CROPPING ALFALFA TO ENHANCE ABOVE AND BELOWGROUND BIODIVERSITY

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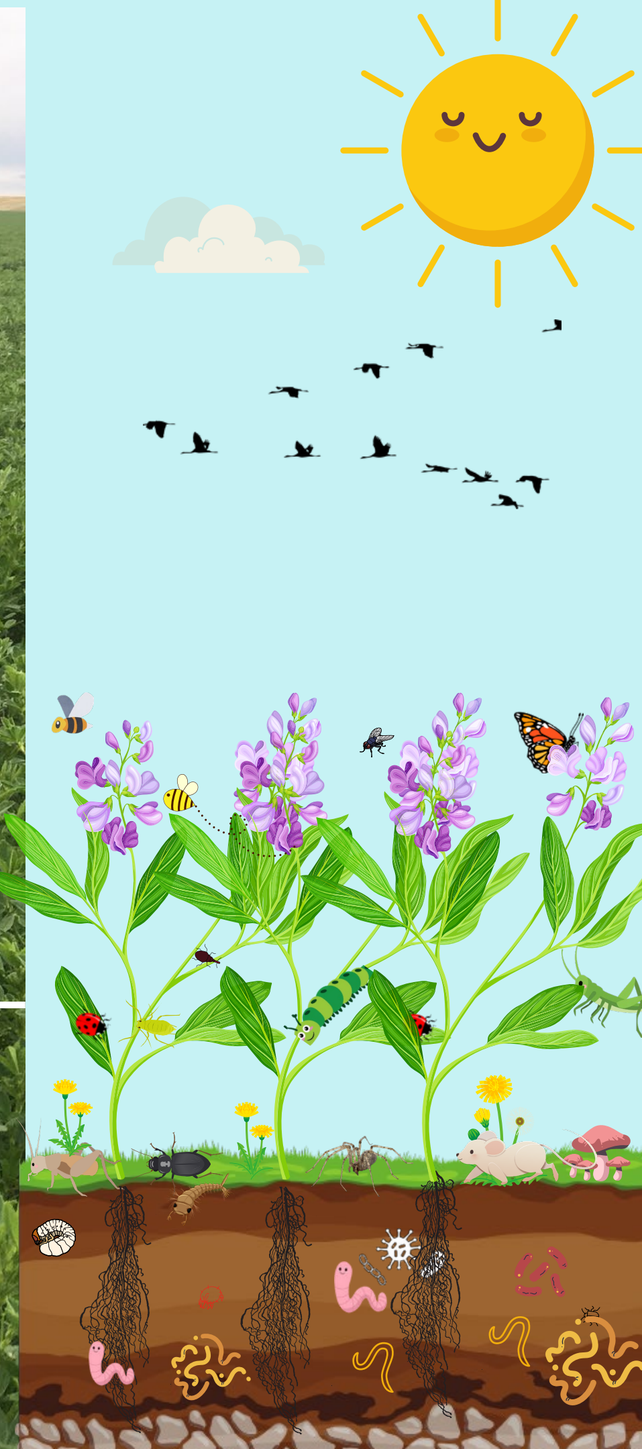
NDSU NORTH DAKOTA STATE UNIVERSITY

