

# Can soil health assessment be improved by adding microbial and plant health indicators?

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## Background

For agricultural systems, the definition of soil health as "the capacity of a soil to function" implies both a healthy microbial community and a well-growing crop. However, microbial and plant indicators are seldom included as part of a soil health assessment.

## Questions we asked

- Do microbial and plant indicators improve assessment of overall ecosystem health?
- How do microbial or plant indicators relate to traditional soil health indicators (SHIs)?

These are preliminary results from the first year of the study.

## Location

The Century Experiment at the Russell Ranch research facility at the University of California, Davis was started in 1993 and has run continuously for 26 years. A corn-tomato rotation either receives poultry manure compost and a cover crop (ORG) or conventional fertilizer and no cover crop (CONV).

## Experimental Design

Soil was collected for a soil health assessment prior to planting and at flowering from ORG and CONV plots, in both corn and tomato rotations.

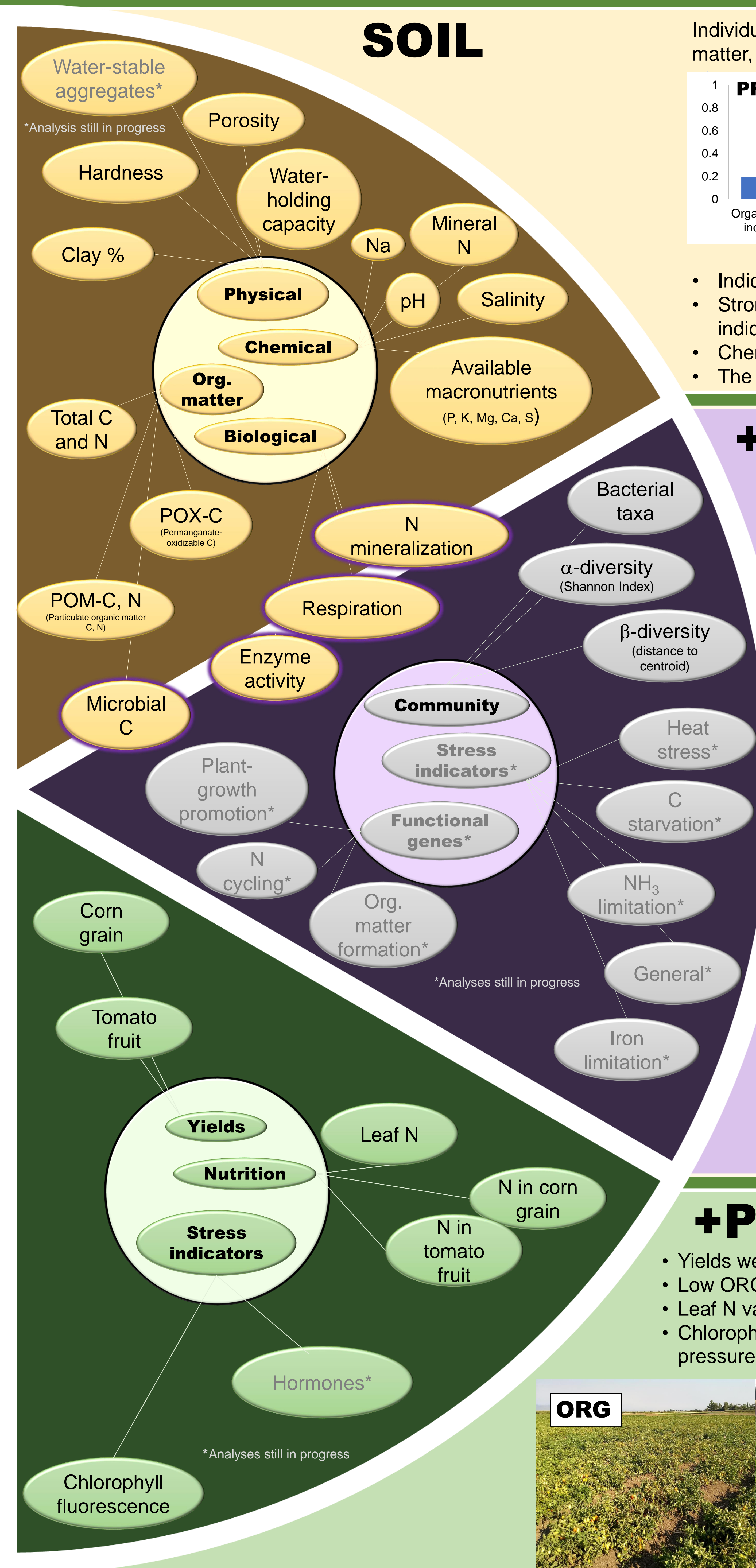
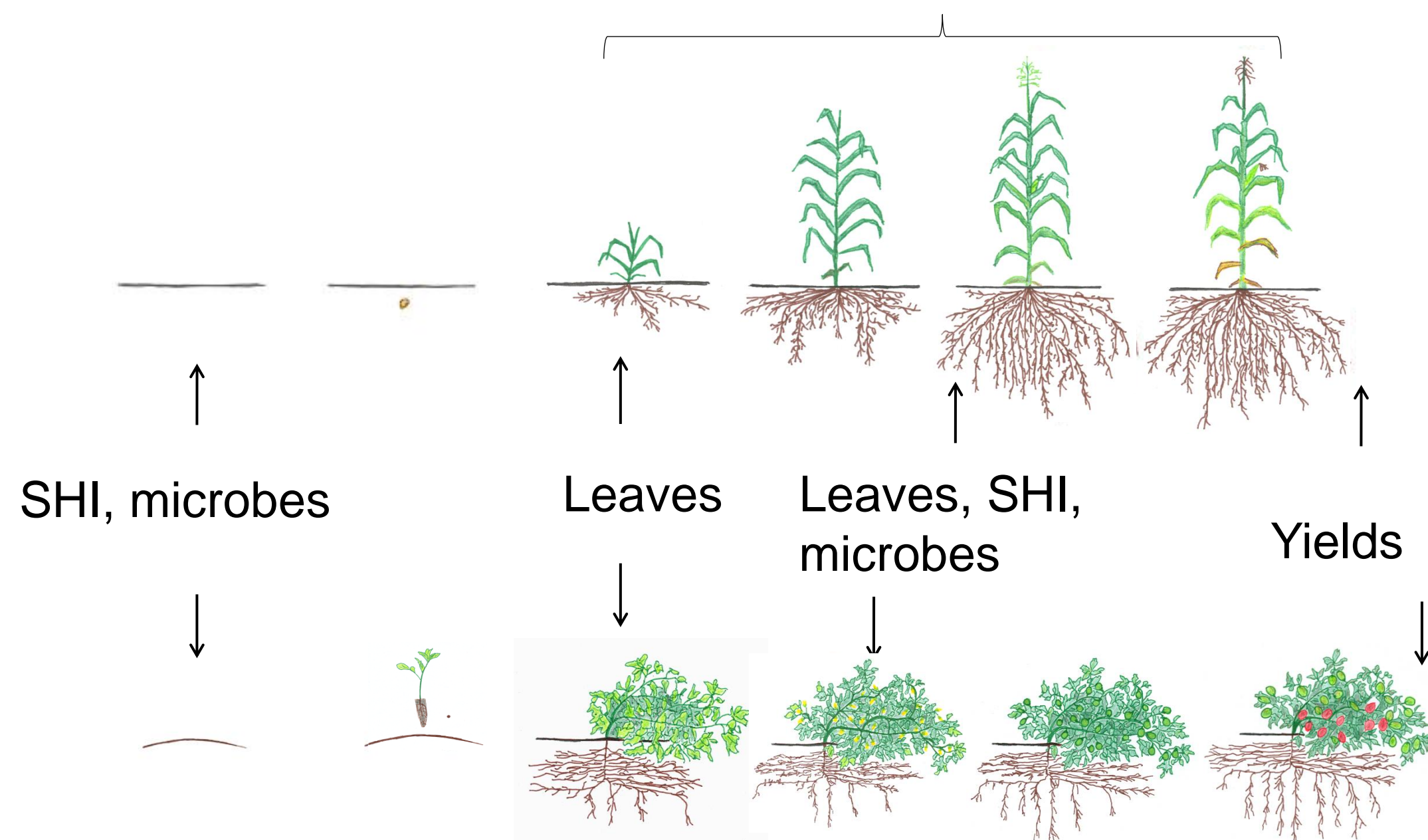
From soils collected at the same times from the same locations, total soil DNA was extracted for microbial community analysis.

Metagenomic analysis will also be performed.

