Characterizing ammonia oxidizing communities under legumes and non-legume plants in the Sonoran Desert
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INTRODUCTION
- Nitrogen (N) from the atmosphere can be converted to ammonium (NH₄⁺) by the process of nitrogen fixation.
- Microorganisms that oxidize ammonia are called ammonia oxidizers, they possess specialized enzymes, such as ammonia monoxygenases [1, 2].
- Ammonia oxidation studies enhance the knowledge about the relationship between ammonia oxidizer communities and the environment.
- N-fixation, which occurs via N-fixing bacteria in legume root nodules, free-living microorganisms in soil, and mineralization increases NH₄⁺ in soil [3].
- Increased NH₄⁺ in soil is expected to lead to higher ammonia oxidation rates.

RESEARCH QUESTION
What is the difference between the function of ammonia oxidizing microbial communities under legume and non-legume plants?

HYPOTHESIS
An elevated concentration of nitrogen in the soil signifies higher ammonia oxidizer abundance and ammonia oxidizing rates.
- Due to the additional NH₄⁺ available from N fixation, we expected the nitrogen fertilized soil under non-legume (non-legume + N) to have the highest ammonia oxidation rates, followed by the legume soil.
- Soil samples were collected at a depth of 5cm from below the canopy of treatment plants.
- The treatments are: control mesquite (legume; Fig. 4), control ambrosia (non-legume; Fig. 5), and nitrogen fertilized ambrosia (non-legume + N).
- Nitrogen fertilized soil receives 60kg of N/hectare/year [1].
- Nitrification potential [2] was used to analyze the rate at which the ammonia oxidizing bacteria oxidized NH₄⁺ into nitrite (NO₂⁻) at 0, 2, 4, 6 hrs (Fig. 6).

METHODS
- Samples were collected at South Mountain Park-East (SME) in Phoenix, AZ (Fig. 3).
- Soil samples were collected at a depth of 5cm from below the canopy of treatment plants.
- The treatments are: control mesquite (legume; Fig. 4), control ambrosia (non-legume; Fig. 5), and nitrogen fertilized ambrosia (non-legume + N).
- Nitrogen fertilized soil receives 60kg of N/hectare/year [1].

RESULTS
Are ammonia oxidation rates higher in non-legume + N than in the legume treatments?
- Rates of ammonia oxidation are not significantly different between legume, non-legume, and non-legume + N.
- Soils under legumes appear to have higher mean rates of ammonia oxidation than non-legume soil. (n=5)

DISCUSSION
- Non-legume + N (N-fertilized soil) results were lower than expected.
- Even though N-fertilized soils are treated with significant amounts of nitrogen, they are not as fertile as soil under legumes.
- After soils are fertilized;
  - Fate 1: N is not retained and it does not accumulate, hence, microorganisms are not able to utilize it.
  - Fate 2: Even though it is fertilized, ammonia oxidizing communities have not adapted to fertilized environment, therefore not reacting to the nitrogen.
  - Fate 3: Ammonia oxidizers adapt to the new conditions. However, we did not see this response after sampling in only one location.
- Soil under legumes provide a fertility spot for microorganisms, where nitrogen fertilization does not compare to a natural soil.

PROSPECTIVE EXPERIMENTS
- We will collect new samples from three locations to account for the heterogeneity across different soil types. Fig. 3 black circles indicate the two new locations: White Tank Mountain (WTM) and Salt River Recreation (SRR).

REFERENCES
3. Fig. 4 & 5. cas.ucsb.edu & fireflyforest.net

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Fig. 1 & 2 represent hypothesized patterns.