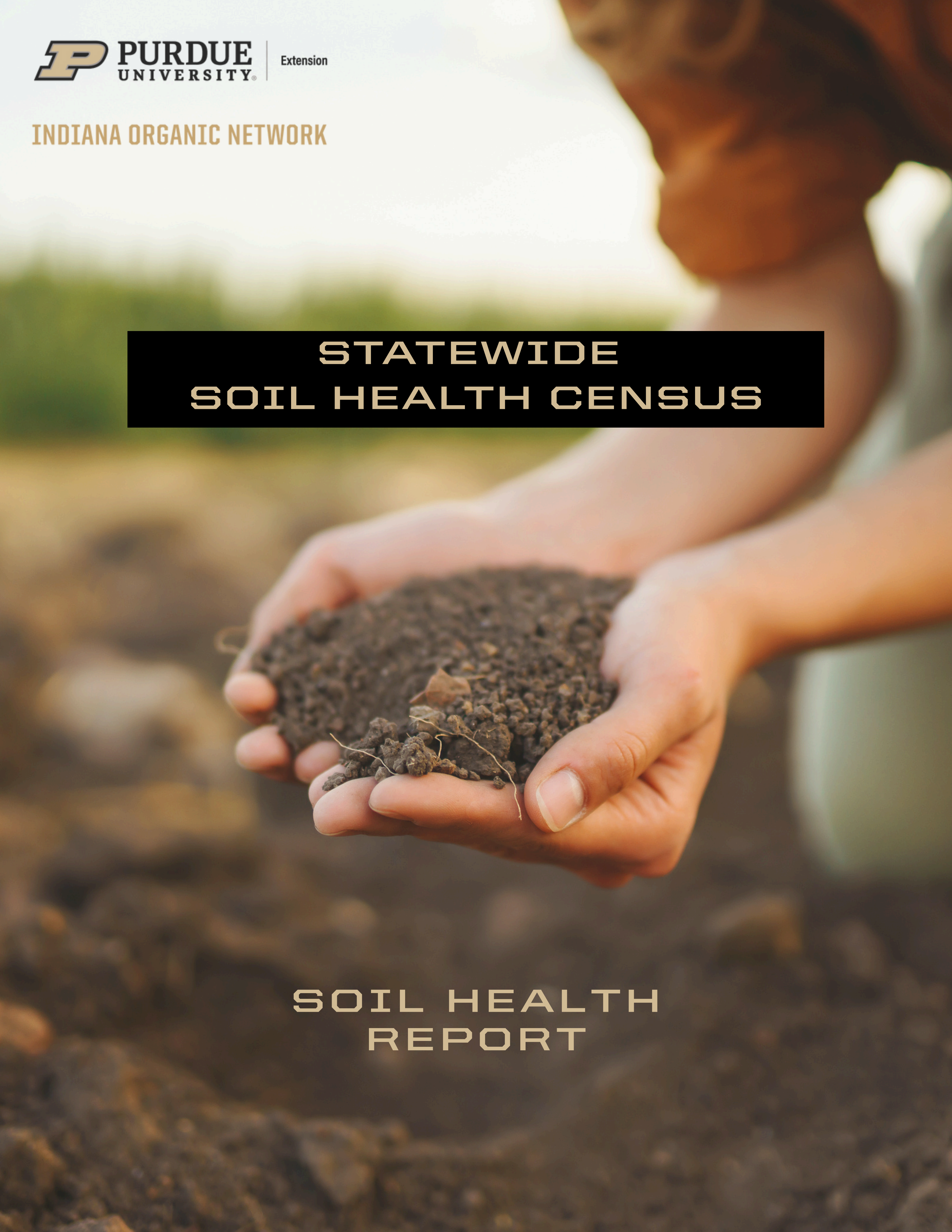
PURDUE UNIVERSITY | Extension

INDIANA ORGANIC NETWORK



STATEWIDE SOIL HEALTH CENSUS

SOIL HEALTH REPORT

INDIANA ORGANIC NETWORK

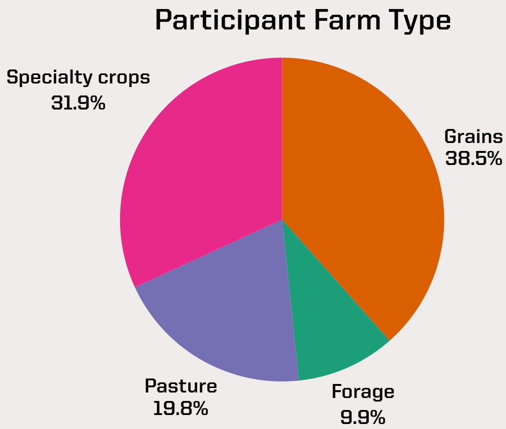
01. OVERVIEW

Purdue University researchers and Extension educators launched the **Indiana Organic Network (ION)** in spring 2024 to build community and foster connections among organic farmers in Indiana, while gaining insights into the successes and challenges they face. By identifying both strengths and opportunities for growth, ION aims to support farmers with knowledge and resources that enhance their productivity and profitability. A core initiative of ION, this statewide soil health census focuses on assessing and understanding soil health of organic farms throughout Indiana.

02. PARTICIPANTS & COUNTIES

Indiana is home to over 700 certified organic farms, yet there is limited published information on their soil health status statewide. To address this gap, we collected soil samples from nearly 100 locations across 21 counties, including certified organic fields, fields transitioning to organic certification and uncertified fields managed organically in preparation for transition.

By compiling and sharing soil health data from fields across the state, we aim to empower organic farmers to evaluate their own soil conditions, compare with peers and adopt effective soil-building strategies.