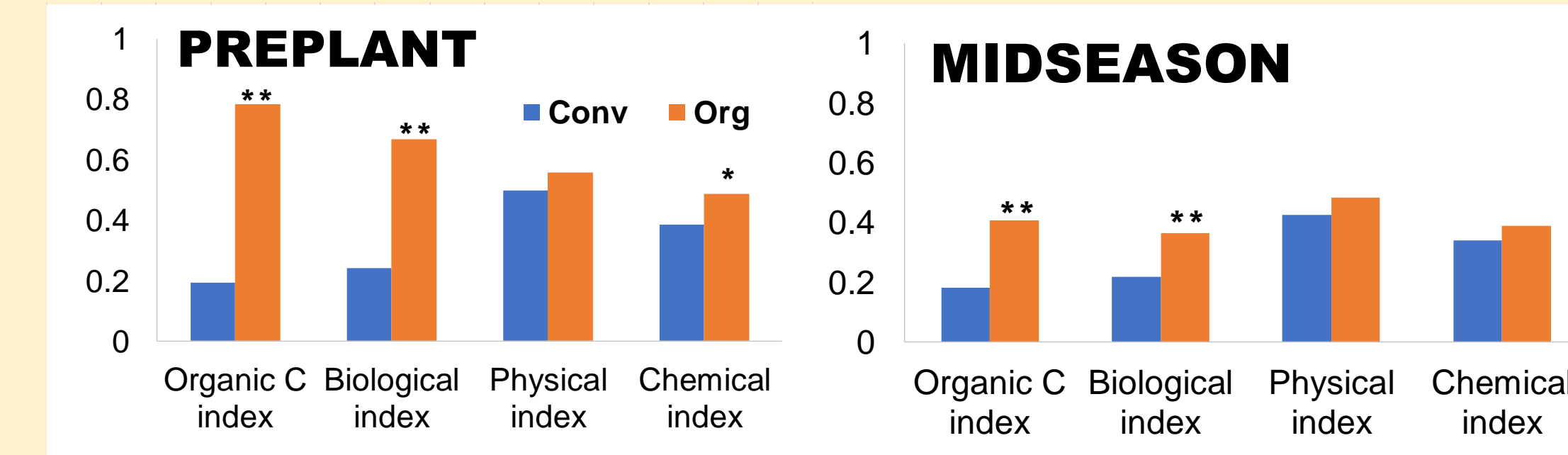


Plant health was monitored using chlorophyll fluorescence (a measure of photosynthetic efficiency) and nitrogen concentrations in a young mature leaf, and the yield and nitrogen concentrations in harvested grain and fruit.

Chlorophyll fluorescence in a young, mature leaf



Individual soil health indices were calculated for soil organic matter, biological, chemical, and physical indicators.

