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Managing soil health in potatoes: opportunities and challenges

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WSU Mount Vernon NWREC
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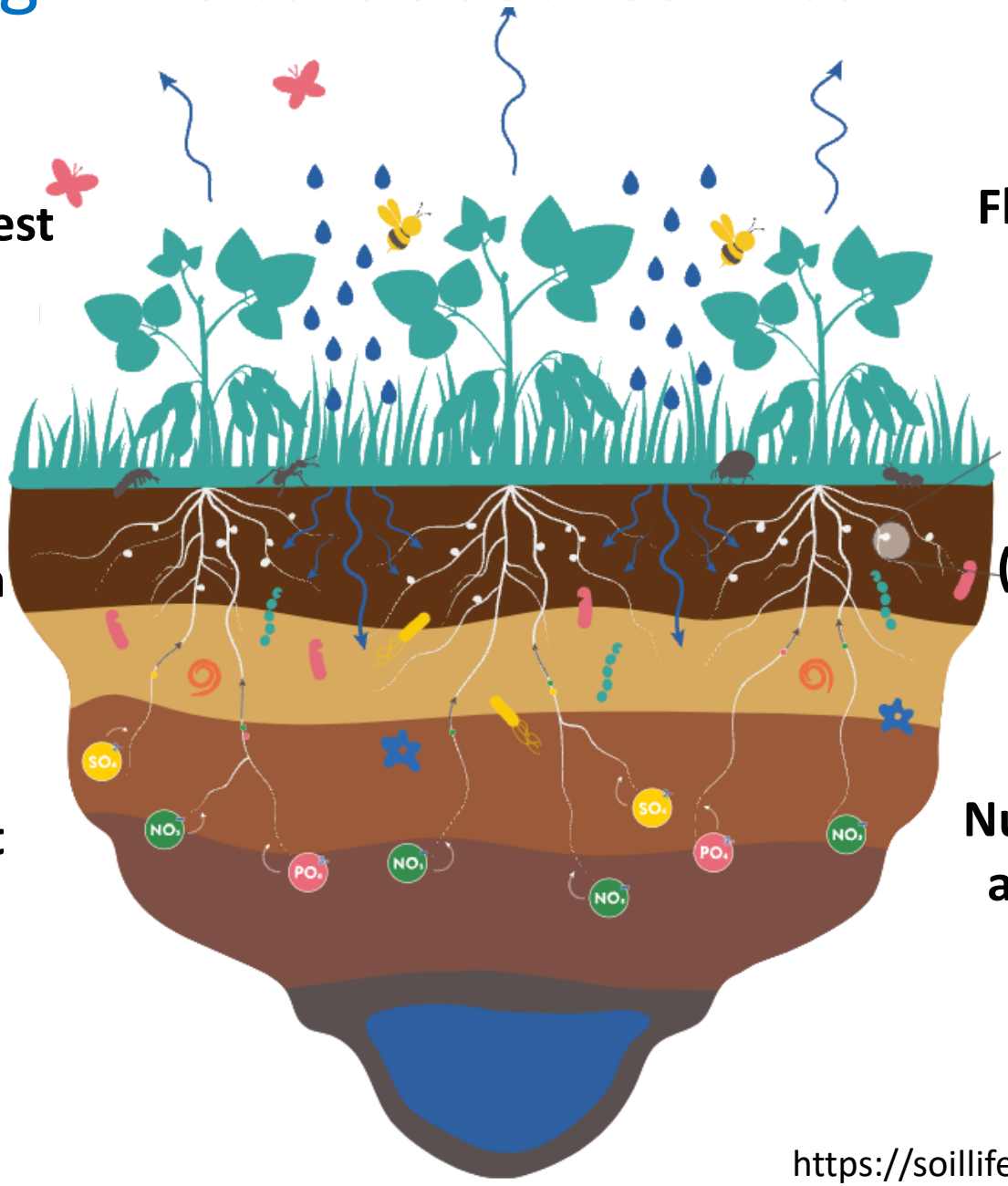
Why might we care about soil health?

