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of Agriculture

Agricultural Research Service

*A Coordinated Research
Enterprise on Agricultural Soil
Microbiomes and Soil
Ecosystems Across USDA
Research Locations*



GLOBAL SYMPOSIUM ON SOIL BIODIVERSITY | 2-5 February 2021

Introduction

The sustainability and resilience of the soil ecosystem on which we rely to produce food, feed, fiber and fuels is a global concern

- I will share about the advanced soil ecosystem research efforts being conducted by scientists within the USDA ARS to understand the soil ecosystem and apply that knowledge to enhance agricultural productivity and improve the environment
- It is my hope that my talk will catalyze international dialog and collaboration around this important research topic and its benefits to agriculture



- USDA Agricultural Research Service (ARS)
- Soil Microbiome and Ecosystem Research Foci
Snapshots of addressing knowledge gaps in soil ecosystem function and management related to agricultural production, stressors to soils, and climate change
- How to collaborate?



USDA Agricultural Research Service

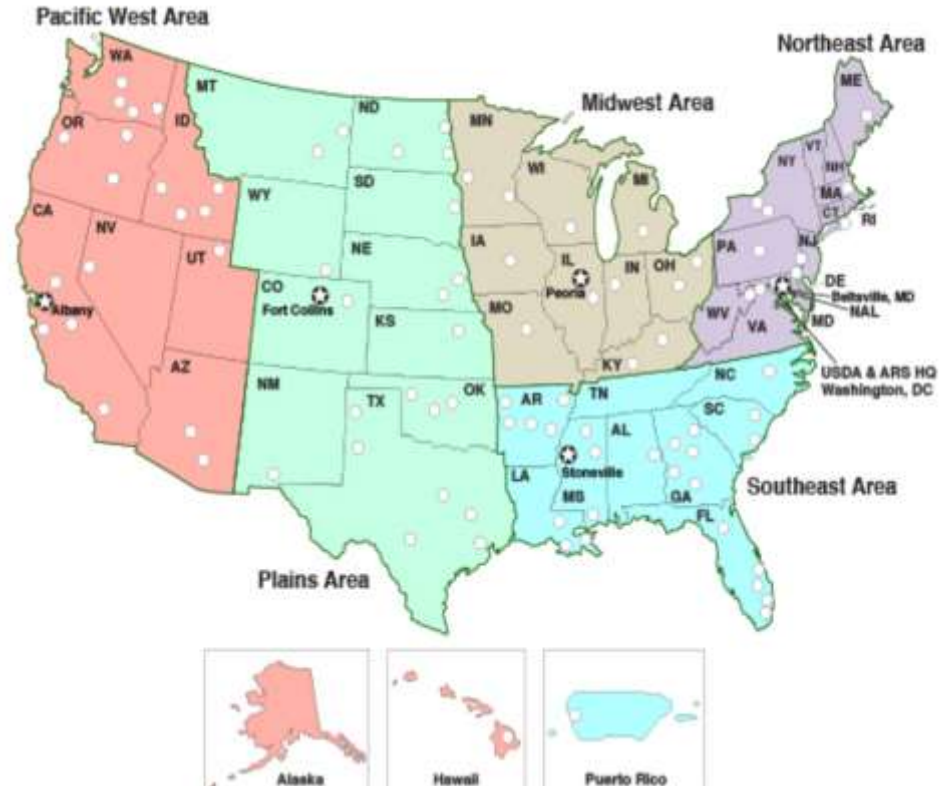
4 research program areas

1800 PhD Scientists
(8000 total staff)

690 Projects

\$1.4 Billion budget

Ninety locations



Four of *hundreds* of efforts that are addressing knowledge gaps in soil ecosystem function and management to

Improve yields

Be resilient to climate change and stress

Understand and enhance carbon sequestration

(other topics as well!)



Soil Microbiome Signatures Unveiled in Stress Tolerant Soils

Soil Health Assessment Initiative

Plot locations



Bacterial genes and soil community population abundances correlated to soil health and stress tolerance indicators

SOM/ C cycling & decomposition

- Total microbial biomass
- Genes encoding for C mineralization

Biomass
bglB

Aggregation

- Actinobacteria
- Firmicutes (*Bacillus*) and other extracellular polysaccharide producers

Actinobacteria
Firmicutes

Nutrient cycling

- Nitrogen fixers
- P-solubilizing bacteria

nifH
ppqC



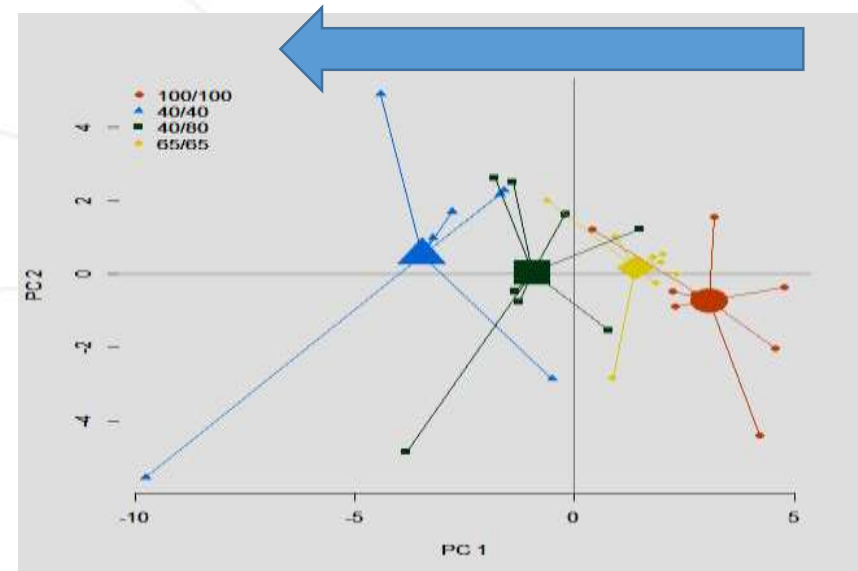
Microbial communities respond when maize is drought stressed

