Experimental design

Soil was collected from underneath:

- Large lupines (“lupine” type)
- Native grassland (“grassland” type)
- Individuals of Bromus diandrus (not pictured) (“invaded” type)

The majority of the soil was sterilized using an autoclave, and then half of each soil type was re-inoculated with 1/3 volume unsterilized soil to create “live” and “sterile” subtypes.

20 seeds of B. diandrus were sown on live and sterile soil of all three types. 20 seeds of H. brachyantherum were sown on live and sterile soil from lupine and grassland types. Emergence was recorded, and dry biomass measured after 42 days.

RESULTS: Biomass accumulation

- Biomass accumulation of both species was higher on lupine soil than other soils ($P = 0.0005$ overall; Fig. 1.1, 1.2), due to higher nitrogen content in the lupine soil.
- While B. diandrus biomass increased slightly on live grassland and invaded soils, it decreased on live lupine soil (Fig. 1.1).
- On native grassland, B. diandrus has a distinct advantage: Biomass increased 21.3% in the presence of soil biota. H. brachyantherum biomass decreased 12.9% in live soil (Fig. 2). Is B. diandrus experiencing enemy release?
- This advantage decreased on invaded soil - does B. diandrus accumulate specific pathogens over time?

RESULTS: Time until emergence

- Differences in the length of time until emergence were not significant between soil types.
- However, an interesting trend was noted: B. diandrus emerged faster on live soil, and H. brachyantherum emerged faster on sterile soil ($P = 0.13$, Fig. 5).
- Is there an advantage to germinating faster in the presence of soil biota?

RESULTS: Rate of emergence

- Emergence of both species was higher on sterile soil ($P = 0.001$ overall, Fig. 3.1, 3.2).
- However, for B. diandrus there were no significant differences between live and sterile for individual soil types. Live lupine soil reduced emergence the most ($P = 0.09$ compared to sterile lupine soil, Fig. 3.1).
- H. brachyantherum emergence decreased significantly on live grassland soil ($P = 0.001$), but not significantly on live lupine soil ($P = 0.3$, Fig. 3.2).
- B. diandrus emergence increased 26.7% in sterile lupine soil; H. brachyantherum increased 58.3% in sterile grassland soil (Fig. 4).

Conclusions

Although biomass accumulation of B. diandrus is increased by the elevated nitrogen in lupine soil, lupine soil fosters biota which negatively impact B. diandrus compared with surrounding microhabitats. Similar to the effect on biomass, emergence of B. diandrus was most inhibited by lupine soil biota, while H. brachyantherum was most inhibited by native grassland soil biota.

In native grassland, soil biota give B. diandrus an advantage over the native H. brachyantherum, but this advantage is not present in lupine rhizospheres where antagonists exist. In addition, the increase in biomass of B. diandrus seen in native grassland soil declines in grassland where B. diandrus is already established.