Disease and pest suppression

Residue decomposition

Support plant growth



Flow and storage of water

Soil stability (reduced soil loss)

Nutrient cycling and retention

https://soillife.org/soil-101/soil-health

How do we improve soil health?

There are overall guiding principles,

but solutions may be different for each system

We know exercise is beneficial for our bodies, but people are suited to different activities

Soil health indicators – vital signs of the soil

chemical

soil organic matter

nutrient concentrations

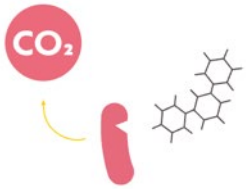
pH

salinity

biological

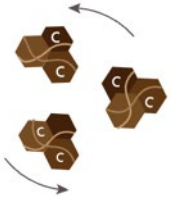
microbial biomass and diversity

earthworms/ invertebrates



respiration

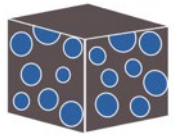
physical



aggregate stability

infiltration rate

water holding capacity



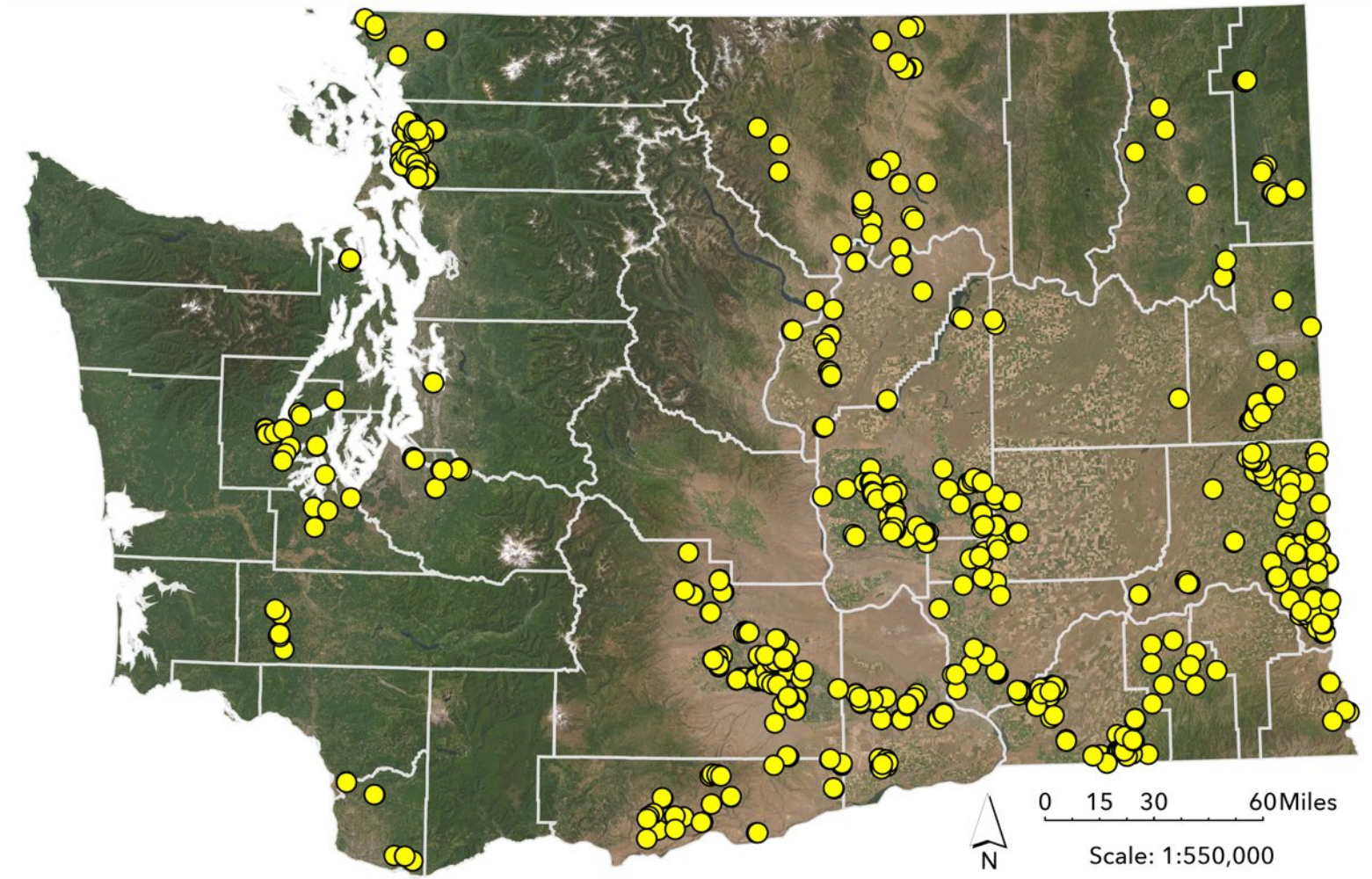
bulk density

https://soillife.org/soil-101/soil-health

The ‘State of the Soils’ Assessment

974 sites sampled thus far across WA

How do climate, soil type, crop, and management impact soil health?



Approach: Sampling

Potato Soil Survey Assessment

Columbia Basin and Skagit Valley

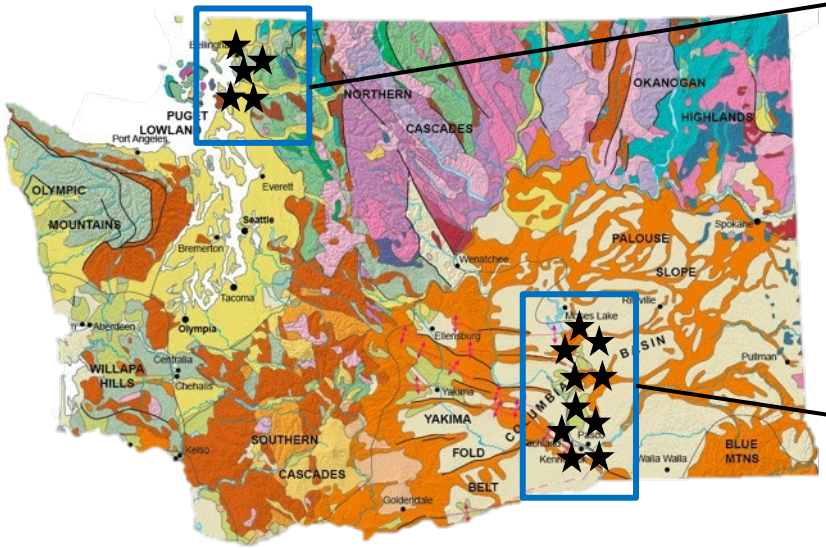
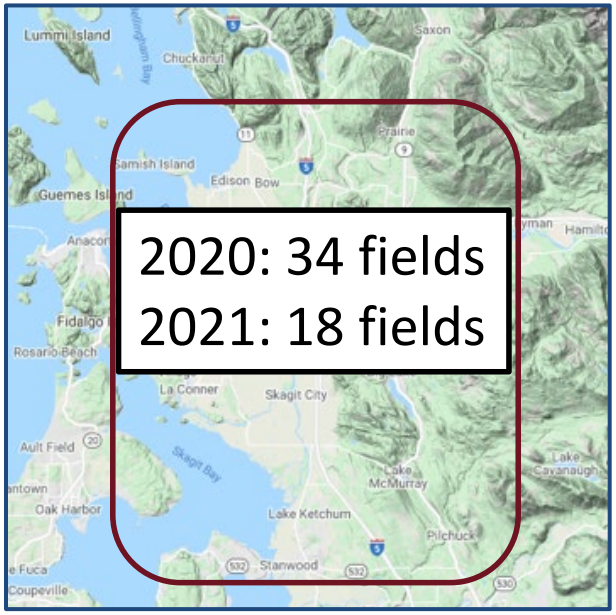
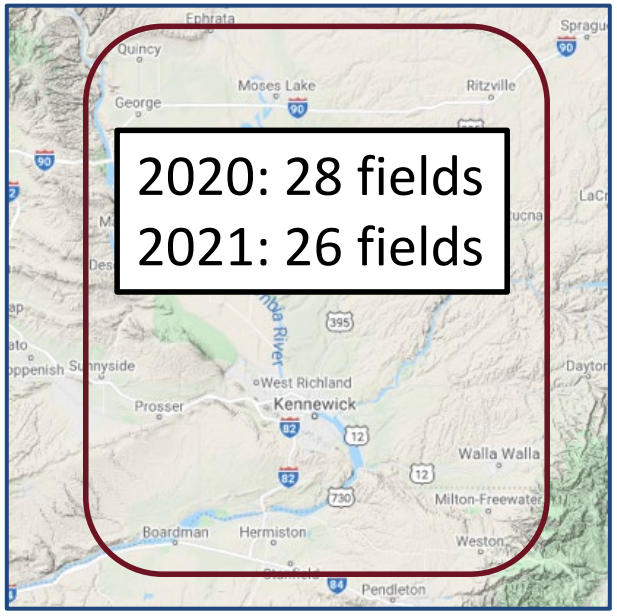


