Competition and Allelopathy in Invasive *Lespedeza cuneata*

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Abstract. Invasive species such as *Lespedeza cuneata* (sericea) can have detrimental effects on invaded ecosystems. One proposed explanation for invasive success such as sericea is production of allelopathic chemicals that suppress adjacent native species. We tested this hypothesis in a greenhouse experiment in which a native grass was grown with sericea and alone. Three different treatments were factored among the pots. These treatments include different soil histories, autoclaving the soil, and an extract made from mature sericea. After twelve weeks plants were collected, dried and biomass recorded. Results indicated that the soil history has an effect on sericea biomass. This suggests that sericea may be able to change the soil microbial communities over time, leading to long-term negative effects on surrounding native plants.

1. Introduction

Lespedeza cuneata (sericea) is an invasive plant that has strong negative effects on native prairie species. Sericea is an Asian legume introduced in the 1930s to the U.S. as erosion control and forage, but it can form dense monocultures. One proposed explanation for the invasive success is that sericea produces allelopathic chemicals that suppress native species. Sericea may also have a competitive advantage due to physiological traits.

To examine the underlying reasons for this high invasiveness, two primary questions were posed:
1. Does sericea have a negative chemical (allelopathic) effect on indiangrass (*Sorghastrum nutans)*, a dominant native grass?
2. Does this potential allelopathic interaction operate by directly affecting neighbor plants or through changes to soil microbial communities?

2. Experiment, Results, Discussion and Significance

Design

To test the research questions, a greenhouse experiment was designed. The soil used was collected from 18 experimental plots at the University of Kansas Field Station (KUFS) near Lawrence, KS, that were dominated by Indiangrass. In nine plots, sericea had previously been sown and allowed to grow for three years while the other plots had unsown controls (Houseman, unpublished data). Half of soil from each group was autoclaved. This included autoclaving the soil at 121 degrees Celsius for 30 minutes on three consecutive days to sterilize the soil [1]. The soil of both types was then distributed into 262 mL sterile containers.

Due to typically low germination rates of legumes in the lab, the sericea seeds underwent a sulfuric acid scarification before sowing. The seeds were sown directly into the pots, covered with a thin layer of soil, and thinned one week after germination to two plants per pot (either two indiangrass, or one indiangrass and one sericea) [2].

An additional treatment included an extract from ten, adult sericea plants also collected at the KUFS. This treatment was intended to detect allelopathic effects. Leaves and roots from each plant were rinsed with distilled water and then soaked in distilled water at a ratio of 1gram biomass per 20 mL water. After forty-eight hours, the solution was filtered to remove particulates and 2 mL of extract was applied to the base of each plant once a week [2]. The plants not receiving extract received 2 mL of water as a control. Each treatment was replicated nine times. Plants grew for twelve weeks, after which each plant was removed from the pot, dried, and massed. Data were analyzed with a three-way split plot ANOVA with soil history as the whole plot and autoclaving and extract as split plot factors.

Results

There were two primary results of interest. First, sericea biomass increased when grown in soil with a sericea history as opposed to a soil with a history of native species alone ($F_{1,\ 16}=4.79$, $P=0.04$). This may indicate that sericea is able to condition the soil over time to facilitate its own growth. Second, autoclaving increased the biomass of indiangrass regardless of soil history ($F_{1,\ 112}=101.19$, $P=<0.001$), and furthermore, the biomass of indiangrass increased more in the autoclaved soil that had a history of sericea rather than the soil with a native plant history ($F_{1,\ 112}=3.93$, $P=0.0499$).

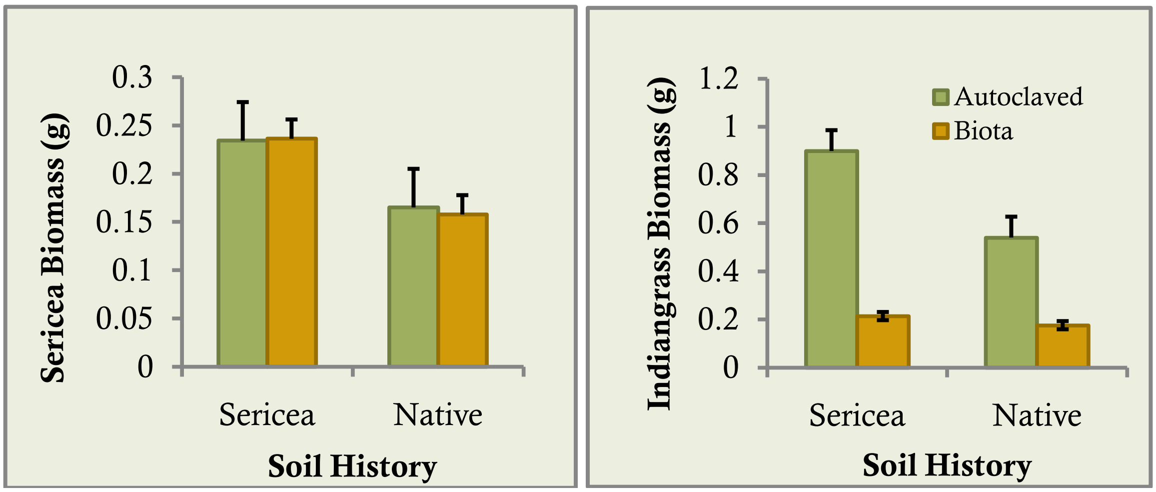

Figure 1: Effect of soil history on sericea and indiangrass biomass.

3. Conclusions

Soil with a history of sericea has a positive effect on the sericea grown in that soil, leading to an increase in biomass of the sericea. This may indicate a positive feedback in which sericea is able to foster its own growth by altering the soil conditions. Soil history does not affect growth of indiangrass unless the soils are autoclaved. Additional experiments are underway to test whether these effects are due to changes in soil nutrients or microbial communities.

By identifying the specific mechanisms that sericea uses to suppress native species, we hope to design new control measures for this problematic grassland invader.

4. Acknowledgements

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References

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