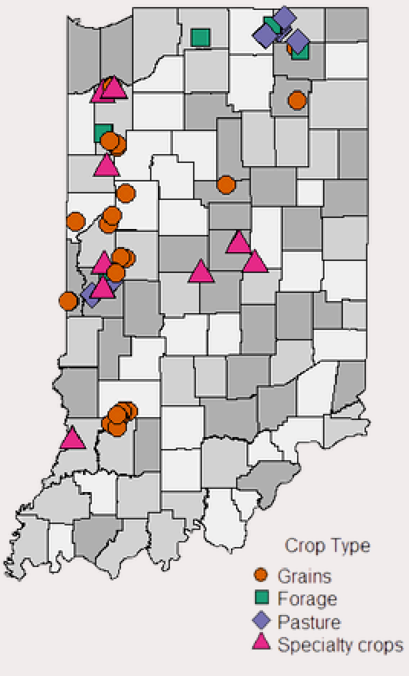


03. SOIL HEALTH

Soil health is foundational to organic farming, as reflected in the wide range of practices employed by organic producers. With synthetic inputs excluded, they rely on ecological approaches—such as crop rotation, cover cropping and organic amendments – to build fertility. These practices enrich the soil and nurture biodiversity and microbial life, both vital to the sustainability of organic systems.

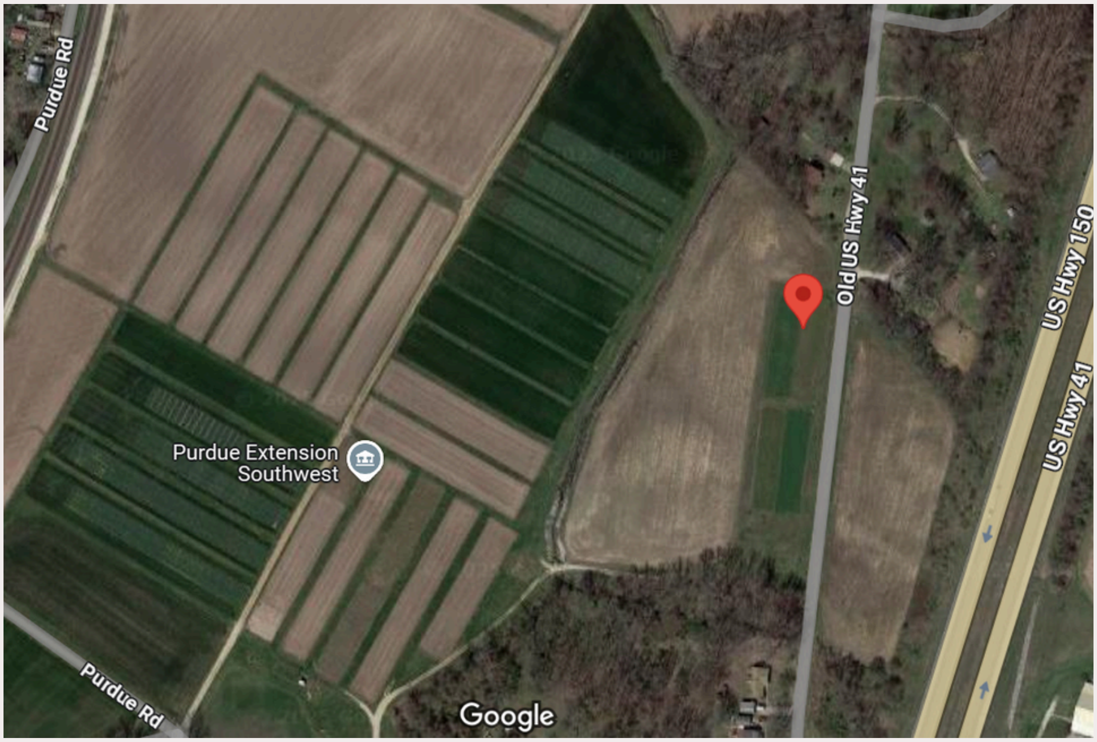
Beyond management, a soil's inherent characteristics —such as texture—play a key role in its ability to support soil health. As the Crossroads of America, Indiana is home to a range of soils shaped by diverse landscapes and geologic histories. The interaction between environmental factors and management practices ultimately determines soil health in a given organic field.

In this project, we partnered with each participating farm to collect samples from one "**high-performing**" and one "**low-performing**" field, based on the farmer's assessment. This approach allows us to study how soil health varies across different fields, regions and management systems.