Image: https://olytumfoundation.org/





- Selected grower-identified “good” and “challenging” paired fields
- Collected bulk and rhizosphere (root zone) soil at mid-potato season
- Measured nutrients, pH, C pools, physical properties, pathogens, nematodes, microbiome

Approach: Grower Interviews

- Gathering management information from growers including
  - Rotational history
  - Tillage practices
  - Irrigation
  - Amendments
  - Soil challenges
  - Yields

How are soil health indicators affected by….

… Soil disturbance?

- Calculated a tillage intensity rating (GTIR) for each field over the 5-year rotation
- Based on implement, # of passes, depth, % area of field tilled

…. Increased crop diversity of rotations?

- Calculated a crop diversity index over the 5-year rotation

…. Inclusion of cover cropping?

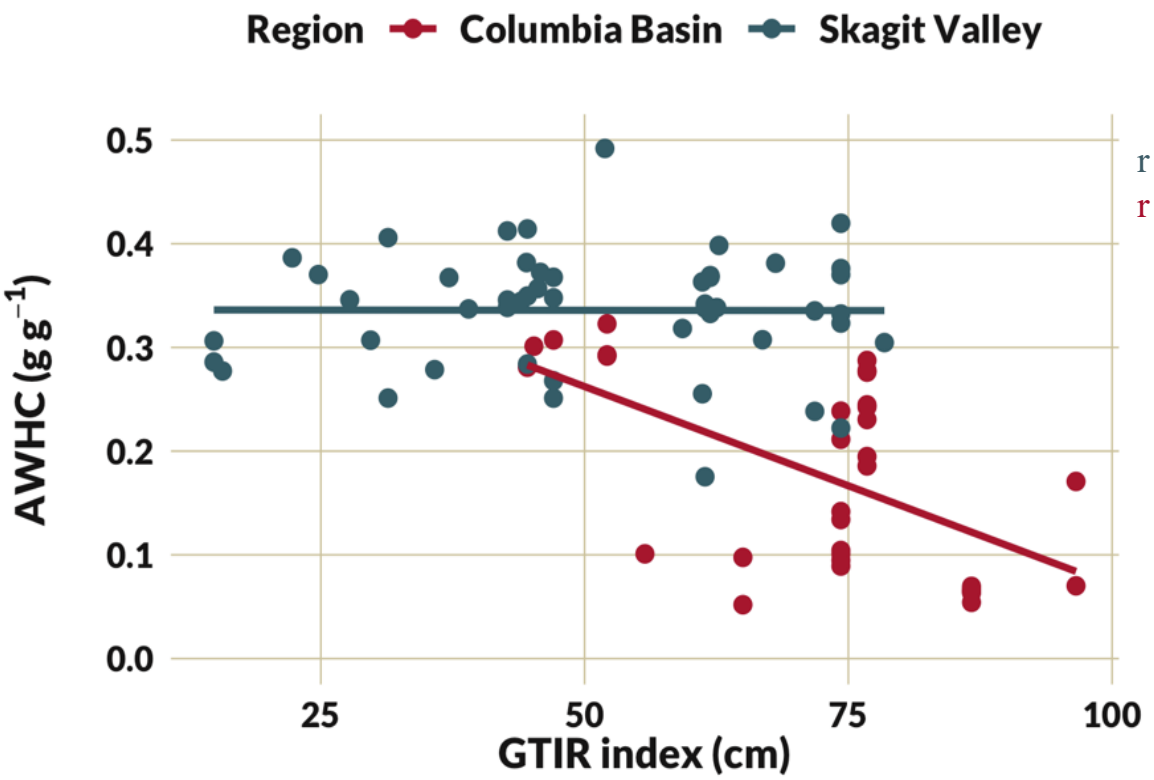
- Treated as a binary yes/no

…. Organic matter amendments?

- Included compost, manure, humic acids, biochar

How is soil disturbance over time impacting soil health indicators?

In the Basin, fields with more disturbance had lower water holding capacity.
No relationship in Skagit.



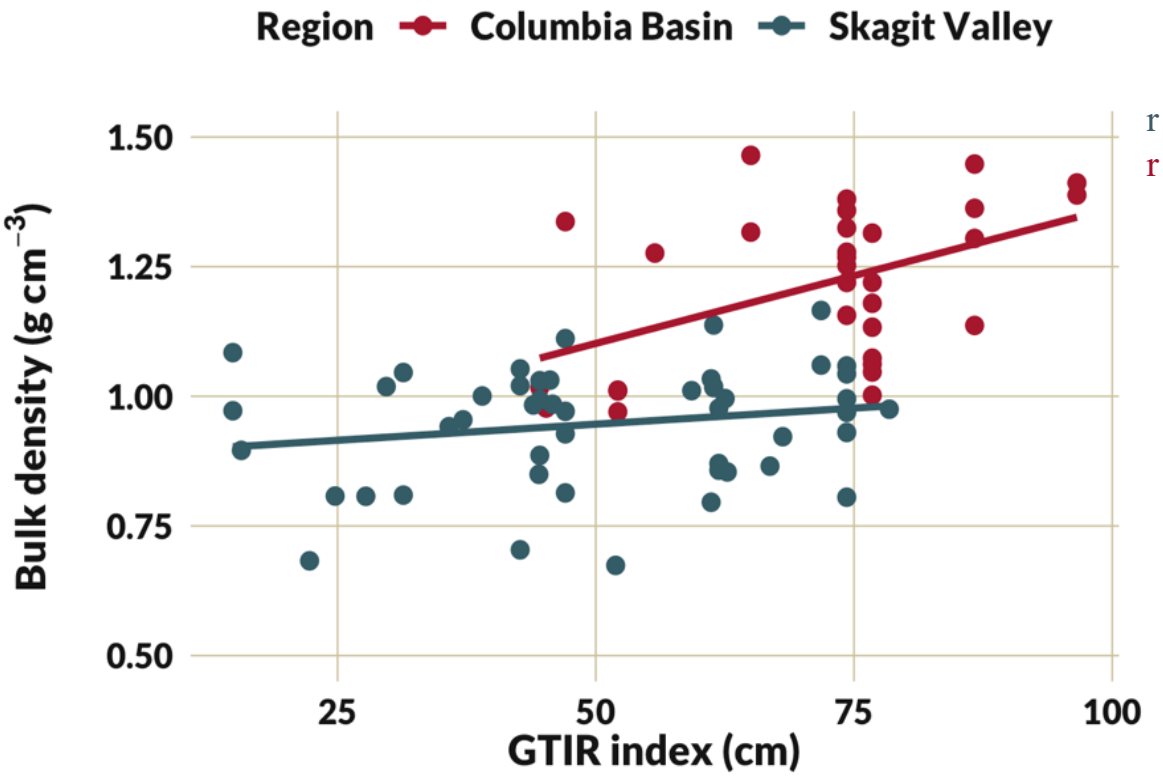
r = 0.05, p = 0.827
r = -0.69, p = 0.001**

Controlled for clay content in stats analysis

Sarpong et al., in prep

How is soil disturbance over time impacting soil health indicators?