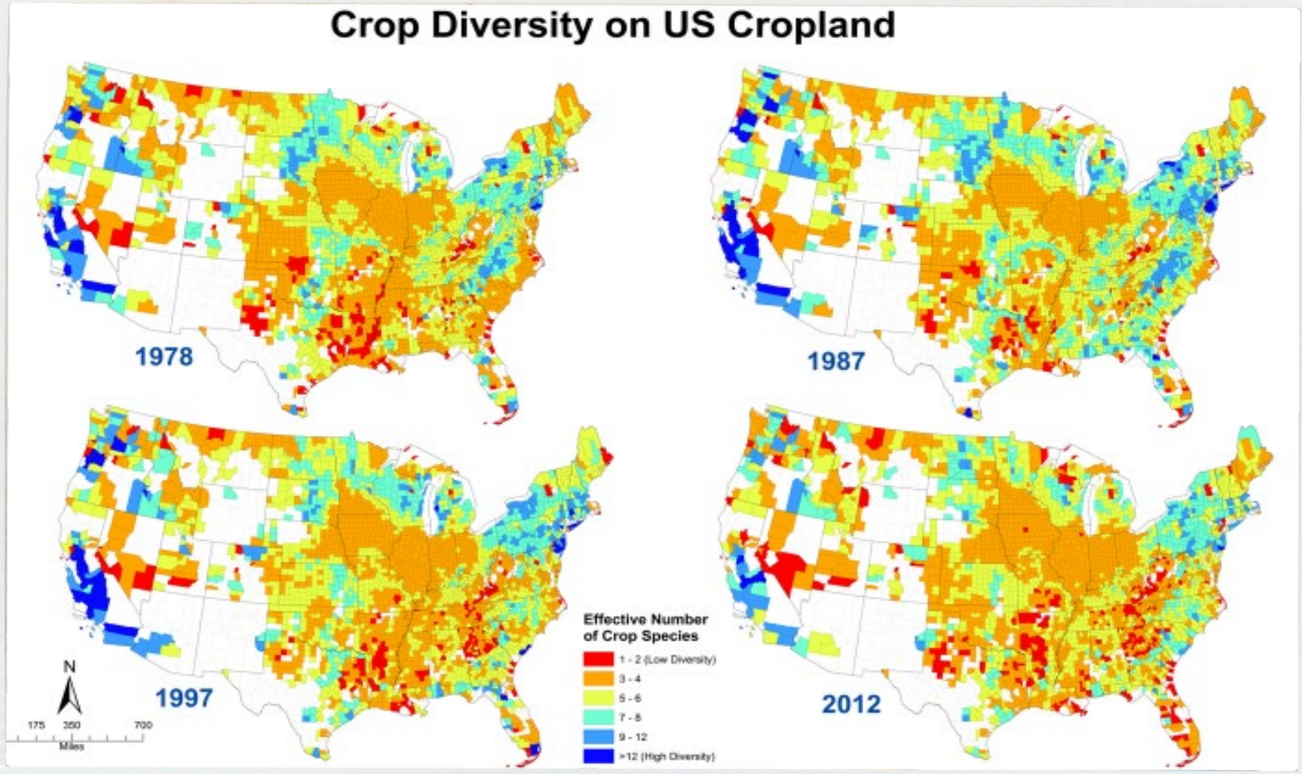


What is BIODIVERSITY?

All the different kinds of living organisms you find in one area, including plants, animals, fungi, and microorganisms like bacteria.

Healthier
Resilient
Stable

CONVENTIONAL INTENSIFICATION OF CROP PRODUCTION



Decreased crop diversity

Chemical fertilizers

Pesticides

Larger farms

Market forces

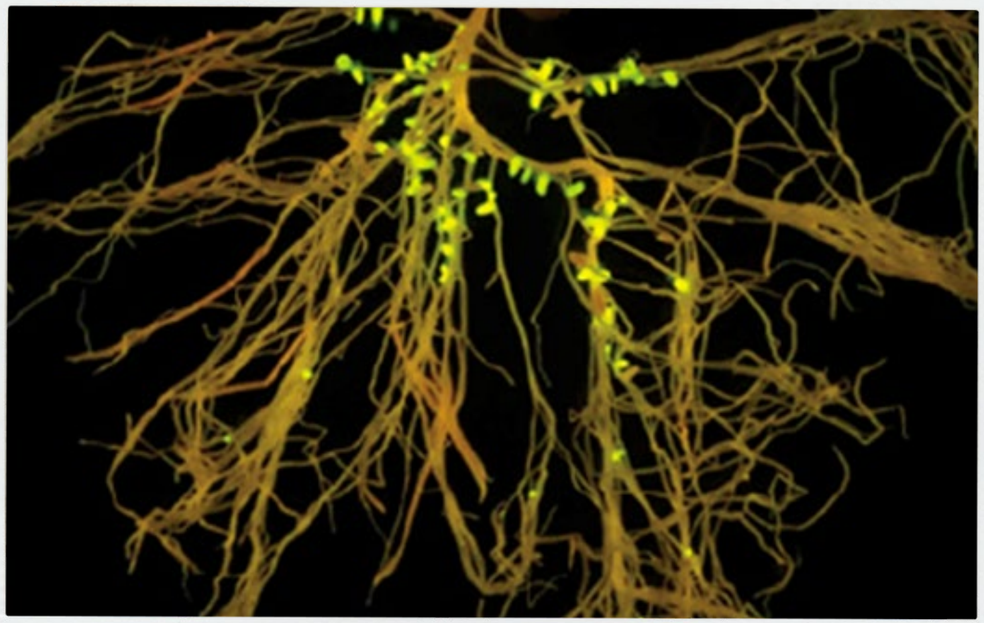
Aguilar et al., 2015

ECOSYSTEM SERVICES PROVIDED BY ALFALFA

Aboveground

Plants, habitat for insects, small herbivores, birds, reptiles, amphibians, bacteria and fungi