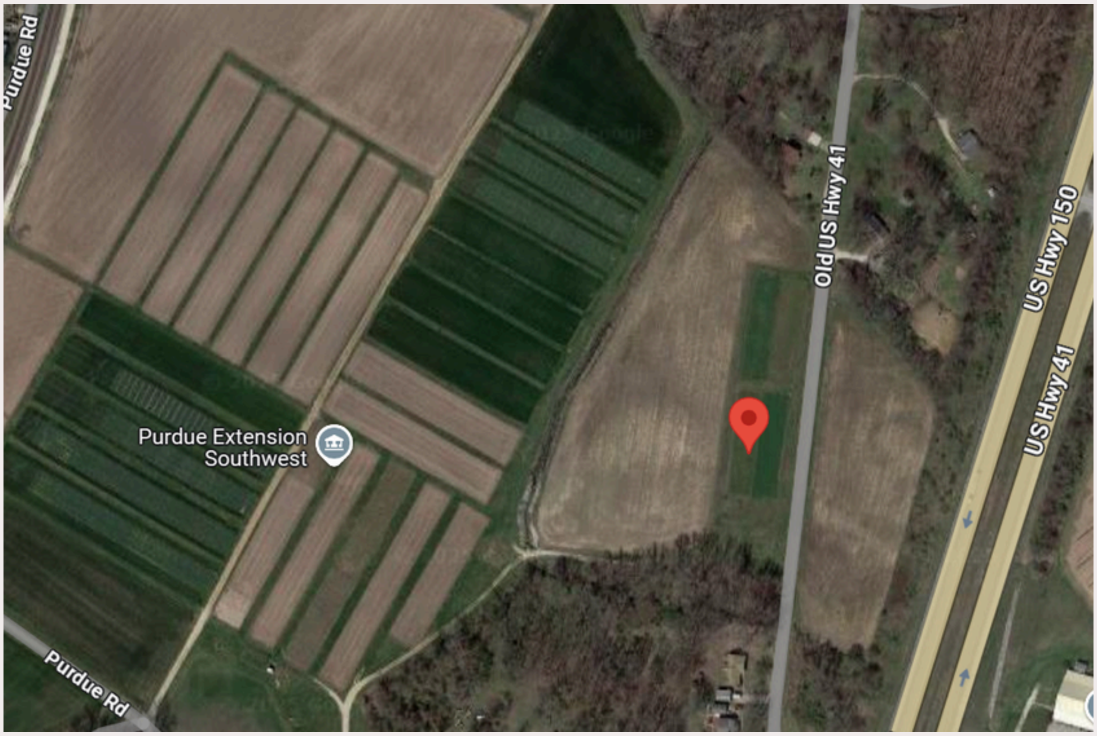


SOUTHWEST PURDUE AG CENTER (SWPAC)

High Performing Location:



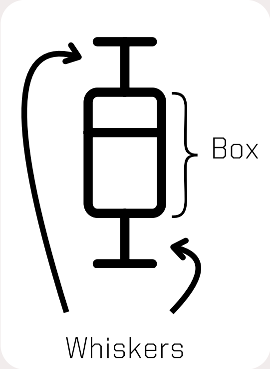
Low Performing Location:



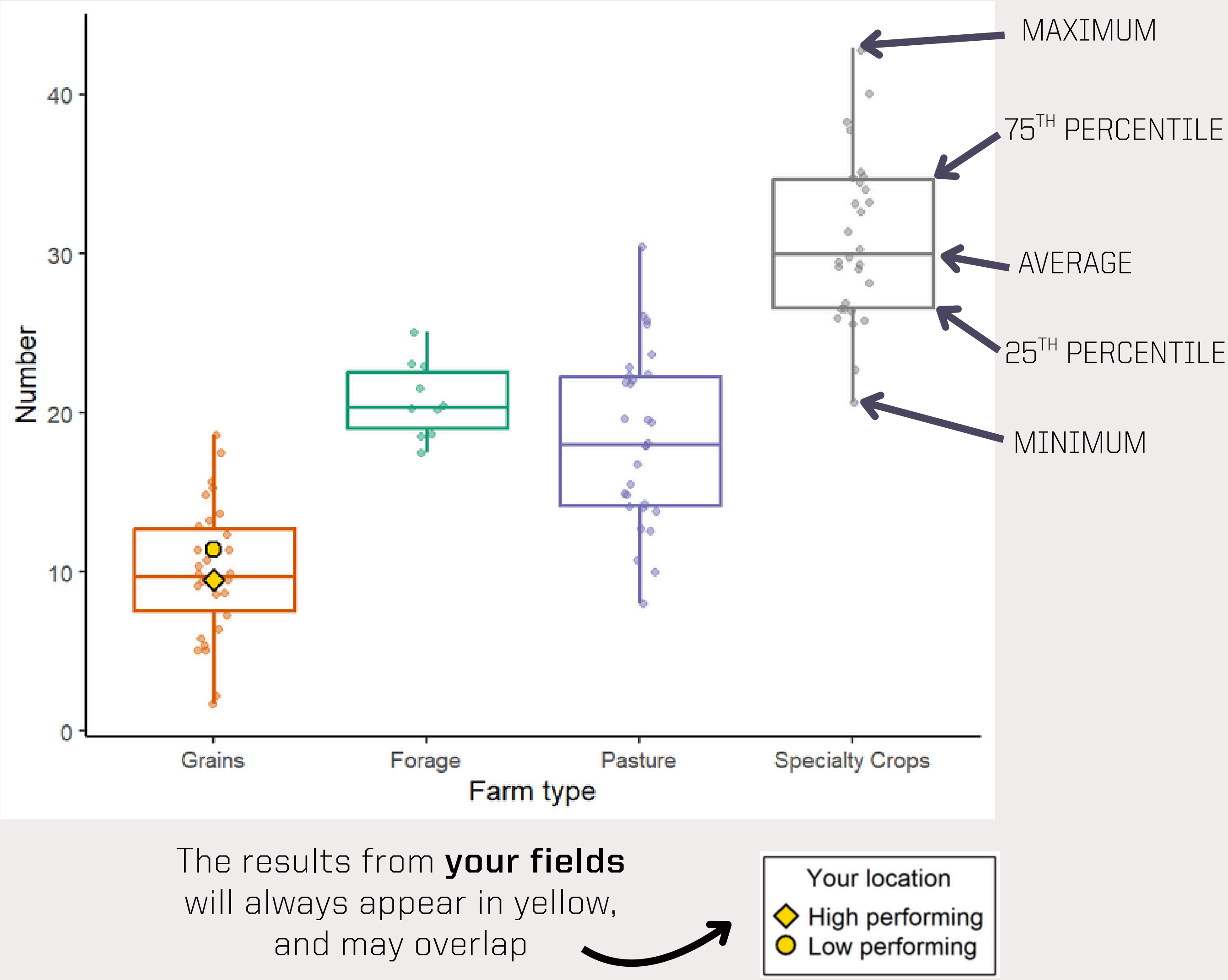
HOW TO INTERPRET THE GRAPHS

On the following pages, we present your results in “**box and whisker**” plots:

- The dots represent every individual data point from our set of participants’ soil samples.
- We sorted the results by “Farm Type,” a loose category describing the type of field we sampled from (e.g., Grain, Forage, etc.).
- You can use these charts to compare data of your two fields to other organic farms across the state.