In the Basin, fields with more disturbance had higher bulk density.
No relationship in Skagit.



r = 0.01, p = 0.110
r = 0.42, p = 0.049*

Controlled for clay content in stats analysis

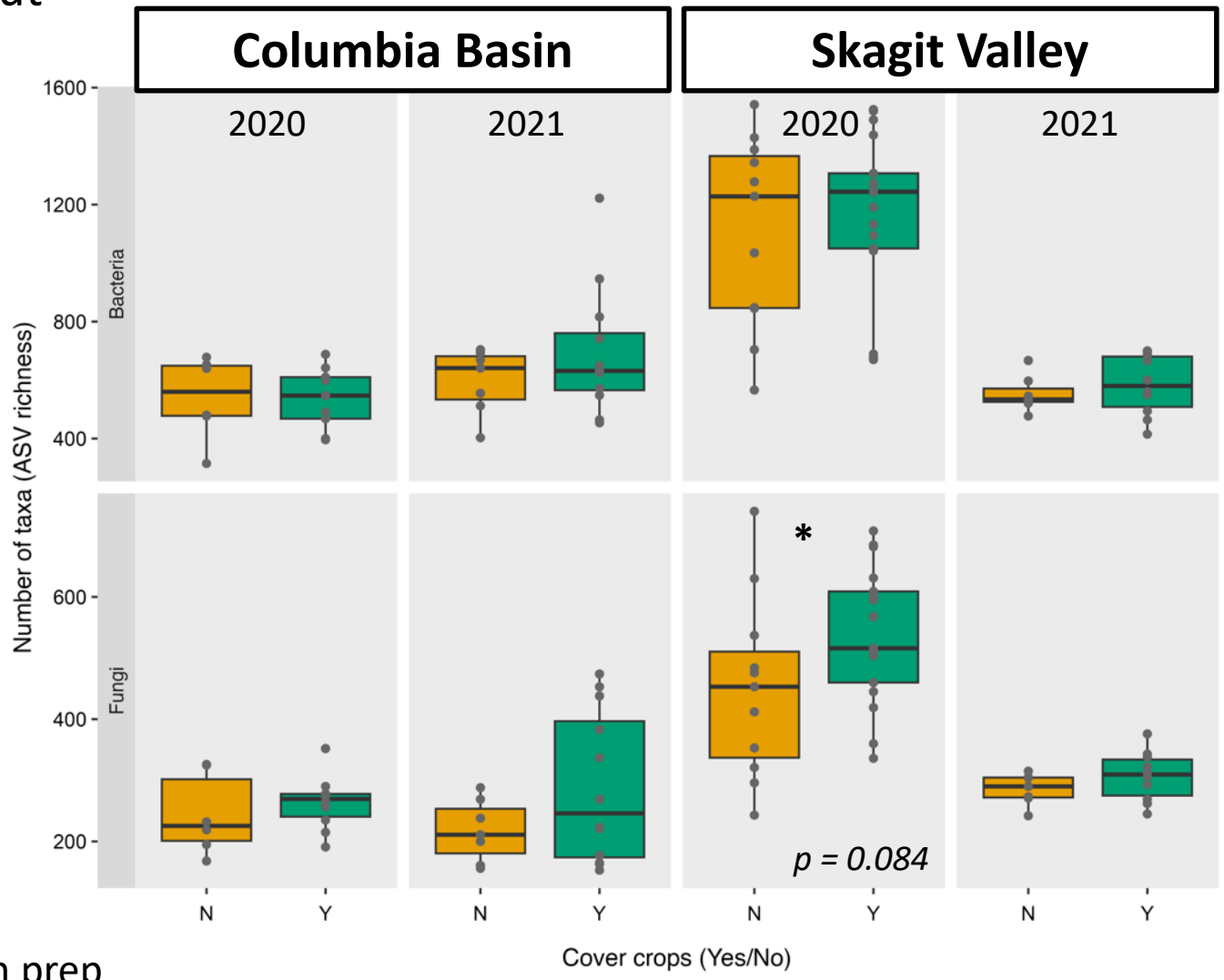
Sarpong et al., in prep

Inclusion of cover crops?

