Soil bacteriome composition under increasing cover crop densities and diversities

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Sustainable Agriculture

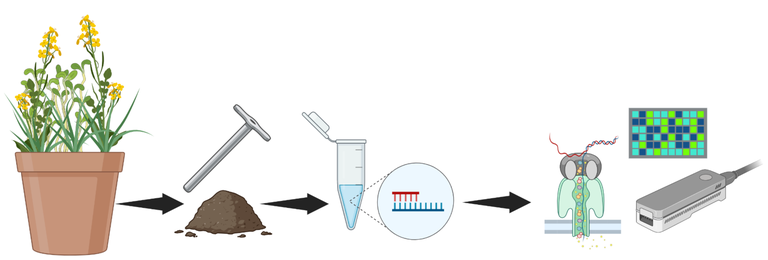
- **Cover crops** are plants grown to improve **soil health**, not necessarily for harvest/profit
- Ex. Alfalfa-nitrogen, fescue-organic carbon, brassica-antimicrobials
- Higher forage biomass increases cover crop effectiveness
- **Monoculture**-one crop, intraspecific competition, leads to issues like **soil exhaustion**
- **Polyculture**-two or more crops, intraspecific competition, mimics natural systems and **effectiveness depends on plant mixture**
- **Plants recruit specific beneficial microbes** based on their environment, **but the effect of** how competition or facilitation of **neighboring plants influence the plant recruitment of soil microbes is understudied**

Aim: To identify correlations between microbial species and enhanced cover crop biomass under different monoculture and polyculture conditions as density increased

We hypothesize that an increased plant density and diversity increases bulk soil bacteriome diversity and functionality with plant biomass indicating plant co-existence

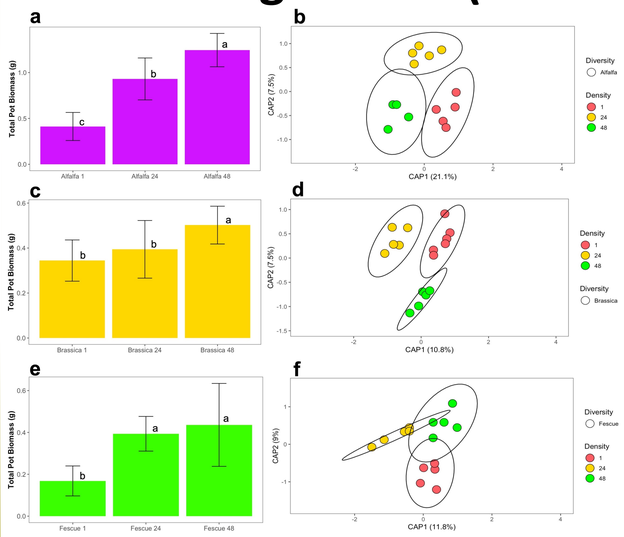
Microcosm – Simplified and Representative

- **Greenhouse experiment**
- **Autoclaved soil**
- **Irrigated with DI water**
- **3 Cover crops: alfalfa, brassica, and fescue**
- **3 Densities: low (1-3 plants, medium (24 plants, and high (48 plants)**



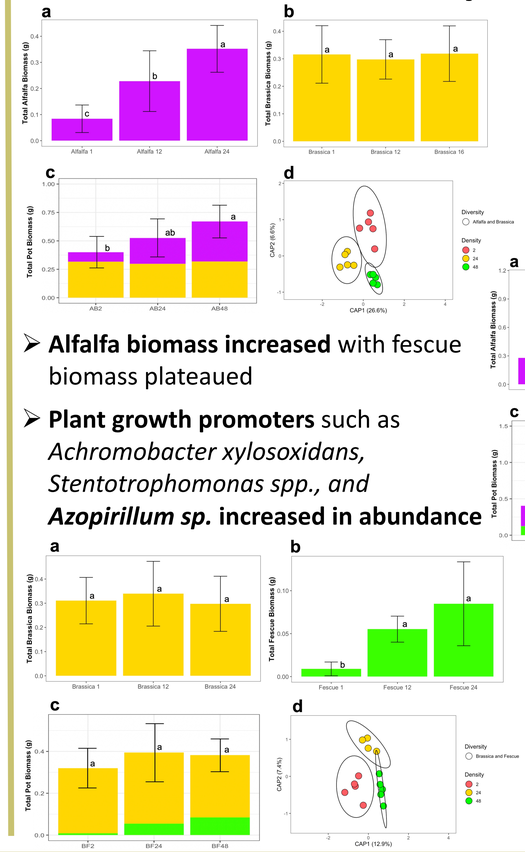
- **Plants, bulk soil collection, DNA Extraction, Nanopore sequencing**