Example:



The results from **your fields** will always appear in yellow, and may overlap

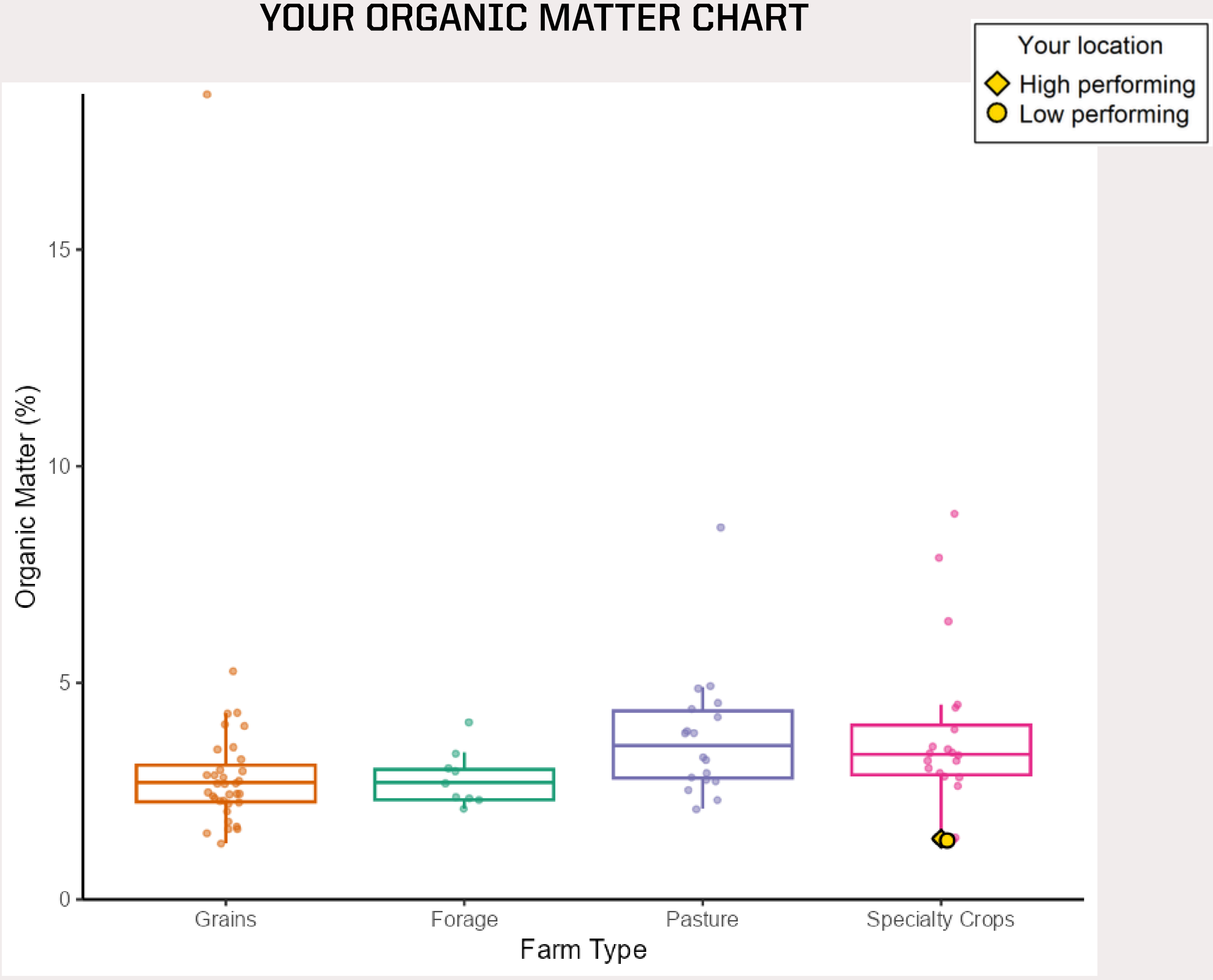
SOIL ORGANIC MATTER

Organic matter (OM) content is the soil property that holds perhaps the most influence over a large number of soil health parameters. Soils with higher organic matter content tend to have **better aeration, faster infiltration, improved aggregate stability** and an **enhanced ability to retain nutrients.**

To determine OM content, we weigh a soil sample, ignite it to burn off all carbon-based compounds so only mineral particles remain, then weigh it again to find the percent OM by weight.

In this project, OM content is generally higher in pasture and specialty crop fields, reflecting the influence of perenniality and organic amendments. The large variability within each farm type suggests the impact of inherent soil properties and individual management practices.

