

How does climate change affect endophytic fungi?

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Introduction

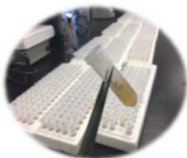
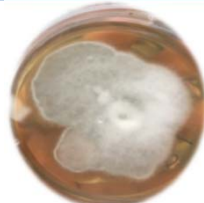
- Plant-associated microorganisms can have major effects on plant health (e.g., growth, pathogen defense)
- Climate change can affect plant microbiomes
 - Ex: Elevated CO₂ concentration in the atmosphere increased populations of nitrogen-fixing rhizobia bacteria in white clover roots (Grover et al. 2015)
- It is unknown how climate change will affect aboveground plant-associated microorganisms, such as foliar endophytic fungi
 - Foliar endophytic fungi are microbial colonizers of all plant species sampled to date

Hypothesis

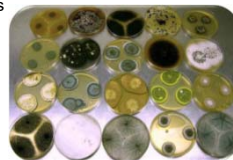
- We hypothesize that **increased CO₂ concentrations will increase species richness and diversity in endophytic fungal communities**, because increased plant photosynthesis under elevated CO₂ will increase the resources available to the fungi

Methods

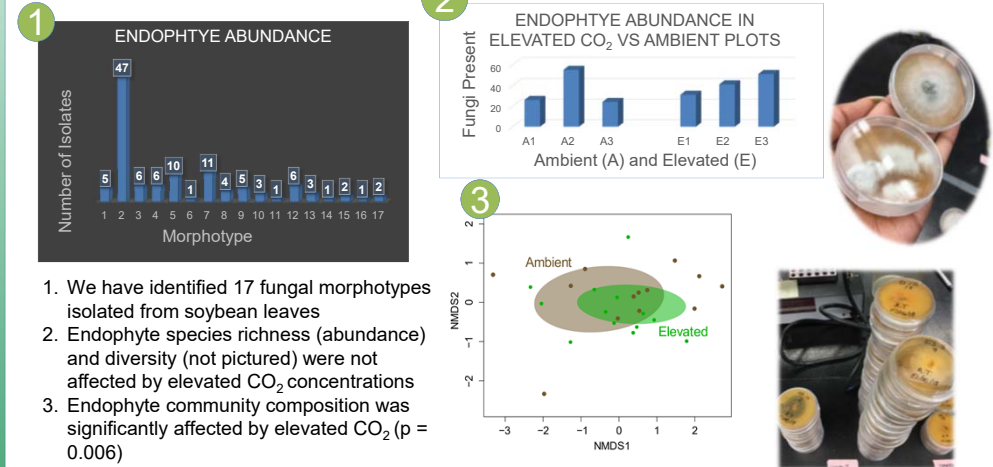
- 1 Collect plant samples**
 - Soybean (*Glycine max*) leaf samples were collected from 3 ambient plots and 3 elevated CO₂ plots at the SoyFACE research facility. 15 samples were taken from each plot (total N=90).
- 2 Cut & surface-sterilize**
 - Leaves were cut into 0.8cm x 0.8cm pieces and further cut into 16 2mm x 2mm pieces
 - Placed in tea strainers and rinsed in ethanol, bleach, and water
- 3 Culture fungi**
 - Individual leaf segments were placed into tubes containing malt extract agar (called slants)
 - 1,440 slants were made containing ambient and enriched CO₂ plant samples



- 4 Subculture fungi**
- Morphotyping**
- DNA extraction**
 - Fungi growing in slants were transferred to agar plates
 - Fungi were classified into morphotypes to be compared and evaluated before DNA extraction to find if there is species diversity, richness, and composition of endophyte communities



Results



1. We have identified 17 fungal morphotypes isolated from soybean leaves
2. Endophyte species richness (abundance) and diversity (not pictured) were not affected by elevated CO₂ concentrations
3. Endophyte community composition was significantly affected by elevated CO₂ (p = 0.006)

Specific endophytes of interest:

- Morphotype 2 (the most common morphotype) was isolated 39 times from elevated CO₂ plots, but only 9 times from ambient plots
- Morphotypes 4 and 9 also showed greater isolation rate from elevated CO₂ plots than ambient plots, while Morphotypes 11, 16, and 6 were only found in elevated plots.

Conclusions

- Elevated CO₂ affects the composition of communities of fungi colonizing soybean leaves, but not their overall abundance and diversity

Future Work

- Ongoing DNA extraction will confirm morphotype assignment and assign species names to fungi
- Endophytes isolated from elevated CO₂ and ambient plots will be re-inoculated onto soybean hosts to test for their different effects on soybean health and growth
- Our work informs engineering of plant microbiomes that could help protect plants against the effects of climate change

References

Olbrich et al. 2010. "Ozone fumigation reduces leaf infestation following natural and artificial inoculation by the endophytic fungus *apiognomonina errabunda* of adult European trees." Environmental Pollution.

Hewitt et al. 2016 "N-fixation in legumes - An assessment of the potential threat posed by ozone pollution." Environmental Pollution.

Grover et al. 2015 "Elevated CO₂: plant associated microorganisms and carbon sequestration". Applied Soil Ecology.

Acknowledgments

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