99% of insects in alfalfa are beneficial
>1000 spp. of insects
182 species of birds, mammals, reptiles, and amphibians (Putnam et al., 2001)



Belowground

Habitat for microarthropods, earthworms, insect's larvae, nematodes, roots, fungi, bacteria

Tri-partite symbiosis with *Synorhizobia* (N_2 fixation) and arbuscular mycorrhizae fungal (AMF) communities

Pollinators

Alfalfa can substantially enhance pollinators
Alfalfa for hay is harvested in late bud or early bloom
Serve as buffer from pesticides in croplands



Canopy insects

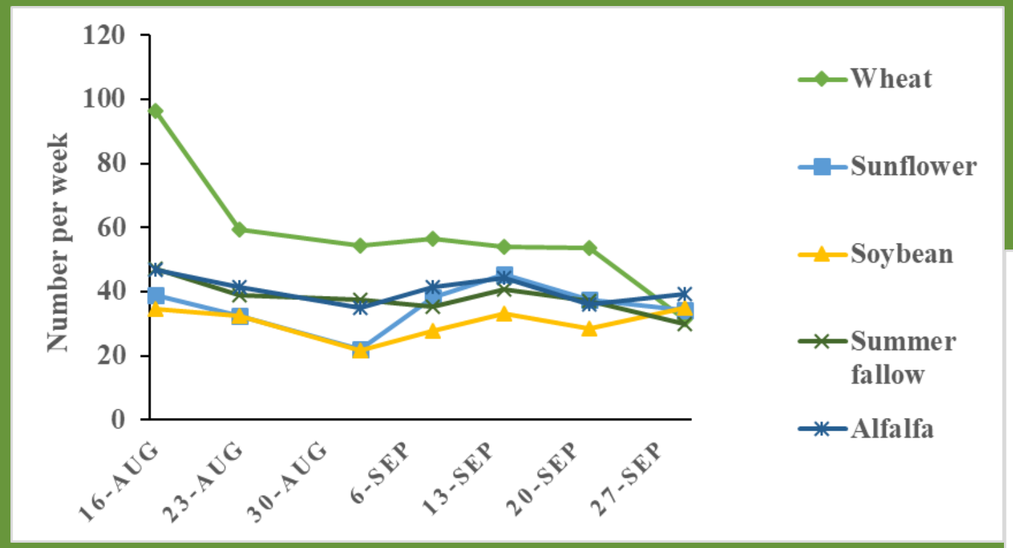
Many non-flying insects and arthropods live in the canopy or below it
many of these are predators of insects pests (spiders, lady bug larvae,syrphid larvae, etc.)

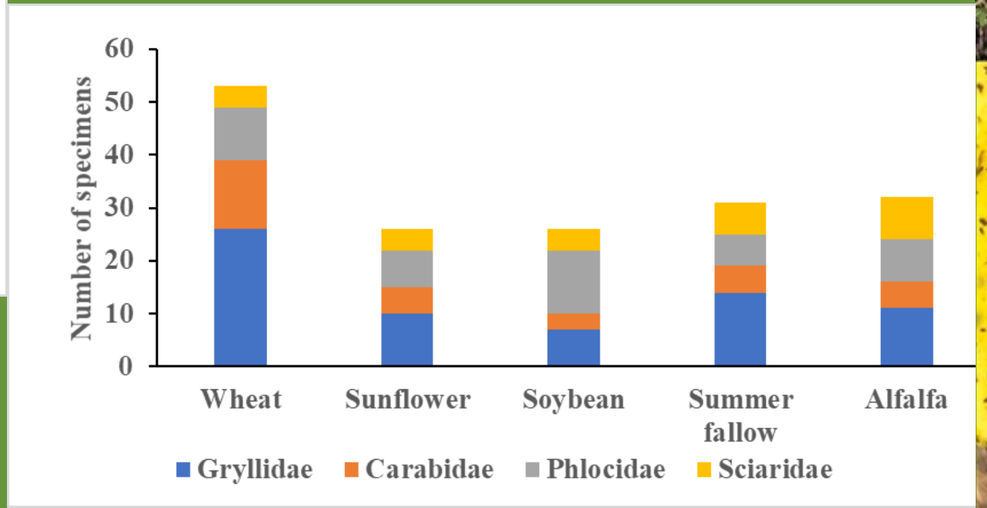



ARTHROPODS DIVERSITY IN DIFFERENT CROPS

Objective: to evaluate the biodiversity of arthropods in alfalfa in comparison to summer fallow (no crop), soybean, corn, wheat, forage sorghum and sunflower and in corn and forage sorghum intercropped with alfalfa.