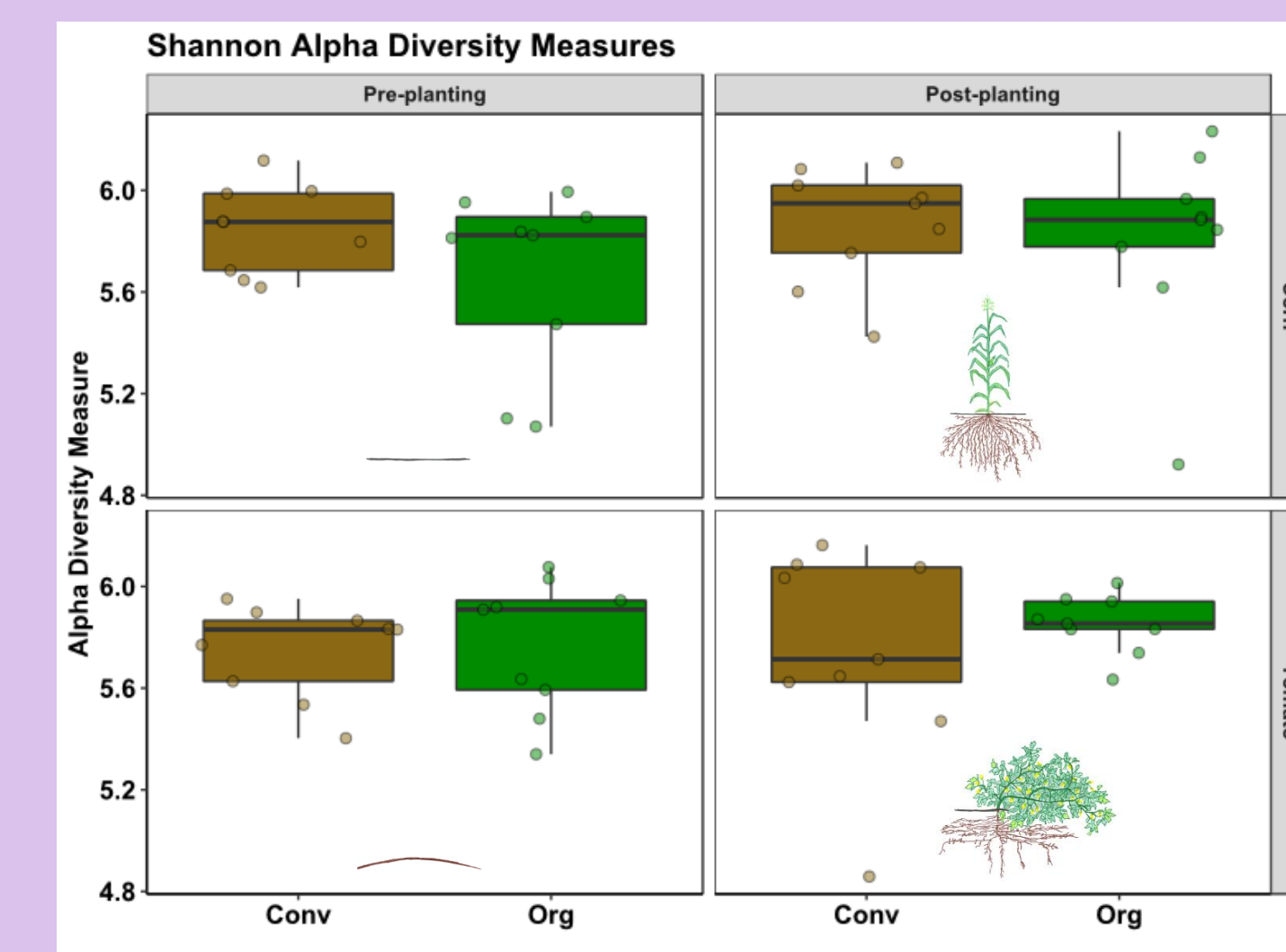


\* Significant at p<0.05 \*\* Significant at p<0.001

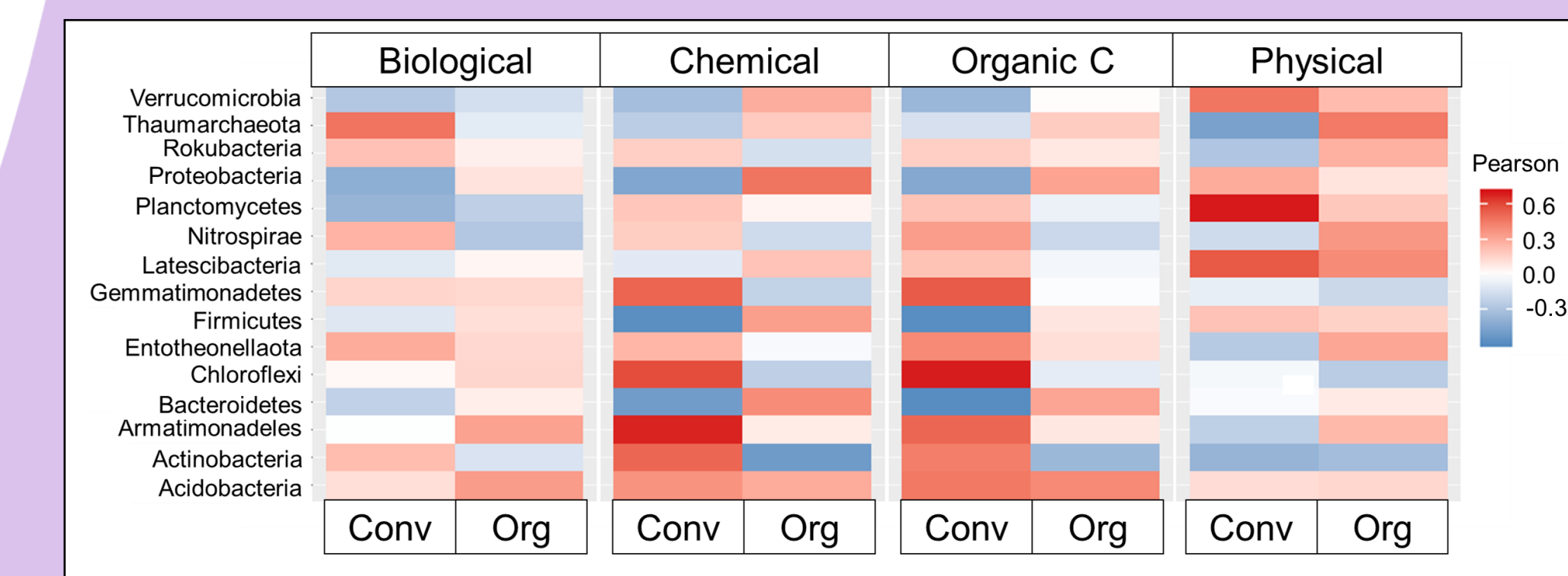
- Indicators did not differ between crops.
- Strong, persistent increases in biological and organic matter indices in soils from ORG plots.
- Chemical index for ORG soils higher in spring but not mid-season.
- The physical index did not differ between systems at either date.