YOUR ORGANIC MATTER CHART



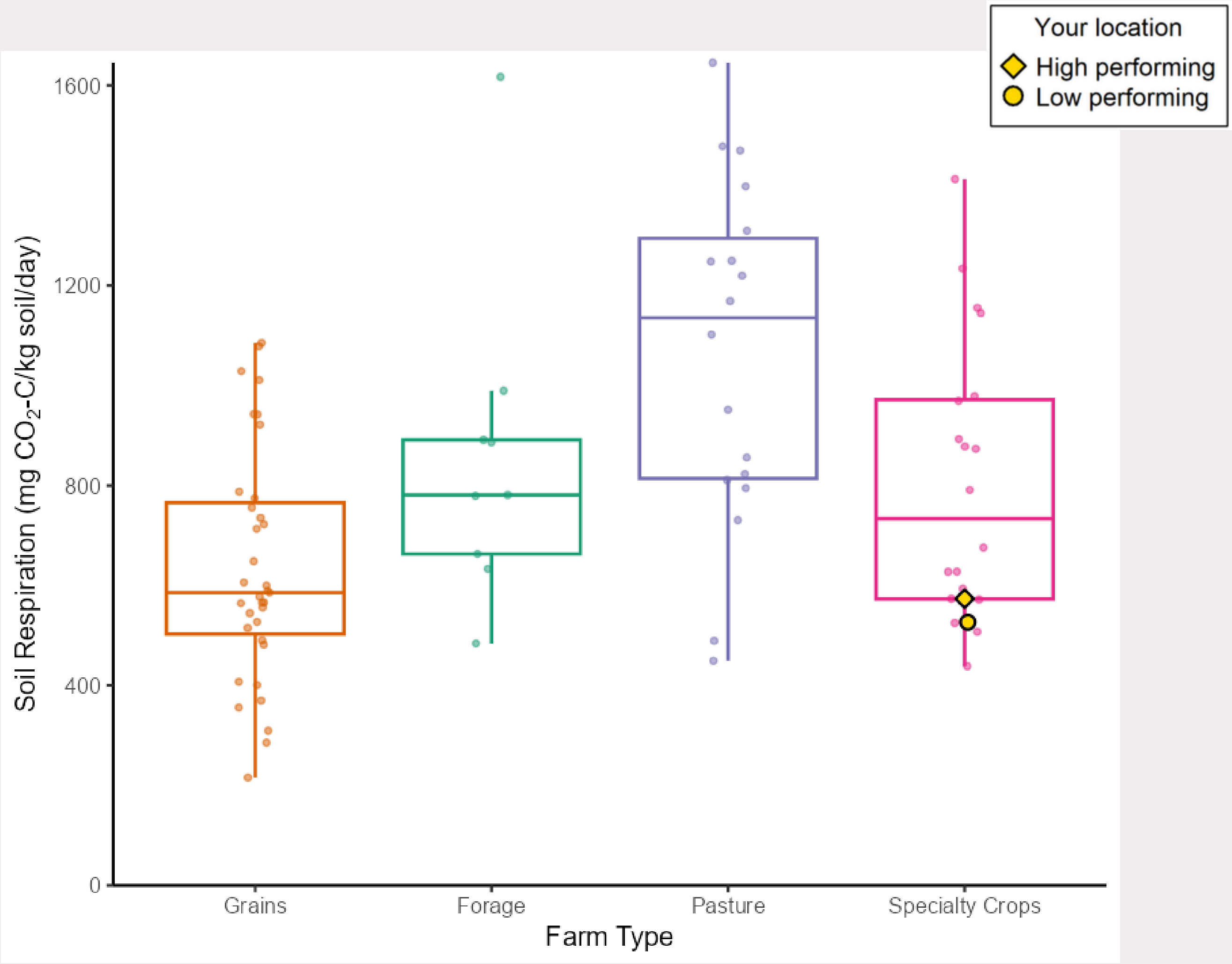
SOIL RESPIRATION

Just like us, **soil microbes exhale CO_2.** As they work to decompose organic matter and cycle nutrients, they produce a measurable amount of CO_2 gas. Respiration informs us of the **metabolic activity of the microbial community within soil.**

To measure soil respiration, we re-wet air-dried soil samples in a sealed jar then measure how much CO_2 is produced after 24 hours.

Similar to OM content, soil microbial respiration is generally highest in pasture fields, followed by specialty crops, forage systems, then organic grain systems.