- In Skagit, fields with cover crops had higher fungal richness than those without

Bacterial richness

Fungal richness

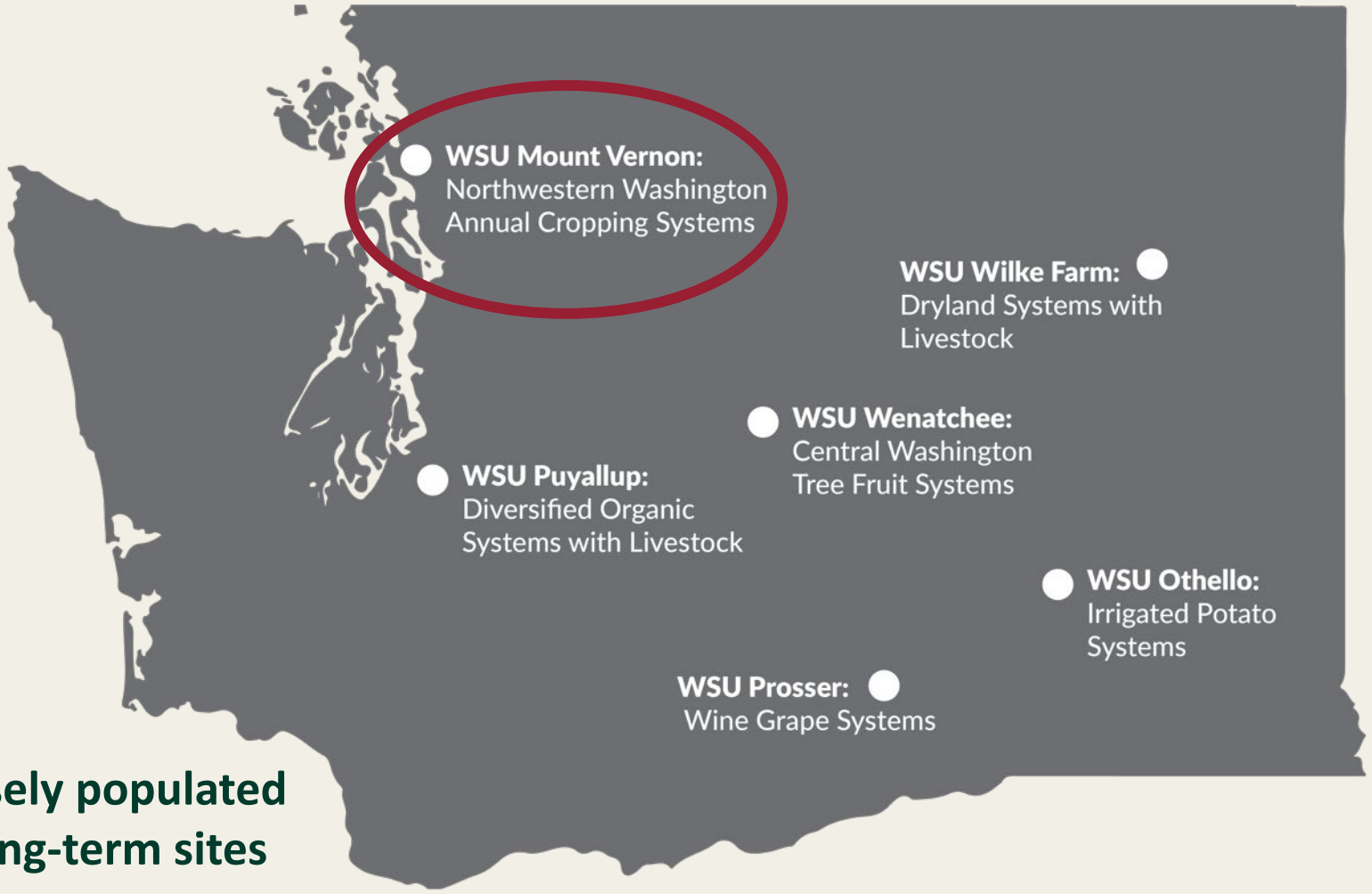


Potter et al., in prep

Other findings

- Fields with cover crops had slightly higher POXC (”active C”) and ACE protein levels than those without
  - We are still learning a lot about what these indicators are measuring and how they relate to soil function
- No clear trends of soil health indicators with parasitic nematode or pathogen levels
  - Pathogens measured via qPCR methods by Chakradhar Mattupalli
- There were no relationships between soil health indicators and yield
  - Caveat: We did not have yield info from all fields
  - Many different cultivars. In the Basin, we normalized yields to Russet Burbank