Preliminary results of 2022: Specimens varied in number and diversity by crop and time of the season.





Anastasia Kurth, MS student

ARTHROPODS DIVERSITY IN DIFFERENT CROPS

In corn -alfalfa intercropping - sticky traps in alfalfa alone had greater number and diversity of species than in corn and alfalfa-intercropped in corn

•USDA-NIFA-ASAFS 9/2022-8/2024. Establishing alfalfa in intercropping with sunflower and sorghum to improve alfalfa yield and profitability, PD, Award no. 2022-70005-38225, $587,671

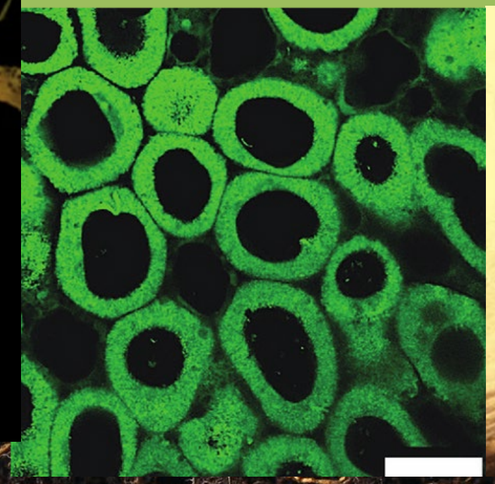
•USDA-NIFA-SAS. 10/2021-9/2026. Fostering Resilience and Ecosystem Services in Landscapes by Integrating Diverse Perennial Circular Systems (RESILIENCE CAP). Award no. 2021-68012-35917; $9,999,978 (to my program $747,868). Agronomy Research lead, co-PD

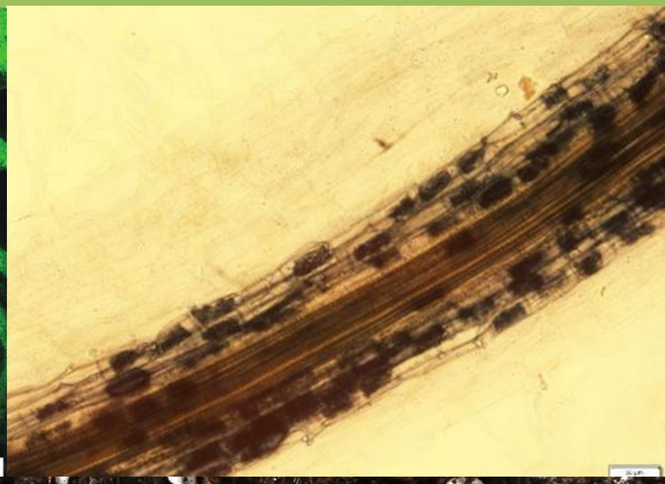
Photos: Haley Mosqueda, PhD student

BIODIVERSITY IN THE SOIL IN ALFALFA

Mesofauna
Microarthropods
Earthworms

Microorganisms
Rhizosphere





DIVERSITY AND RICHNESS OF FUNGAL AND BACTERIAL BIOMASS IN ALFALFA

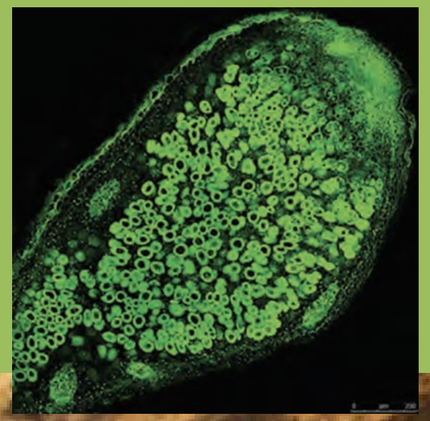
- Rhizosphere of alfalfa has trillions of microorganisms, 10-100 times > soil away from the root.