Full irrigation

Limited irrigation



Soil microbial communities diverge along a gradient of water stress

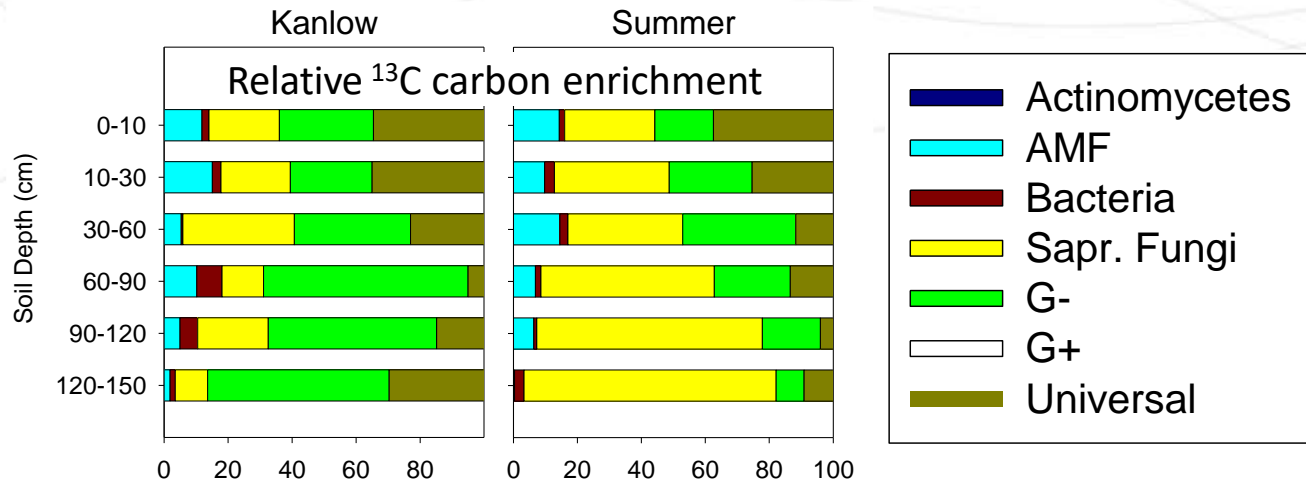


Plant ecotype-specific microbiomes control deep carbon sequestration in soils (during an extreme drought)

More than 50% of the world's soil C stocks are below 20cm. The role of microbial communities in deep soil C stabilization is unknown.

Switchgrass ecotypes had vastly different microbiomes take up the ^{13}C carbon but deposition was similar

The microbiome associated with smaller, less productive plants had the most efficient C stabilization in the soil.



Dialog and collaboration opportunities

Scientists and sites:

NRSAS:	55 locations	423 scientists	110 research projects
Soil and Air National Program:	19 locations	82 Scientists	23 research projects

Networks:

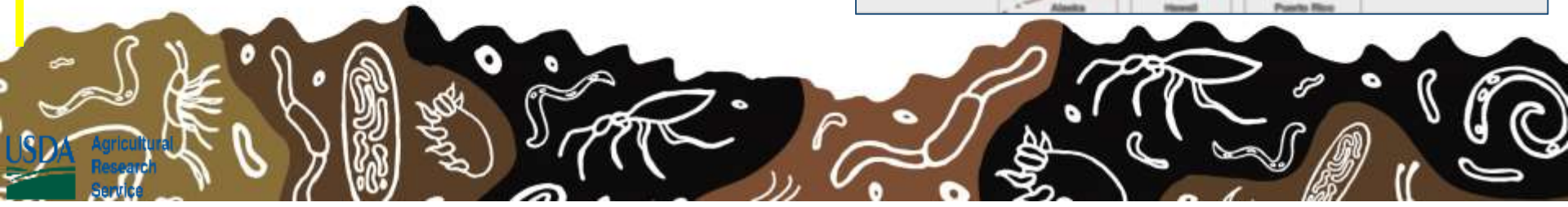
Greenhouse gas Reduction through Agricultural Carbon Enhancement network (GraceNET)
Long Term Agroecological Research network (LTAR)
Agricultural Antibiotic Resistance Network (AgAR)
Climate Hub Network
Biochar network (CHARnet)
Soil Biology Group
Wind Erosion Network

Five Year Cycle Review:

Listening sessions & Stakeholder input

Contact me!

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The background features a stylized illustration of soil. At the top, a single green leaf with white veins grows from a small white stem. Below the surface, the soil is depicted in shades of brown and grey, filled with numerous white line-art drawings of various soil organisms, including bacteria, fungi, and insects. The overall style is clean and scientific.

Thank you for your attention

I thank the scientific contributions of the Soil and Air National Program of ARS, as well as all the soil ecologists in ARS for their contributions to the scientific community, and for providing the scientific basis for this presentation.