Network of Long-Term Research Sites



The most **densely populated** network of **long-term sites**

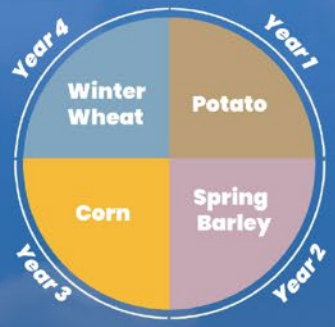
Collaborators:
Gabe LaHue, Co-lead, Soils & Water
Chakradhar Mattupalli, Potato pathology
Chris Benedict, Weed science
Louie Nottingham, Entomology

Kwabena Sarpong

WA Soil Health Initiative • Long-Term Agroecological Research and Extension Site

Investigating **Reduced Disturbance** and **Increased Organic Matter** Additions

The section of the field directly in front of you has each of the four systems represented



General Crop Rotation

System 1

- Full tillage
- Bale and remove crop residue

System 2

- Full tillage
- Leave crop residue
- Annual cover crop

System 3

- Reduced tillage
- Leave crop residue
- Annual cover crop
- Compost addition

System 4

- Reduced tillage
- Leave cover crop residue
- 3-year perennial cover crop
- Compost addition

Cover Crop

Closing thoughts

- The survey sampling approach allows us to capture a variety of soil and crop conditions, but inherent variability means large datasets are needed to elucidate trends

- Soils are slow to change. Long-term rotational trials allow us to understand more mechanistic effects of soil management practices on soil functioning

- We have a variety of low-cost ways to measure aspects of soils, but more work needed to understand the mechanistic role these indicators play in soil functioning and how they interact with one another

Acknowledgements

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- **Grower collaborators** who let us sample on their fields and shared management info
- **Collaborators:** Dani Gelardi, Kobby Sarpong, Chakradhar Mattupalli, Gabe LaHue, Clark Kogan, Teal Potter, Jadey Ryan

Funding:

A PRACTICAL GUIDE TO SOIL HEALTH INDICATORS FOR MONITORING SHIFTS IN SOIL ORGANIC MATTER

Abstract

Improving and maintaining soil health can have a wide range of economic benefits including reduced input costs and improved crop growth, quality, and yield. Soil organic matter (SOM) is a commonly used metric for assessing soil health but can be slow to respond to management changes, taking years or even a decade for measurable changes to occur. Soil health indicators that can detect shifts in microbial activity, carbon (C) cycling, and nutrient cycling are more responsive than SOM and can help producers see if they are moving in the right direction.

This publication provides an overview of soil health indicators that are related to shifts in SOM but can respond more rapidly to management changes. This practical guide will help producers navigate the names of tests, their availability in the Pacific Northwest, and the relevance of each test to production systems.

Dynamic Soil Health Indicators

Increasing soil organic matter (SOM) can address a host of production limitations in agricultural systems by improving soil nutrient supply, biological activity, structure, and water holding capacity. Levels of total SOM in agricultural soils typically range from 1 to 6% and are influenced by climate, soil texture and mineralogy, and management. Practices such as reducing tillage frequency and intensity, integrating cover crops into a rotation, and applying compost or manures can increase SOM levels over time.

The measurement of SOM is common in routine soil testing. Producers can monitor SOM to track long-term effects of changes in management practices. The SOM measurement represents the totality of organic matter in soil, which includes several fractions that play distinct roles in the soil environment. While multiple factors such as soil texture, disturbance intensity, and crop rotation can affect SOM levels, SOM levels are highly dependent on the quantity of organic material being added to the system. Even with high residue inputs in a fine-textured soil (meaning a soil dominated by clay, such as a clay loam, silty

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