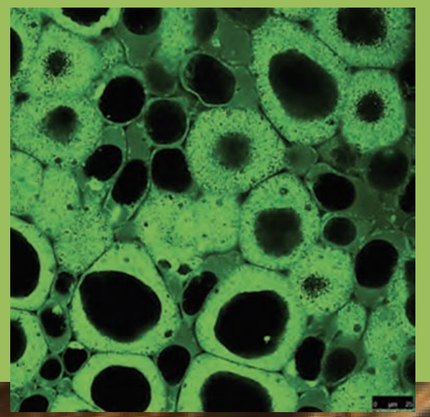
- Crop rotations including **alfalfa** had significantly greater fungal and bacterial biomass, diversity index and richness in the soil compared with corn and soybean (Niu et al., 2020; Potter et al., 2022, Baldwin -Nordick et al., 2022, Potter et al., 2021).

- 62% > microbial biomass in a rotation with 2 years alfalfa compared with corn (Baldwin -Nordick et al ., 2022).

Release of C- and N-rich exudates

Alter microbial communities functions





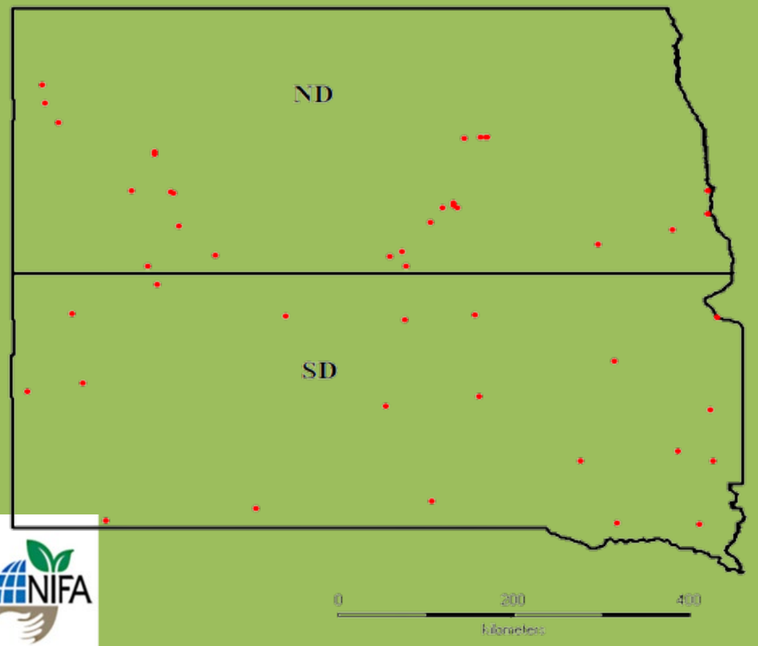
Improving Health, Productivity, and Sustainability in Alfalfa

Objectives

To establish alfalfa while growing corn at 30 and 60 inch row spacing.

To determine the AM fungal colonization in alfalfa plants grown in intercropping systems with corn compared with alfalfa in monoculture .

To identify the diversity of existing arbuscular mycorrhizal (AM) fungal communities in alfalfa production systems in North Dakota and South Dakota.



USDA-NIFA- ASAFS. 2019. Alfalfa management practices and their effect on arbuscular mycorrhizal fungi (AMF) populations- towards improving health, productivity, and sustainability of alfalfa production.

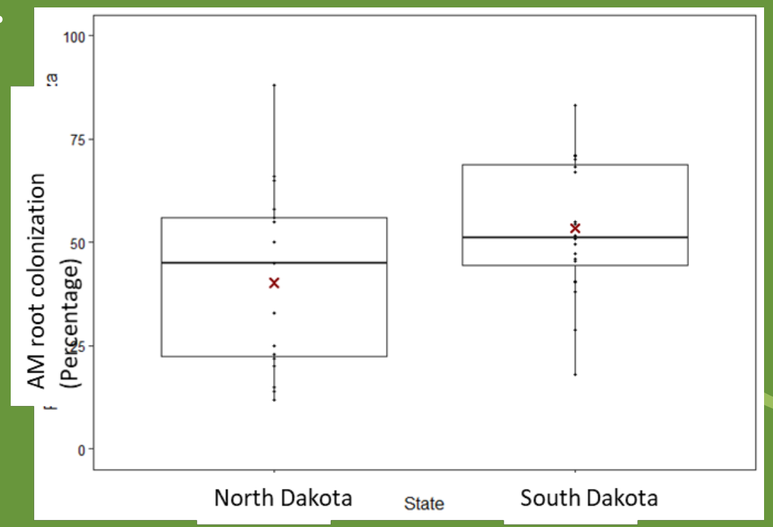
Heike Bucking, University of Missouri and Sara Bauder, SDSU

DIVERSITY OF ARBUSCULAR MYCORRHIZAE FUNGI (AMF) IN ALFALFA

-Colonization of alfalfa roots by AMF was highly variable but there was a slight increase in AMF root colonization in alfalfa grown in intercropping with corn.