YOUR SOIL RESPIRATION CHART

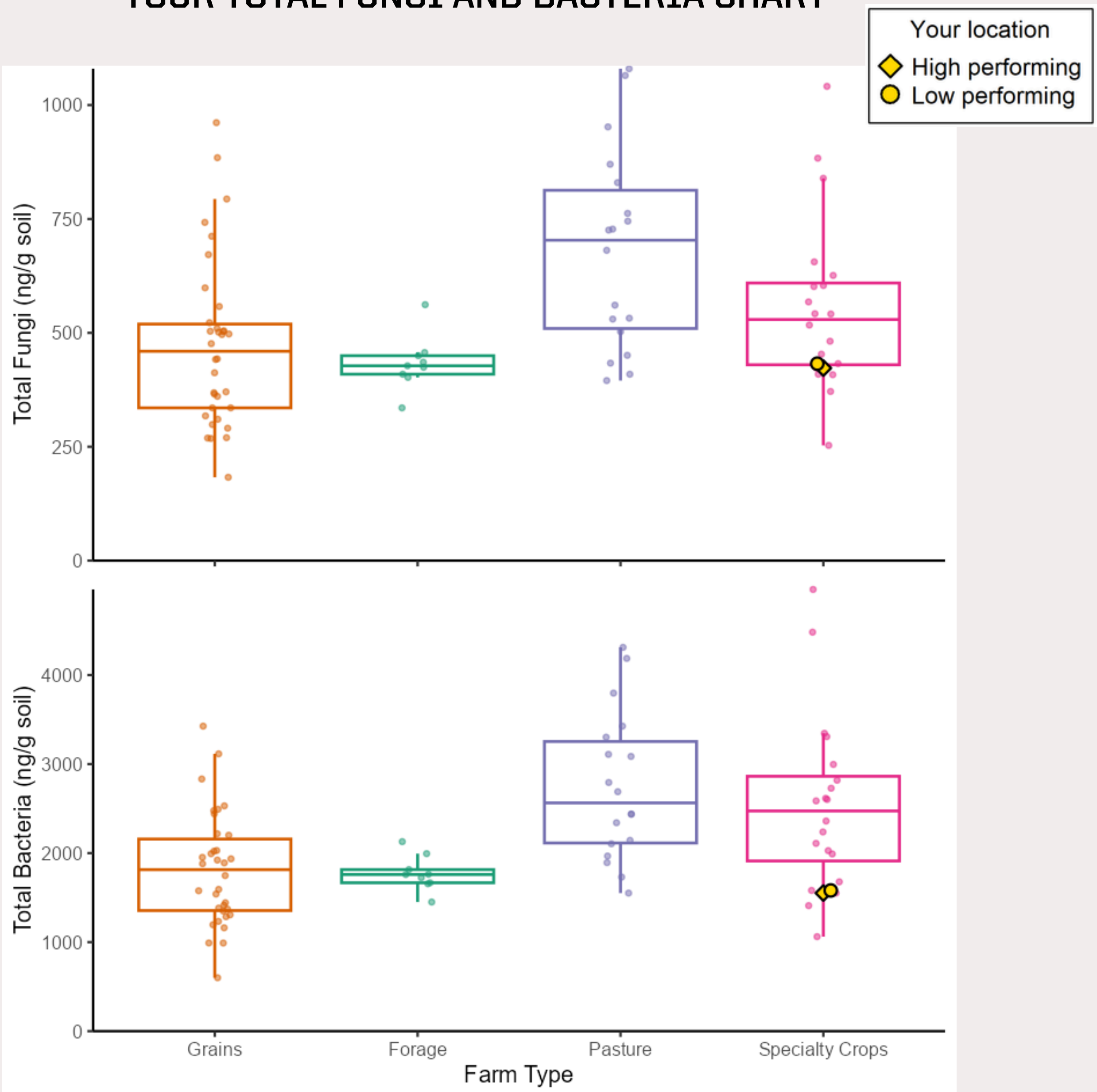


SOIL FUNGI AND BACTERIA

Soil bacteria are rapid decomposers that thrive in disturbed or nutrient-rich environments. They break down simple organic compounds and help cycle nitrogen, playing a key role in **short-term nutrient availability**.

Meanwhile, **fungi** specialize in breaking down more complex materials, such as lignin and cellulose. They are more dominant in undisturbed soils and contribute to **long-term carbon storage, nutrient retention and aggregate formation.**

YOUR TOTAL FUNGI AND BACTERIA CHART

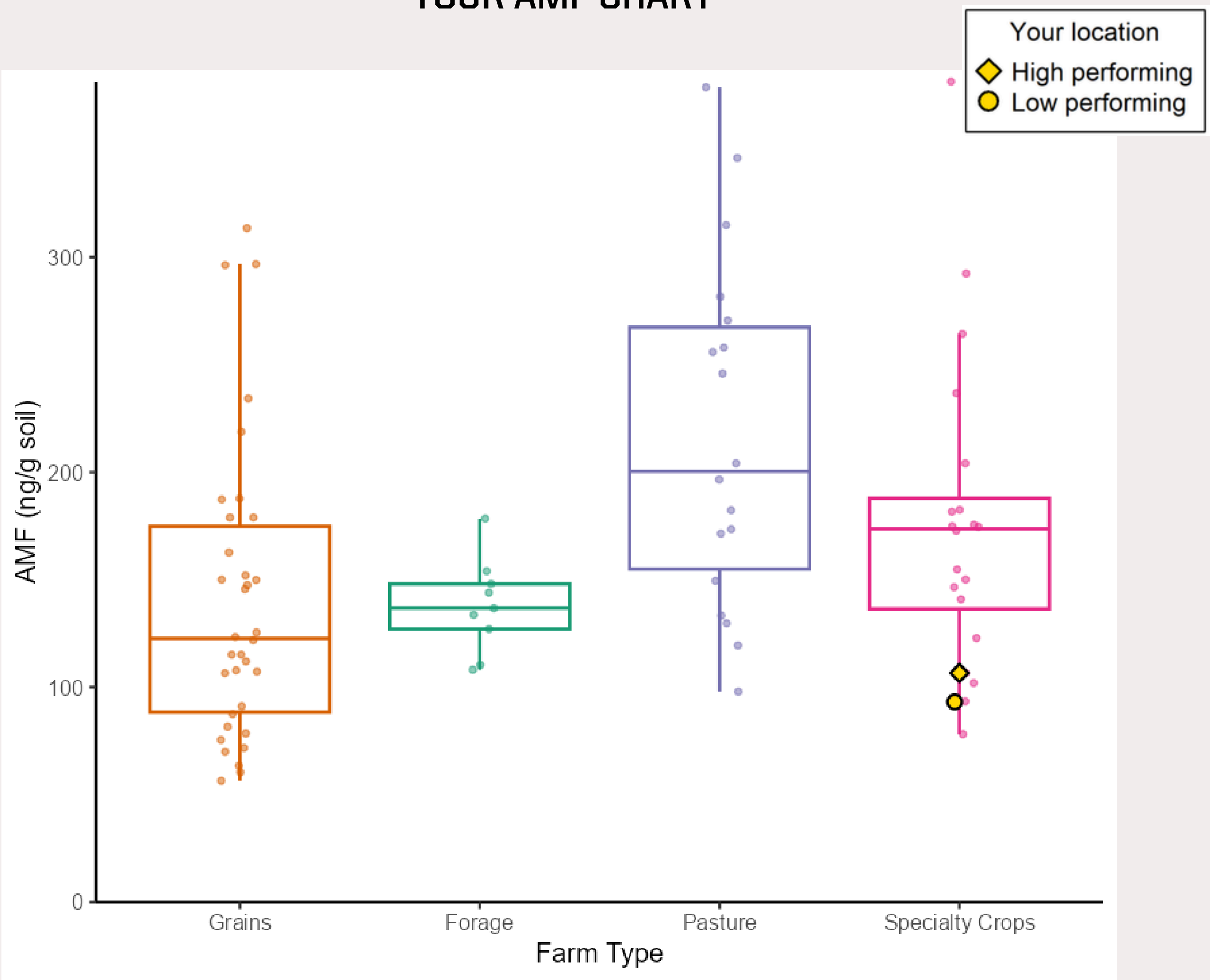


ARBUSCULAR MYCORRHIZAL FUNGI

Arbuscular mycorrhizal fungi (AMF) form **symbiotic relationships** with plant roots. These fungi embed themselves in roots, then extend arms into the soil, essentially **increasing root surface area** and promoting better water and nutrient absorption, especially of phosphorus.