Single Plant (Monocrop)



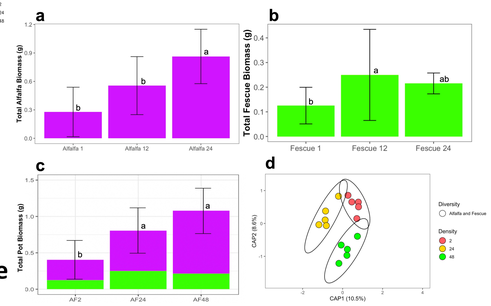
- Total pot **biomass increased as density increased** for all monoculture trials
- **Monoculture** plantings of **brassica** were associated with ***Azospirillum* spp.**
- **Fescue** associated with ***Ensifer adhaerens***
- **Alfalfa** with both bacterial taxa. ***Azospirillum* spp.** and ***Ensifer adhaerens*** which have been previously identified as free-living nitrogen fixers.

Two Plants (Polycrop)



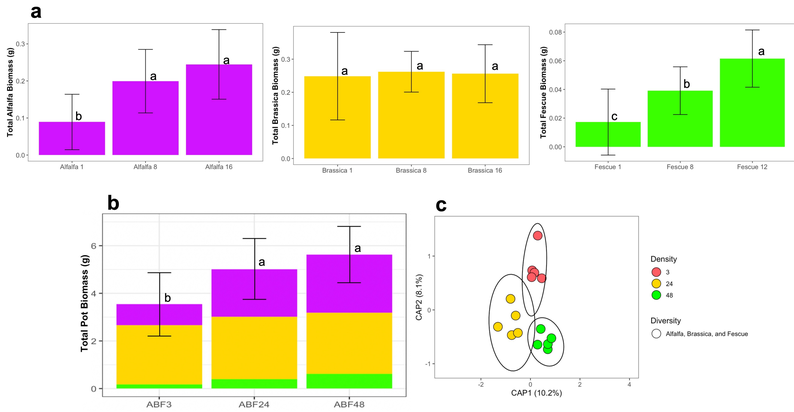
- **Alfalfa biomass increased** with fescue biomass plateaued
- **Plant growth promoters** such as *Achromobacter xylosoxidans, Stentotrophomonas spp., and* ***Azopirillum sp.*** **increased in abundance**

- **Alfalfa biomass increased** with **brassica biomass unchanged**
- ***Azospirillum* spp. did not increase with plant density**
- Denitrifier *Pseudomonas stutzeri* increased in abundance

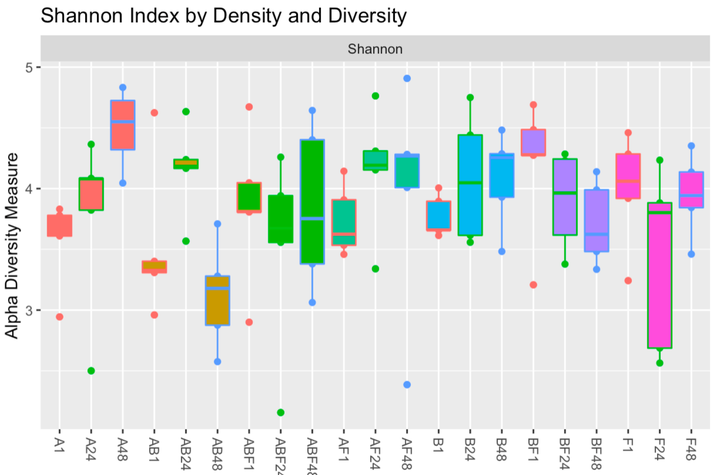


- Fescue biomass increased with **brassica biomass unchanged**
- Nitrogen fixing species **Ensifer adharenes and Azospirillum brasilense** were in increased abundance, which was **similar to monocultures**

Three Plants (Polycrop)



- Three plant mixtures showed a significant **increase of abundance of *Planctomyces* sp. SH-PL14 and *Sandaracinus amylolyticus***



- **Shannon diversity** was **not** consistently **higher in increasing densities or plant diversities**

Main Findings

- **Polycultures highlighted different bacterial taxa** than their respective monocultures, however, abundancies of the same bacteria often increased with plant density within the same polyculture
- **Facilitation was best supported for the alfalfa-fescue** polycrop as the total above ground biomass was the highest of any mixture
- Plant growth promoting rhizobacterium such as *Achromobacter xylosoxidans*, *Stentotrophomonas* spp., and *Azospirillum* sp. increased for higher plant densities