-Colonization of AMF was greater in North Dakota sites vs. South Dakota sites.

-Grazing had a greater impact in colonization than hayed fields.



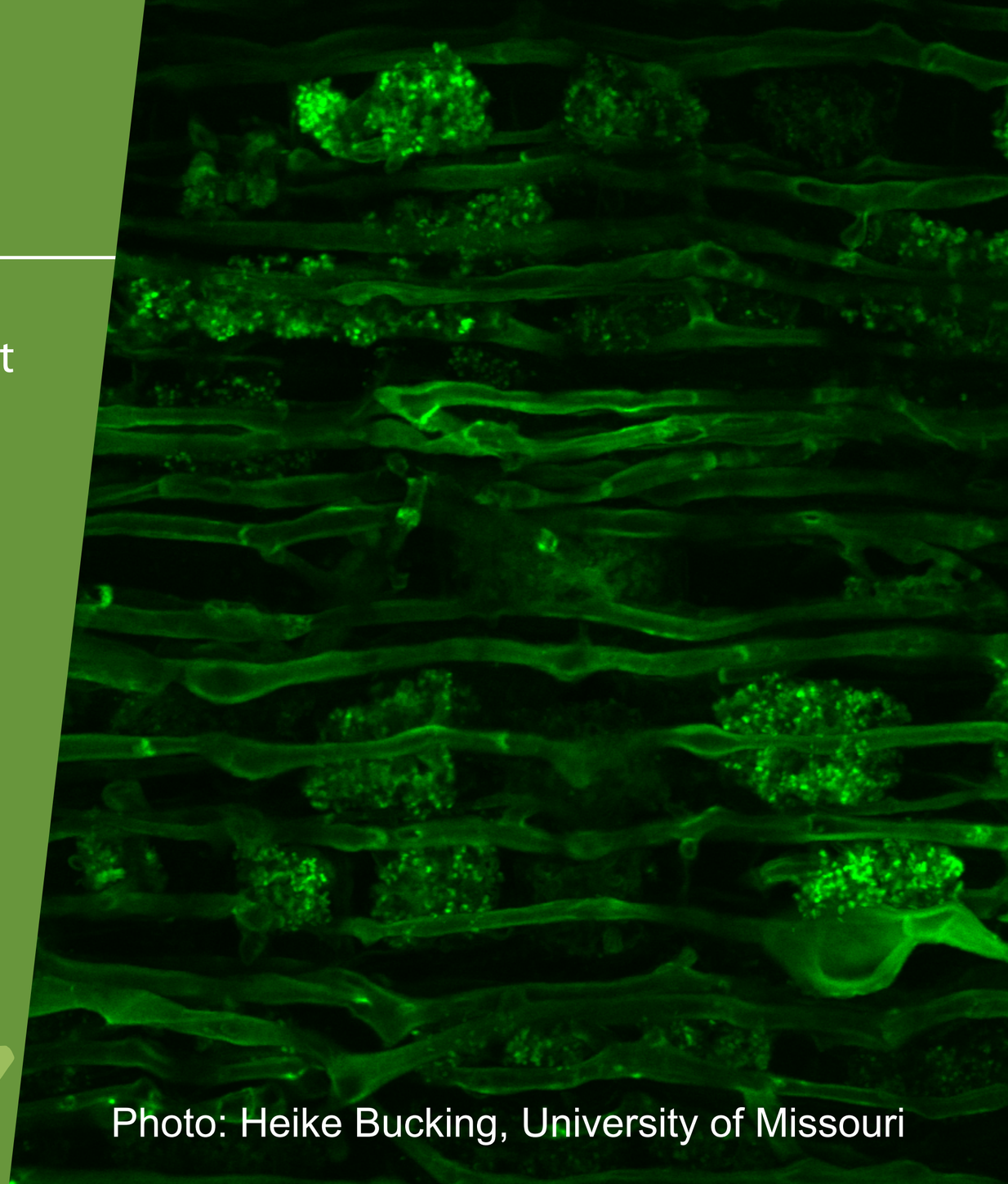
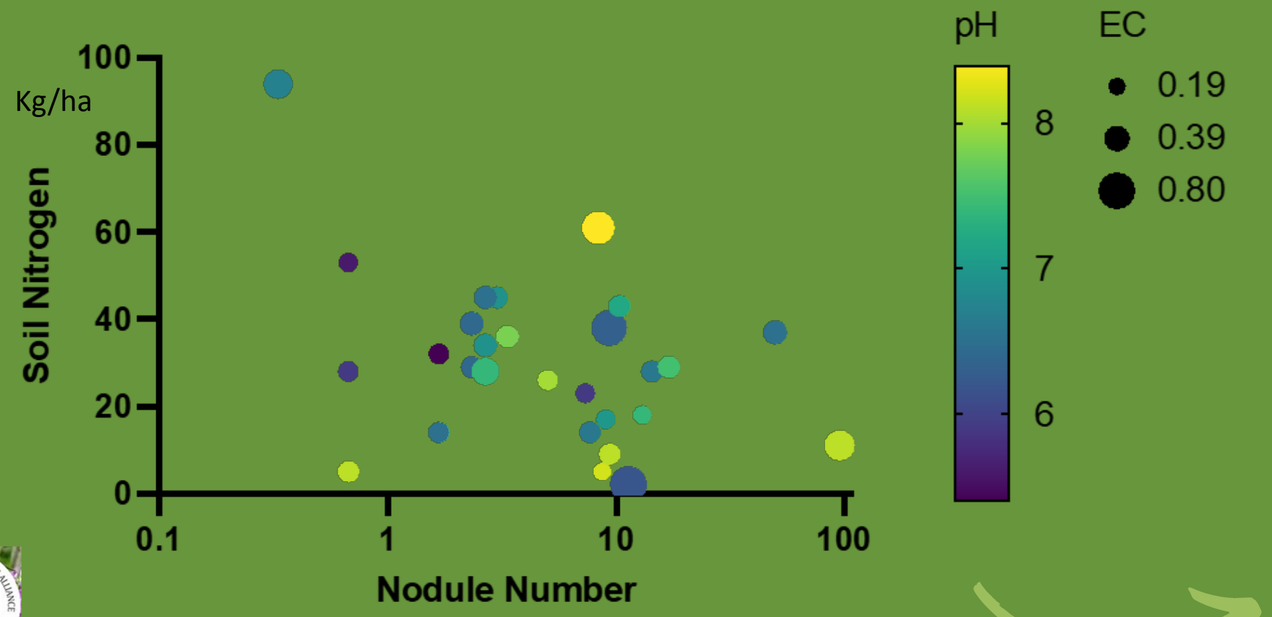


