-season grass (*B. inermis* and *E. canadensis*) biomass?

B. inermis is not expected to experience an increase in biomass with either the commercial or native mycorrhizae. However, *E. canadensis* is expected to experience an increase in biomass when grown in "living" soil with wild mycorrhizae present.

Methods

Soil preparation

- Soil was collected and a portion was sterilized to remove any native mycorrhizal fungi colonies and other microorganisms in the soil.

Plant preparation

- 48 seedlings (24 seedlings per species; *B. inermis* and *E. canadensis*) were transplanted into four treatment groups with six replicates per group:

B. inermis

	Living soil	Sterile soil
Inoculated	LI	SI
Not inoculated	LN	SN

E. canadensis

	Living soil	Sterile soil
Inoculated	LI	SI
Not inoculated	LN	SN

Commercial mycorrhizal fungi inoculation

- For each plant containing commercial inoculum, spores were added to the soil (living and sterilized) during the transplanting process.

Experimental design

- The grasses were completely randomized to reduce interference of environmental factors in results and kept in a laboratory environment.
- Blade height and SPAD measurements were taken and recorded once weekly throughout the experiment. Aboveground and belowground biomasses were recorded at the end of the experiment.
- Statistical analysis was performed using a two-way ANOVA test.

Results

Legend	
Plant Species	**Treatment Group**
Bro: *Bromus inermis*	LI: Living soil/Inoculated
EC: *Elymus canadensis*	LN: Living soil/Not inoculated
	SI: Sterile soil/Inoculated
	SN: Sterile soil/Not inoculated

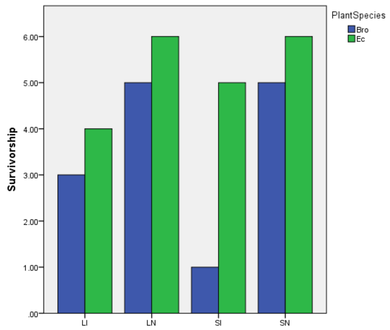


Figure 1: Plant survivorship of each species per treatment group.

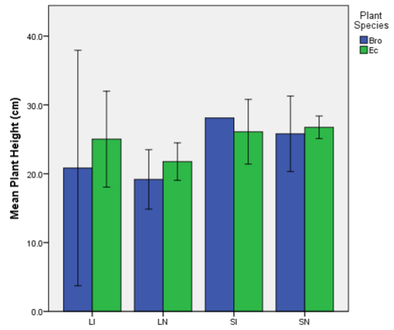


Figure 2: Mean plant height (cm) per treatment group at the end of the experiment.

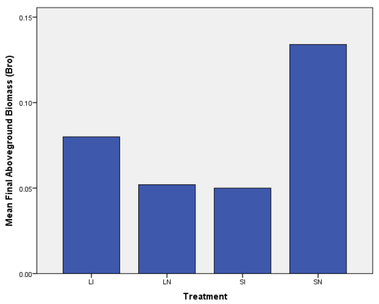


Figure 3: Mean final aboveground biomass (g) of *B. inermis* per treatment group at the end of the experiment.

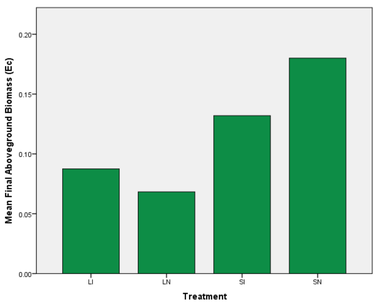


Figure 4: Mean final aboveground biomass (g) of *E. canadensis* per treatment group at the end of the experiment.

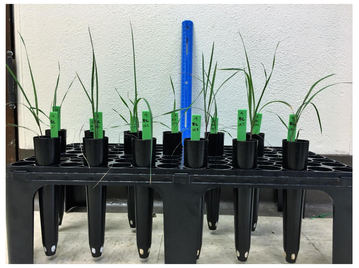
- As shown in the figure 1, *B. inermis* did not survive well under the SI conditions while *E. canadensis* plants survived best in LN and SN conditions. Both plant species showed a higher survivorship in non-inoculated soil.
- Figure 2 illustrates when placed in sterile soil conditions (SI and SN), both plant species grew taller with less variation than under living soil conditions (LI and LN).
- When the data from figure 3 was analyzed, a significant difference (F= 5.023, P= 0.49) was found between aboveground biomass of *B. inermis* and soil treatment (living soil or sterile soil).
- The data from figure 4 was analyzed and revealed a significant difference (F= 4.955, P= 0.04) between the aboveground biomass of *E. canadensis* and soil treatment (living soil or sterile soil).

Conclusions/Discussion

- Our findings demonstrate that mycorrhizal colonization, regardless of origin (native or commercial), did not have a positive impact on the growth of *B. inermis* and *E. canadensis* via blade height, aboveground biomass, or belowground biomass (P>0.05).
- However, a significant relationship was found between each plant species and the soil treatment: sterile or living (F= 11.651, P= .002). According to our findings, both species experienced an increase in growth (aboveground biomass and blade height) when grown in sterile soil.
- **Overall, it appears that *B. inermis* and *E. canadensis* do not experience a significant increase in biomass to either the native or commercial mycorrhizae (P>0.05).**

E. canadensis (front) and *B. inermis* (back) LI treatment group at end of experiment

E. canadensis (front) and *B. inermis* (back) LN treatment group at end of experiment



E. canadensis (front) and *B. inermis* (back) SI treatment group at end of experiment

E. canadensis (front) and *B. inermis* (back) SN treatment group at end of experiment

Literature Cited

1. Hetrick, B.A.D., G.W.T. Wilson., and A.P. Schwab. 1994. Mycorrhizal activity in warm- and cool-season grasses: variation in nutrient-uptake strategies. Canadian Journal of Botany-Revue Canadienne de Botanique 72: 1002–1008.
2. Rua, M. A., Antoninka, A., Antune, P. M., Chaudhary, V. B., Gehring, C., Lamit, L. J., Piculell, B. J., Bever, J. D., Zabinki, C., Meadow, J. F., Lajeunee, M. J., Milligan, B. G., Kart, J., and Jaon D. Hoekema. 2016. Home-field advantage? Evidence of local adaptation among plants, soil, and arbuscular mycorrhizal fungi through meta-analysis. BMC Evolutionary Biology 16: 122-137.
3. Wang, B. & Qiu, Y.L. 2006. Phylogenetic distribution and evolution of mycorrhizas in land plants. Mycorrhiza 16: 299. doi:10.1007/s00572-005-0033-6
4. Weinbaum, B.S., M.F. Allen, and E.B. Allen. 1996. Survival of arbuscular mycorrhizal fungi following reciprocal transplanting across the great basin, USA. Ecological Applications 6: 1365–1372.
5. Weremijewicz, J., and Seto, K. 2016. Mycorrhizas influence functional traits of two tallgrass prairie species. Ecology and Evolution 6(12): 3977-3990.
6. Wilson, G.W.T., and D.C. Hartnett. 1998. Interspecific variation in plant responses to mycorrhizal colonization in tallgrass prairie. American Journal of Botany 85: 1732–1738.

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