25 years of manure and cover crops have significantly improved SHIs in the ORG system at Russell Ranch, especially those related to organic C and biological function.

## +MICROBES



- Preliminary 16S rRNA gene analysis suggested that microbial communities differed between the management systems. However, Shannon diversity did not differ between systems for either crop at either date.
- None of the soil health indices correlated significantly with abundance of any of the thirteen most abundant taxa.

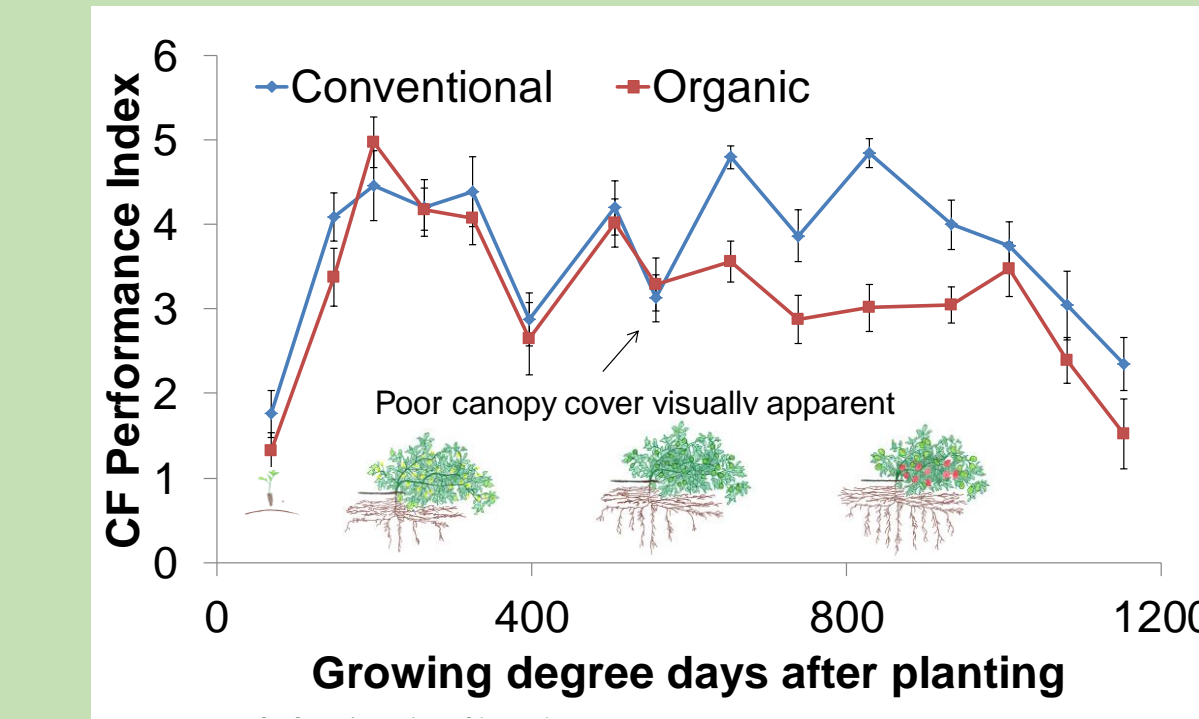


While the soil biological indicators and microbial C pool revealed a more active and abundant microbial community in the ORG than the CONV system, bacterial DNA analysis showed the ORG community was not more diverse, and not very different at a broad taxonomic level.

Preliminary data suggests systems differ functionally rather than taxonomically. Metagenomic data will test this hypothesis.

## +PLANTS

- Yields were higher in CONV than ORG for both corn and tomatoes.
- Low ORG yields were due to disease pressures for both crops.
- Leaf N values suggested N was sufficient for both crops and systems.
- Chlorophyll fluorescence (CF) measurements reflected disease pressures in tomato but not corn, as only tomato symptoms were foliar.



Adding plant performance data shows that soil and microbial community data alone do not give an accurate picture of system health.