AMF abundance provides insight into the biological support system available to plants. **Higher AMF levels often indicate healthier, biologically active soils with strong plant-microbe interactions.**

YOUR AMF CHART

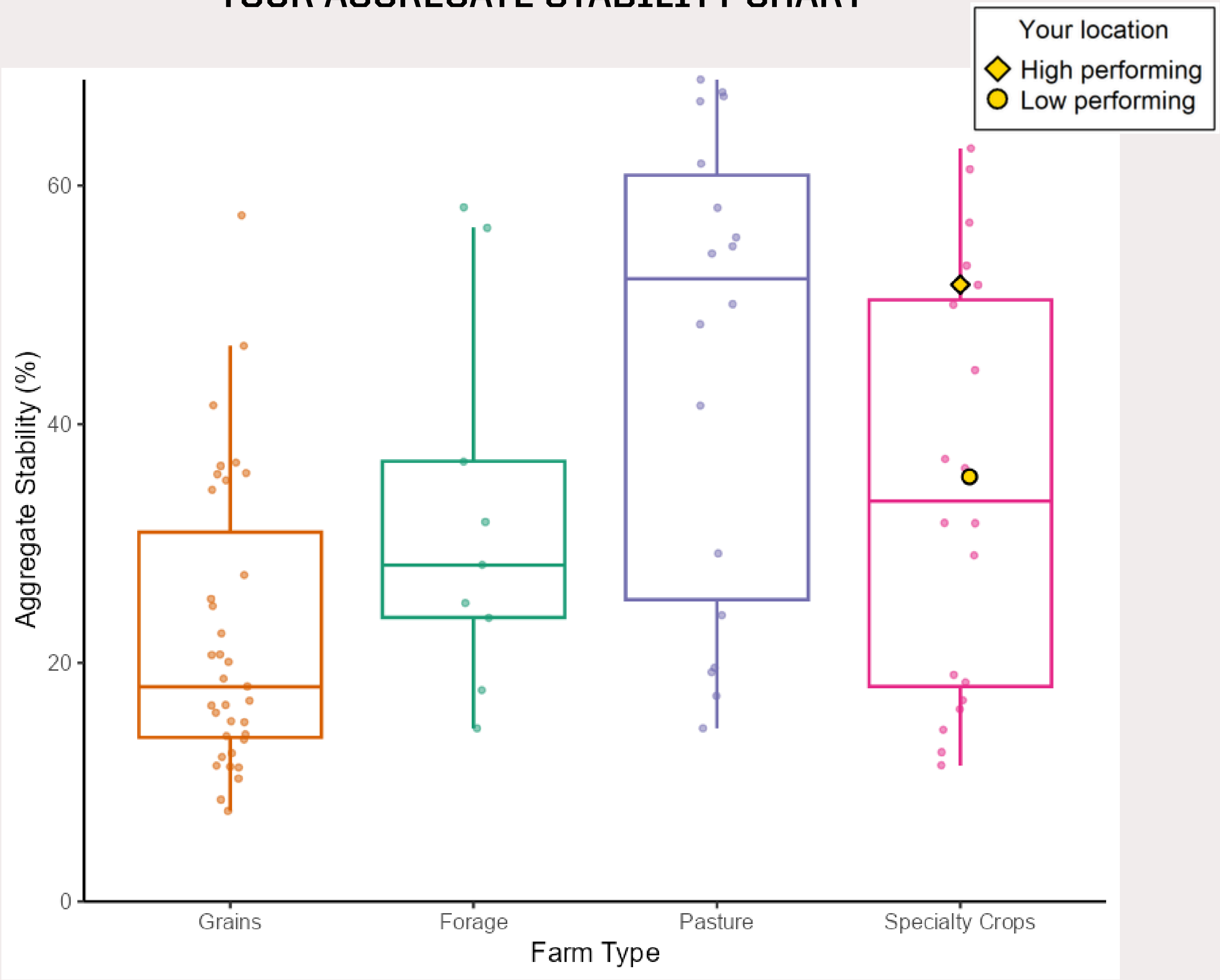


AGGREGATE STABILITY

Aggregate stability refers to **how well soil particles stay bound together** in clumps, or aggregates, when exposed to water or mechanical disturbance. Stable aggregates improve water infiltration, reduce erosion, and help maintain pore spaces that support root growth and microbial activity. **Soils with high organic matter and biological activity tend to have better aggregate stability.**

This parameter is measured by measuring how well aggregates stayed together under simulated rainfall.

YOUR AGGREGATE STABILITY CHART



OTHER RESULTS

Parameter	Unit	High Performing	Low Performing
Organic Matter	percent	1.4	1.4
Soil Respiration	mg CO_2-C/kg soil/day	573.45	526.26
Total Fungi	ng/g soil	422.61	432.4
Total Bacteria	ng/g soil	1551.41	1580.62
Fungi to Bacteria Ratio	NA	0.27	0.27
Arbuscular Mycorrhizal Fungi	ng/g soil	106.59	93.42
Gram Positive	ng/g soil	706.41	712.91
Gram Negative	ng/g soil	845	867.71
Gram Positive to Gram Negative Ratio	NA	0.84	0.82
Total Living Microbial Biomass	ng/g soil	3954.83	4055.45
Actinomycetes	ng/g soil	337.38	294.88
Saprophytes	ng/g soil	316.02	338.97
Protozoa	ng/g soil	97.65	99.98
Predator-Prey Ratio	NA	0.06	0.06
pH	NA	6.5	5.6
Cation Exchange Capacity	meq/100 g	3.2	3.3
P (Phosphorus)	ppm	63	78
K (Potassium)	ppm	95	105
Mg (Magnesium)	ppm	50	40
Ca (Calcium)	ppm	500	300
S (Sulfur)	ppm	6	7
Zn (Zinc)	ppm	2.4	2.6
Mn (Manganese)	ppm	42	43
Fe (Iron)	ppm	21	34
Cu (Copper)	ppm	0.7	1.2
B (Boron)	ppm	0.3	0.2
Wet Aggregate Stability	percent	51.7	35.4
Drainage Class	NA	Somewhat Excessively Drained	Somewhat Excessively Drained
Sand	percent	84	78
Silt	percent	10	16
Clay	percent	6	6
Texture Class	NA	Loamy Sand	Loamy Sand

ADDITIONAL SOIL HEALTH TERMS

BIOLOGICAL

Fungi to Bacteria Ratio: Fungi populations are often considered a stronger indicator of soil health than bacterial populations. A ratio of about 0.2 is considered above average.

