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Time and Environment Influence Abundance of Fungal Microbe Associated with Sagebrush Leaves

Rachel Capezza  
*Boise State University*

Jacob Heil  
*Boise State University*

Leonora Bittleston  
*Boise State University*
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Abstract
The leaf tissues of plants host a myriad of microbes that can influence plant health. Our research investigates the leaf microbiome of sagebrush (Artemisia tridentata), a foundational species within its ecosystem. The sagebrush ecosystem is vulnerable to many anthropogenic stressors such as climate change and increased fire frequency. Discovering the community dynamics of the microbes associated with sagebrush leaves can inform our understanding of their role in sagebrush health and potentially lead to novel methods for ecosystem management. In this study, we focused on Aureobasidium pullulans, a pigmented yeast-like fungus identified on our sampled sagebrush leaves via culturing and DNA sequencing. Here, we seek to quantify abundance of A. pullulans on the sagebrush leaf microbiome and determine how environmental and temporal factors may influence both its absolute and relative abundance. Using photos of confirmed A. pullulans for reference, we used image data of previously cultured samples to morphologically match and record all instances of A. pullulans from March-October 2021. Weather data variables were acquired from the Dry Creek Lower Weather Station near Boise, Idaho, adjacent to our sagebrush sampling site. We found a negative correlation of the microbe's absolute abundance with both air temperature and precipitation, but no correlation with wind speed. No significant differences were found for relative abundance across plants or leaf type. Significant differences were found in both relative and absolute abundance of A. pullulans across sampling dates. These results demonstrate that time and environment both influence abundance of A. pullulans within the microbial community of sagebrush leaves. This study sets the stage for future research into understanding the functional role of A. pullulans in the sagebrush leaf microbiome, and by extension, its impact on the sage-steppe ecosystem.

This student presentation is available at ScholarWorks: https://scholarworks.boisestate.edu/under_showcase_2022/25
BACKGROUND

Sagebrush ecosystems are threatened by environmental stressors
Plant-associated microbes influence plant health
*A. pullulans* is a yeast-like fungus of the phylum Ascomycota
Commonly associated with plant microbiome
Identified on sagebrush leaf microbiome
Extremotolerant
able to persist in inhospitable environmental conditions
Natural fungicide
produces pullulan, an industrially important compound commonly used as a food additive
ability to produce melanin, a protective mechanism against harmful UV rays
May extend protective benefits to plant hosts
potential for ecosystem restoration

This study’s objective is to quantify the absolute and relative abundance of *A. pullulans* and analyze how time, host factors, and weather variables influence the population dynamics of the the sagebrush-associated microbe.

METHODS

Weather Variables
- precipitation
- wind speed
- air temperature

Host Factors
- host plant
- leaf type

Use photos of *A. pullulans* isolates confirmed by DNA extraction and sequencing as reference
Based on similar morphology, identify *A. pullulans* among all previously subcultured isolates
Cross-reference plate ID with morphospecies count data to determine abundance (in CFUs)
Graphically and statistically compare abundance to environmental and temporal factors

RESULTS

- No significant differences were found in absolute or relative abundance across plants (Fig. 1) or leaf type.
- Absolute and relative abundance of *A. pullulans* differed significantly across sampling dates (Fig. 2, p = 4.5 x 10^-7 and Fig. 3, p = 1.5 x 10^-6, respectively).
- Negative correlations existed between absolute abundance of *A. pullulans* and air temperature (Fig. 4, p = 2 x 10^-10) as well as precipitation (Fig. 5, p = 4.23 x 10^-2), while no correlation was found between abundance and wind speed.
- No correlations between relative abundance and weather variables were found.

Future Work

- Gain a more comprehensive picture of the dynamics of *A. pullulans* within the sagebrush leaf microbiome by analyzing data that encompasses a full year of cultures
- Perform more DNA extractions and sequencing to improve identification accuracy of *A. pullulans* isolates
- Determine whether morphology of *A. pullulans* is influenced by temporal or environmental factors
- Investigate potential interactions between *A. pullulans* and other microbes within the phyllosphere community
- Isolate experimental sagebrush with *A. pullulans* to determine whether it affects plant growth, defense, or health

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References