Photo: Heike Bucking, University of Missouri

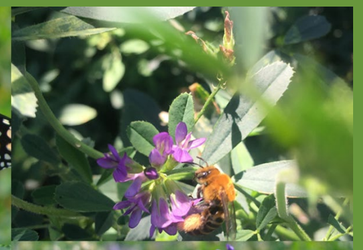
DIVERSITY OF *SINORHIZOBIA* IN ALFALFA

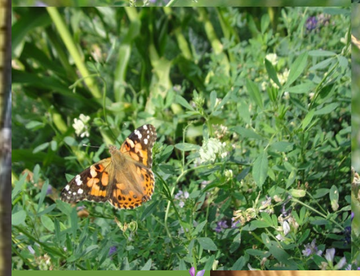
Relationships between soil parameters and nodules found in 2021. Points are average nodule number found at individual sites across ND. Generally acidic pH and high soil nitrogen content resulted in less nodules.



NAFA 10/2021 -09/2022. Barney Geddes and M. Berti. Identification of rhizobium inoculants tailored for performance with new alfalfa varieties and diverse soil types. Photo: Barney Geddes.

Photo: Barney Geddes





Summary

Although the information is preliminary, past research and new research is indicating integrating alfalfa into cropping systems:

Increases quantity and diversity of arthropods in the canopy

Increases fungal and bacterial biomass and richness

Enhances diversity of *Sinorhizobia* and arbuscular mycorrhizal fungi

A lot more wonders of alfalfa yet to come

Thank you!

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