Gram Positive: Bacteria that exhibit greater resilience to water stress, due to their ability to form spores.

Gram Negative: Bacteria that exhibit greater resilience to plowing and pesticide use, due to having a protective outer membrane.

Gram Positive to Gram Negative Ratio: An indication of present stressors. A higher ratio indicates a greater proportion of gram positive bacteria and water stress. A lower ratio indicates a greater proportion of gram negative bacteria and soil disturbance or pesticide stress.

Total Living Microbial Biomass: The total amount of active bacteria, fungi, and other types of microbes.

Actinomycetes: Filamentous bacteria that play a significant role in forming stable soil aggregates by producing organic compounds that help bind soil particles together.

Saprophytes: Bacteria or fungi that decompose organic matter and transform nutrients into inorganic forms that plants are able to take up.

Protozoa: Single-celled organisms that feed on bacteria.

Predator-Prey Ratio: This is the ratio of protozoa to bacteria. While predator populations will always be lower than bacterial populations, a relatively higher ratio is viewed positively as it indicates that there are sufficient nutrients in the system to support multiple trophic levels. Ratios above 0.01 are considered above average.

CHEMICAL

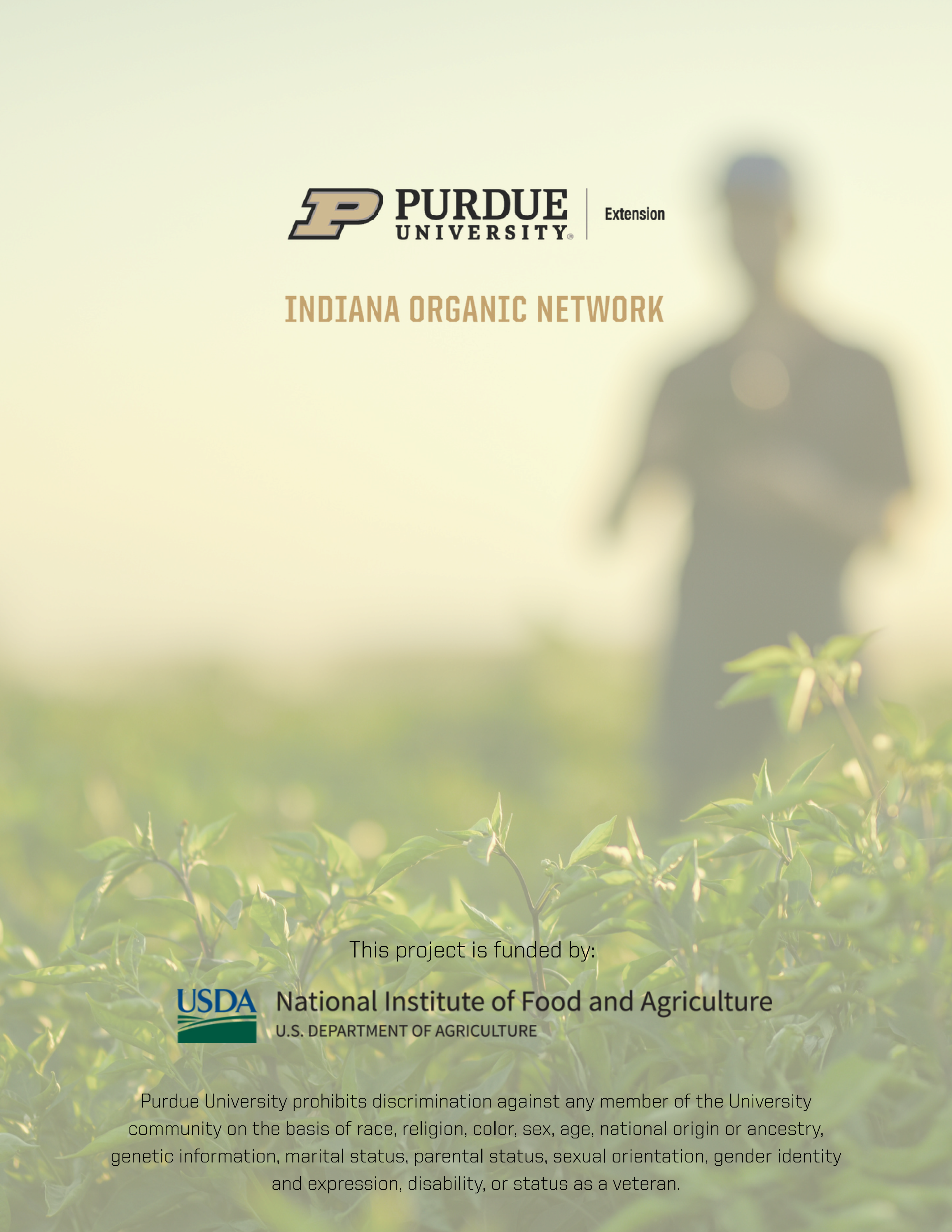
Cation Exchange Capacity (CEC): Soils do not all have equal ability to absorb and hold onto nutrients. Many nutrients integral to plant health are positively charged (cations) and need particles with a negative charge (anions) to latch onto. High clay and organic matter content are associated with high CEC.

Macronutrients: Phosphorus, potassium, magnesium, calcium, sulfur.

Micronutrients: Zinc, manganese, iron, copper, boron.

PHYSICAL

Drainage class: A soil characteristic defined by the USDA Web Soil Survey, indicating the natural drainage capacity of the soil based on water movement and saturation patterns.



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This project is funded by:

USDA National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE