SOIL HEALTH

Introduction to Soil Health

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SECTIONS

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Beginning Farmer
Resource & Decision-Making Guide

Soil Health

INTRODUCTION

Soil is one of the most important resources for farmers. It's where plants grow, and it supports all life on the farm. Many cultures throughout history have understood how valuable soil is. Early farmers were likely amazed to see how seeds placed in the ground would sprout and grow into food year after year.

Soil is more than just something underfoot—it's the foundation for growing healthy crops. It holds water and nutrients, supports plant roots and provides a home for many living things that help plants grow.

It's important to know that **soil is not the same as dirt**. Soil is a mix of minerals, organic matter, air, water and living organisms. The Soil Science Society of America defines soil as "the unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants." This is the basis of farming and growing food. Soil scientists describe soil as a natural part of the earth's surface that has formed over time through the effects of climate (water, temperature, wind), living organisms, and the shape of the land.

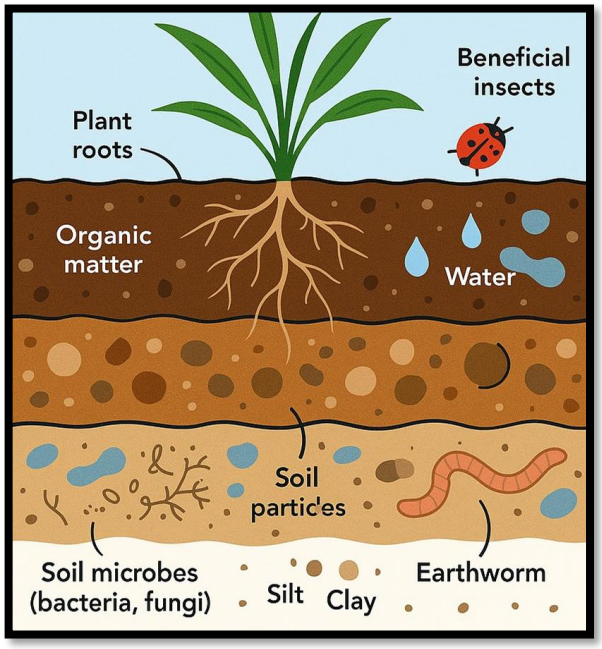
Soil serves as a foundational component of agriculture as well as infrastructure such as roads and buildings. It plays a critical role in hydrological processes by absorbing precipitation and gradually releasing it into groundwater systems. Additionally, soil acts as a natural filter for chemical substances and provides habitat for a diverse community of organisms—including insects, earthworms, fungi and bacteria—that contribute to soil health and nutrient cycling. Organic matter within the soil is essential for carbon sequestration and supports the biological processes that supply nutrients to plants

Understanding Soil Health

These days, there's a lot of talk about "building healthy soils." But what exactly does that mean? The challenge is that there isn't one single, agreed-upon definition of what makes soil "healthy."

For the purposes of this discussion, we'll use the definition provided by the USDA Natural Resources Conservation Service (USDA-NRCS), **"Healthy, fully functioning soil is balanced to provide an environment that sustains and nourishes plants, soil microbes, and beneficial insects."**

For agricultural growers one of the most important points about soil is that healthy soil promotes plant growth, feeds microorganism living in the soil, and creates a home for other organisms such as insects. It's a living system.



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Soil is much more than dirt—it's a bustling ecosystem, teeming with visible and invisible life. From earthworms to microorganisms such as bacteria and fungi , countless organisms call soil home, relying on it not just for shelter but also for nourishment. In fact, a single teaspoon of healthy soil holds more living organisms than the entire human population. These microorganisms play a critical role in maintaining soil health and balance. When soil supports a rich and diverse biological community, it can better perform life functions like nutrient cycling, water filtration, and plant growth—hallmarks of a truly healthy soil.

Soil Functions

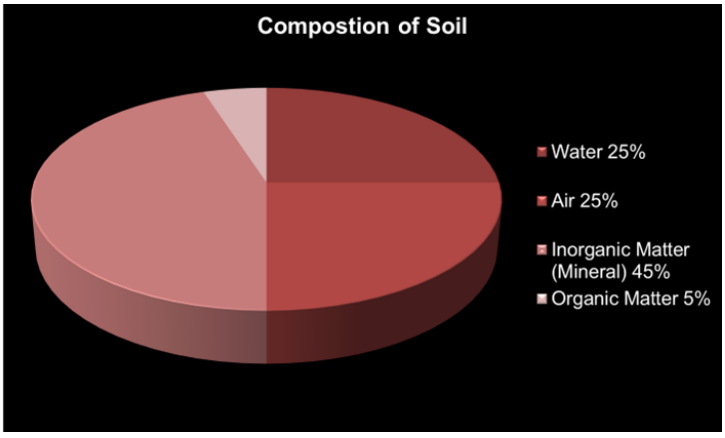
Healthy plant growth depends on what the soil can offer. Healthy soil provides:

- A healthy space where plants can grow well
- Provides microbes a place to live
- Water to transport nutrients and cool plants as plant-water evaporates.
- Air for roots to absorb oxygen and release carbon dioxide
- Nutrients to build plant tissues
- Anchors plants to keep them steady and supports good root growth

Soil Composition

Soil is made of four key parts:

- **Minerals**: Sand, silt, and clay containing essential elements like calcium and magnesium
- **Water**: Holds dissolved nutrients and supplies moisture to plants
- **Air**: Provides oxygen for roots and removes carbon dioxide
- **Organic Matter**: Helps form soil aggregates, improving water flow and air exchange. **Soil organic matter** is all non-mineral solids in soil, arising from biological tissues, byproducts, and wastes living and decomposing.



The ideal soil includes:

- 45% minerals
- 25% water
- 25% air
- 5% amount of organic matter

Soil Formation

Most Michigan soils come from weathered rock. Over time, forces like rain, ice, wind, plants and even microbes break rocks down into tiny particles. Glaciers helped grind and mix these particles into sand, silt, and clay—building blocks of Michigan's mineral soils.

Soil Formation Basics:

Soil formation begins with parent material, such as weathered rock or wind-blown silt known as loess. Over time, this raw material transforms into soil through natural processes—organisms grow and die, precipitation carries away minerals through infiltrating through the soil or runoff, and distinct soil horizons slowly develop. These layers take years to form and reflect the ongoing influence of climate, plant life, and biological activity. In Michigan, where forests dominate the landscape, soils typically have thinner topsoil compared to those found in the deep-rooted grasslands of prairie regions. This difference affects how the soil supports crops and how it should be managed for farming.

Photo Courtesy: Michigan State University

Soil Horizons Overview:

This is more soil science vs improving soil for healthy crops, you said you needed to reduce this, maybe just mention there are horizons or soil layers and the top 2

- **O horizon**: Surface litter and plant debris
- **A horizon**: Dark topsoil rich in organic matter
- **E horizon** (often missing): Leached zone with few nutrients
- **B horizon**: Subsoil where minerals and clays collect
- **C horizon**: Partially weathered parent material
- **R horizon**: Bedrock (deep below in Michigan)

Special Michigan Soils:

Soils form in wet areas and include:

- Peat: Partially decomposed plant matter
- Muck: Fully decomposed organic material

These soils, rich in organic matter, are great for vegetables when drained.

Soil Surveys:

Soils are grouped into series based on traits like texture and slope. The USDA Soil Survey provides maps and descriptions to help farmers understand their land available at websoilsurvey.nrcs.usdaa.gov.

How To Get Started

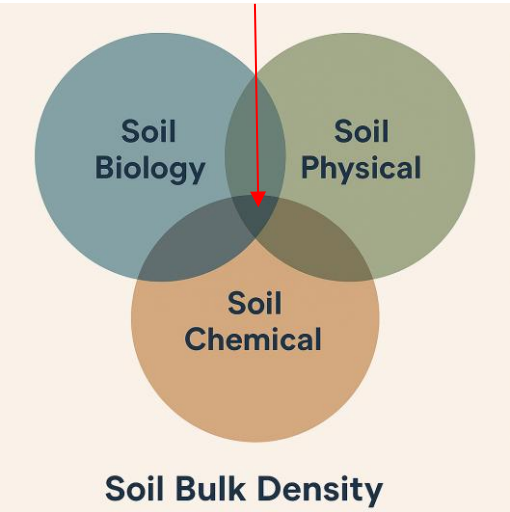
Soil health can be divided up into 3 soil characteristics:

1.Biological

2.Physical

3.Chemical

Where these three characteristics all intersect is where to find good healthy plant producing soil:



We will explore each of these soil characteristics to better understand how growers can manage their soil to have better production.

Food for thought: **Consider ways to manage soil that improve crops and your profits-matching your farm goals.** What we mean is to not try to produce crops that prefer muck soils such as elderberries or certain root crops in sandy soils.Grow crops that grow well in the soil that you have. Start wisely to end happily.

Photo Credit: https://extension.psu.edu/earthworms

RESOURCES & PARTNERS

Soil Resources

To explore your soil visit the USDA-NRCS Web Soil Survey

https://websoilsurvey.nrcs.usda.gov/app/

"Building Soils for Better Crops". SARE Publication 10

https://www.sare.org/resources/building-soils-for-better-crops/

Photo Credit: https://www.ndsu.edu/soilhealth/?page_id=410

SECTION 1

Soil Physical Properties

Soil's physical traits affect how it behaves and how we can use it. Key properties include:

- Texture
- Structure
- Temperature
- Density
- Porosity
- Moisture
- Organic Matter
- Color

Heavily Tilled Soil

Soil Physical Properties

Texture: What Soil Is Made Of

Soil texture is the mix of sand, silt, and clay particles. These vary in size:

Particle Type	Size Range
Sand	2–0.05 mm
Silt	0.05–0.002 mm
Clay	< 0.002 mm

Most soils contain a mix of these particles. Texture influences drainage, water holding and nutrient availability. A loam, for example, balances sand, silt, and clay—making it great for farming.

The textural triangle is a tool used to identify a soil's texture class, based on lab-tested percentages of sand, silt, and clay.

Feel and Function

You can feel texture by hand:

- **Sand** feels gritty
- **Silt** is smooth and silky
- **Clay** is sticky when wet

Texture shapes:

- How water moves and drains
- How roots grow
- How nutrients are held
- How soil warms or cools

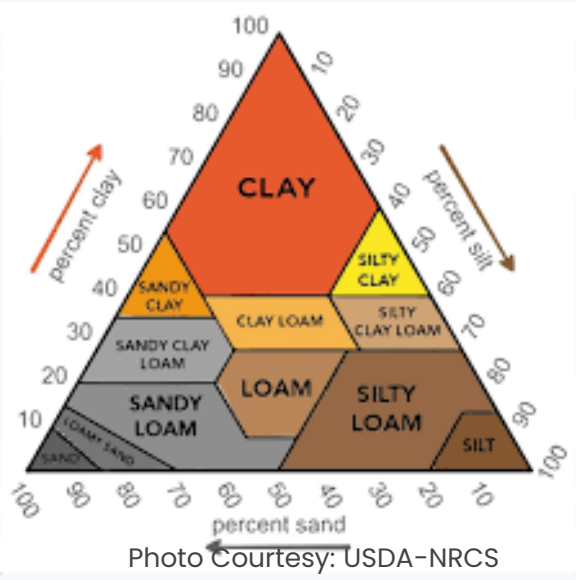


Photo Courtesy: USDA-NRCS

Structure: How Soil Holds Together

Soil structure is how particles stick together to form aggregates. These affect root growth, water movement, nutrient availability and soil health.

Structure forms through:

- Microbial activity That add gums and glues
- Wetting and drying cycles
- Plant roots, decaying plant materials and burrowing organisms

Good structure means good tilth—easy for roots to grow and water to flow. While texture can't be changed, structure can be improved through healthy practices like organic matter addition and reduced compaction.

Soil Physical Properties

How Soil Structure Gets Damaged—and How to Protect It

Healthy soil has good aggregation: large pores for air and drainage, small pores for water and nutrients. But compaction, over-tillage (shattering), and organic matter loss are common threats.

1. Compaction

- Happens when soil is worked while wet (e.g., driven or walked on), causing aggregates to press together.
- Reduces pore space, restricts air, water and root movement.
- High bulk density = poor plant growth.
- Compaction can reach subsoil depths and become long-lasting or permanent.

2. Shattering (Over-Tillage)

- Excessive use of rototillers, disks or cultivators pulverizes aggregates, forming weak, unstable soil.
- Dry or sandy soils are especially vulnerable.
- Rain or irrigation then causes crusting, which blocks air/water movement and plant emergence.
- Surface runoff may lead to erosion and water pollution.

3. Organic Matter Depletion

- Frequent tillage accelerates breakdown of organic matter.
- Without regular replenishment (e.g., compost, crop residues), aggregation declines.
- Depleted soils become more prone to compaction and breakdown.

Bottom Line

Tillage is a tool—not a fix-all. Use it wisely. Understand your soil's condition, choose the right equipment, and prioritize soil health with minimal disturbance and regular organic inputs.

Soil Physical Properties

Improving Soil Health: Practical Steps for Farmers

One of the most effective ways to build healthy soil is by adding organic matter. This strengthens soil structure, supports good water movement, and boosts fertility. It also feeds microbes that create sticky substances (microbial gums) which bind soil particles together into stable aggregates.

What to Add:

- Crop residues and compost help build structure and retain nutrients.
- Cover crops (also known as green manure) protect soil during off-seasons and add biomass when turned under.

Using Manure Safely

- Raw manure should not be applied less than 120 days before harvest to avoid contamination risks (e.g., E. coli).
- Composted manure (120 days) is safer and provides excellent nutrients.
- Always follow food safety guidelines, especially for crops eaten raw.

Earthworms: Nature's Engineers

Earthworms improve soil health by:

- Mixing organic matter with minerals fertilizer
- Creating channels for water and air
- Supporting microbial activity
- A healthy worm population is often a sign of a thriving soil ecosystem.

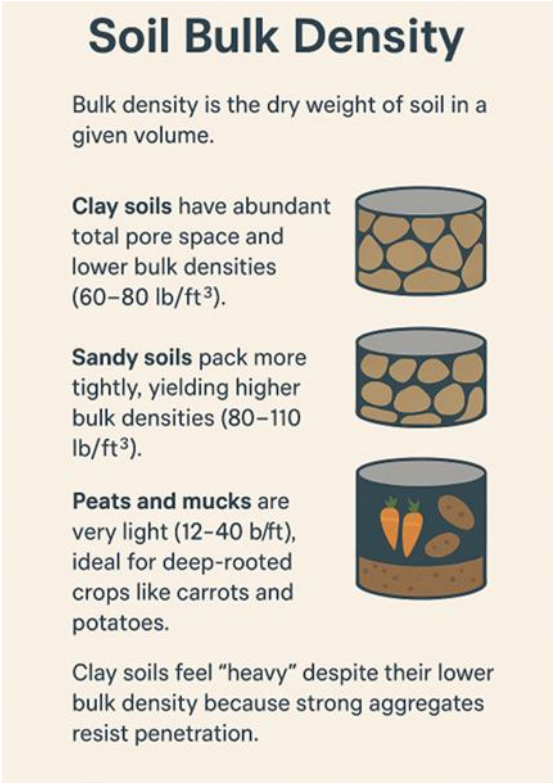
Some growers try to "fix" sandy soils by adding clay—or clay soils by adding sand. While small, balanced mixes (e.g., 5–10% clay into sand) can work, too much clay turns soil into concrete. A better, more reliable solution? Add organic matter.

What about adding soil amendments

Before adding any soil amendments, a wise grower will take a soil test. Add soil amendments based on recommendations of the soil test. Adding amendments without knowing what the soil needs can cause more harm than good, reducing yields and crop quality. For example, gypsum (calcium sulfate) may help improve structure in high-sodium soils by replacing sodium with calcium, allowing clays to form aggregates again. Most soils in Michigan and Eastern U.S. do not have high sodium. Gypsum is usually unnecessary unless soil is impacted by salt, like near roads or sidewalks. Unlike lime, gypsum is pH-neutral, so it won't raise soil pH. but it can also interact with other nutrients causing a soil nutrient imbalance.

Bulk Density and Soil Weight

Bulk density measures the dry weight of soil in a given volume. It reflects how tightly soil particles are packed and influences root growth, water movement, and aeration.



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- Clay soils have abundant total pore space and lower bulk densities (60–80 lb/ft³).
- Sandy soils pack more tightly, yielding higher bulk densities (80–110 lb/ft³).
- Peats and mucks are very light (12–40 lb/ft³), ideal for deep-rooted crops like carrots and potatoes.
- Clay soils feel "heavy" despite their lower bulk density because strong aggregates resist penetration of water and roots.

Key Takeaways for Beginning Farmers

- Aim for a balance of macropores (for drainage and roots) and micropores (for water storage).
- Improve structure with organic matter rather than altering texture.
- Monitor soil moisture to time irrigation and avoid water stress.
- Maintain healthy porosity to reduce compaction, erosion and poor aeration.

Soil Temperature

Appropriate soil temperature is crucial for seed germination, root growth and nutrient uptake. It's influenced by:

- Heat Input: Solar radiation warms the surface; darker soils (clay) absorb more heat than lighter soils (sand).
- Water Content: Wet soils heat and cool more slowly due to water's high heat capacity.

Management Practices:

- Mulching: Insulates soil, evens out temperature swings, and conserves moisture. • Remove mulch in spring so soil can warm quickly for planting.
- Tillage: Brings cool subsurface soil to the surface for faster warming. • Drying the tilled layer and removing residues increases solar heating.
- Frost Protection : Avoid cultivating, hoeing, or adding mulch when frost is expected—these actions reduce soil's ability to warm the air around the plants and can worsen frost damage.

Soil Color

Soil color reveals organic matter content, surface heating rates, and natural drainage:

Photo Generated with AI

Summary

1. Test soil before applying soil amendments like gypsum or lime
2. Know Your Soil Profile : A loamy topsoil over gravel at 2–3 feet can be drier than it appears.
3. Building Structure: Adding organic matter improves soil aggregation—but avoid nutrient overload with excessive manure.
4. Manage Compaction: Fine textured, wet soils are most vulnerable. If you must till to break compaction layer do it when the soil is dry.
5. Control Erosion: Maintain ground cover on slopes or adopt no-till methods. Use residues and mulches to shield soil from rain and wind.
6. Frost Warning: Hold off on any soil disturbance when frost is predicted to avoid increasing risk of damage.

Tips and Tricks to Minimize Physical Degradation of soil

Compaction:

1. Ball Test: Squeeze soil into a ball. If it crumbles, it's dry enough to till.
2. Avoid: Heavy machinery on wet soils and repeated use of plows/disks at the same depth.
3. Tip: Use tillage only when necessary—and only when soils are dry enough to break compacted zones.

Shattering

Tip: Rotate tillage tools and depths. Reduce tillage intensity. Protect soil with cover crops and organic amendments.

Organic Matter Depletion

Tip: Add organic matter as needed and limit disturbance. Healthy microbial activity builds resilient soil structure.

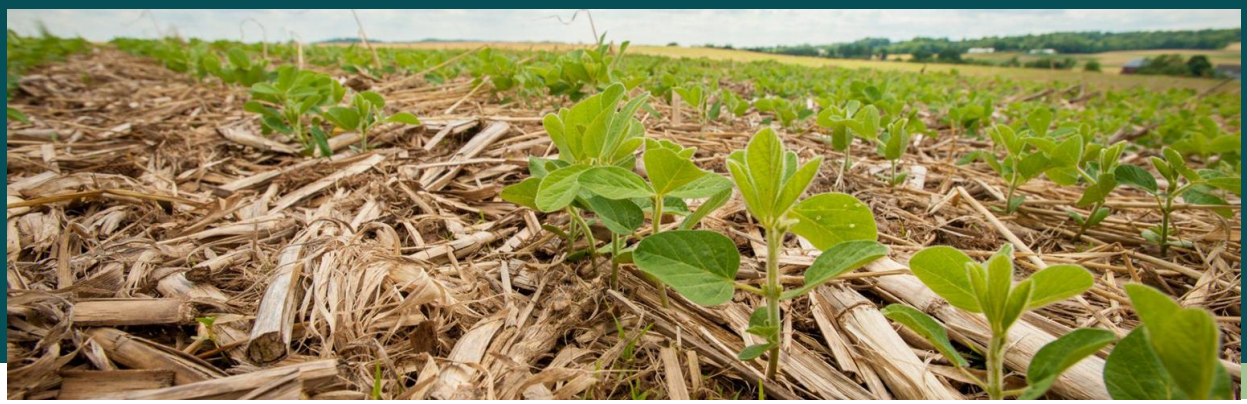

Photo Credit: https://covercropimages.sare.org/p113337072

RESOURCES & PARTNERS

Soil Resources

To explore your soil visit the USDA-NRCS Websoil Survey

https://websoilsurvey.nrcs.usda.gov/app/

"Building Soils for Better Crops". SARE Publication 10

https://www.sare.org/resources/building-soils-for-better-crops/

Soil Health Nexus Toolbox

https://soilhealthnexus.org/resources/soil-properties/soil-physical-properties/

"Beginning Farmer Curriculum- Soil Health"

https://www.beginningfarmercurriculum.org/soil-health

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SECTION 2

Soil Chemical Properties

Understanding Plant Nutrients for Beginners

To grow strong and healthy plants, 16 essential nutrients are needed. Think of these nutrients as the building blocks that help plants develop properly.

Each capital letter in the chart below stands for one of these nutrients:

H-Hydrogen	C-Carbon
O-Oxygen	B-Boron
P-Phosphorus	Mg-Magnesium
K- Potassium	Cl-Chlorine
N-Nitrogen	Mn-Manganese
S-Sulfur	Mo-Molybdenum
Ca-Calcium	Cu-Copper
I-Iron	Zn-Zinc

Where Do These Nutrients Come From?

- Hydrogen from the water in the soil.
- Oxygen comes from air, plants absorb it through their stomata and lenticels.
- Carbon comes from carbon dioxide in the air, absorbed through the plants stomata.
- Nitrogen mainly comes from decaying organic matter in the soil, but legumes can also enrich the soil by fixing nitrogen. This process, called nitrogen fixation, occurs when bacteria living on their roots convert nitrogen from the air into a form the plants can use.
- The other nutrients are found in soil minerals and organic matter.

Macronutrients vs. Micronutrients
Plants need macronutrients in larger amounts and micronutrients in smaller amounts—but both are equally important!

Macronutrients	Micronutrients
Nitrogen (N)	Boron (B)
Phosphorus (P)	Chloride (Cl)
Potassuyn (K)	Manganese (Mn)
Magnesium (Mg)	Nickel (Ni)
Calcium (Ca)	Copper (Cu)
Sulfur (S)	Iron (Fe)
	Molybdenum (Mo)
	Zinc (Zn)

Next Steps
Understanding how each nutrient helps plants and how to manage them in your soil is key to successful farming. Up next: a closer look at the six macronutrients—what they do, how they behave, and how to make sure your plants get enough of them.

Macronutrients: What Plants Need Most

Plants need six main nutrients in large amounts to grow well. These are called **macronutrients**, and each one helps with different parts of plant growth.

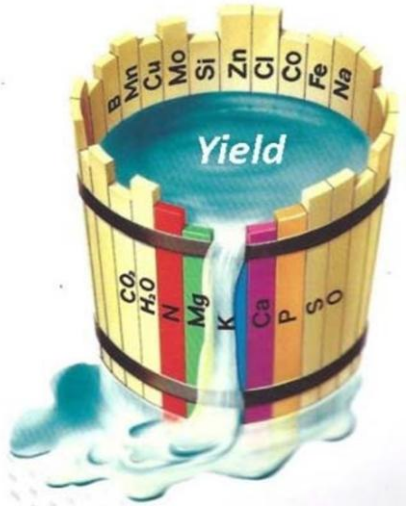
🌱 Macronutrient	🌿 Role in Plant Growth	🧪 Common Sources	⚠️ Deficiency Symptoms	🚫 Excess Symptoms
Nitrogen (N)	Leaf and stem growth; chlorophyll production	Compost, manure, ammonium nitrate, urea	Yellowing of older leaves; stunted growth	Weak, fast growth; fewer fruits
Phosphorus (P)	Root development; flower formation; energy transfer	Bone meal, rock phosphate, superphosphate	Small size; purple/brown leaves; leaf drop	Blocks zinc and iron uptake
Potassium (K)	Fruit development; water regulation; disease resistance	Potash, wood ash, potassium sulfate	Weak stems; leaf edge browning; fewer fruits	Blocks magnesium and calcium uptake
Magnesium (Mg)	Chlorophyll formation; seed production	Epsom salts, dolomitic lime	Yellowing between veins on older leaves	Blocks calcium absorption
Calcium (Ca)	Cell wall strength; root and leaf development	Lime, gypsum, calcium nitrate	Curled leaves; weak stems; blossom-end rot	Raises soil pH; blocks other nutrients
Sulfur (S)	Protein and amino acid formation	Gypsum, elemental sulfur, sulfate fertilizers	Pale leaves; slow growth	Soil acidification (rare)

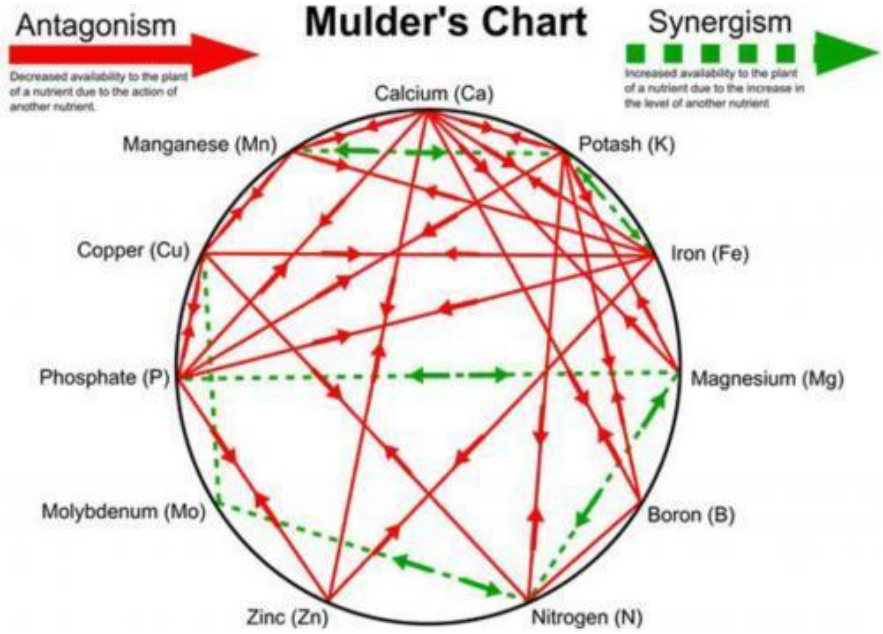
Why Nutrient Balance Matters in Soil
It's not just about having the right nutrients in your soil—it's about having the right *balance* of them. Plants need both **macronutrients** (like nitrogen and potassium) and **micronutrients** (like iron and zinc). If there's too much or too little of any one, it can cause problems.
Some nutrients help each other work better—this is called a **synergistic** relationship. Others can get in each other's way—this is called an **antagonistic** relationship, see Mulder's Chart.

Example:

- **Potassium** helps plants use **iron** and **manganese**.
- But if there's *too much potassium*, it can block the plant from using **magnesium**, **boron**, **nitrogen**, **phosphorus**, and **calcium**—even if those nutrients are in the soil!
- Sometimes, a nutrient like **calcium** can:
- **Outcompete** other nutrients like potassium and magnesium at the root level.
- **Change the soil's pH**, making nutrients like iron and boron harder for plants to absorb.

Another way to look at it is imagine nutrients as the wooden slats of a bucket. If one slat is shorter than the others, the bucket can't hold much water. That's how nutrient imbalance works—plants can only grow as well as the *least available* nutrient allows.





Photos Courtesy of Ron Goldy, MSUE retired

Understanding Soil pH

Soil pH tells us how acidic or alkaline the soil is. It's based on the amount of hydrogen ions (H^+) in the soil. More hydrogen ions mean the soil is more acidic; fewer mean it's more alkaline.
Soil pH is measured on a scale from 0 to 14:

- 7 is neutral (like pure water).
- Below 7 is acidic.
- Above 7 is alkaline.

Each step down the scale (for example, from 7 to 6) means the soil is 10 times more acidic. So, soil with a pH of 4 is 1,000 times more acidic than neutral water at 7!

Why does this matter? Because soil pH affects:

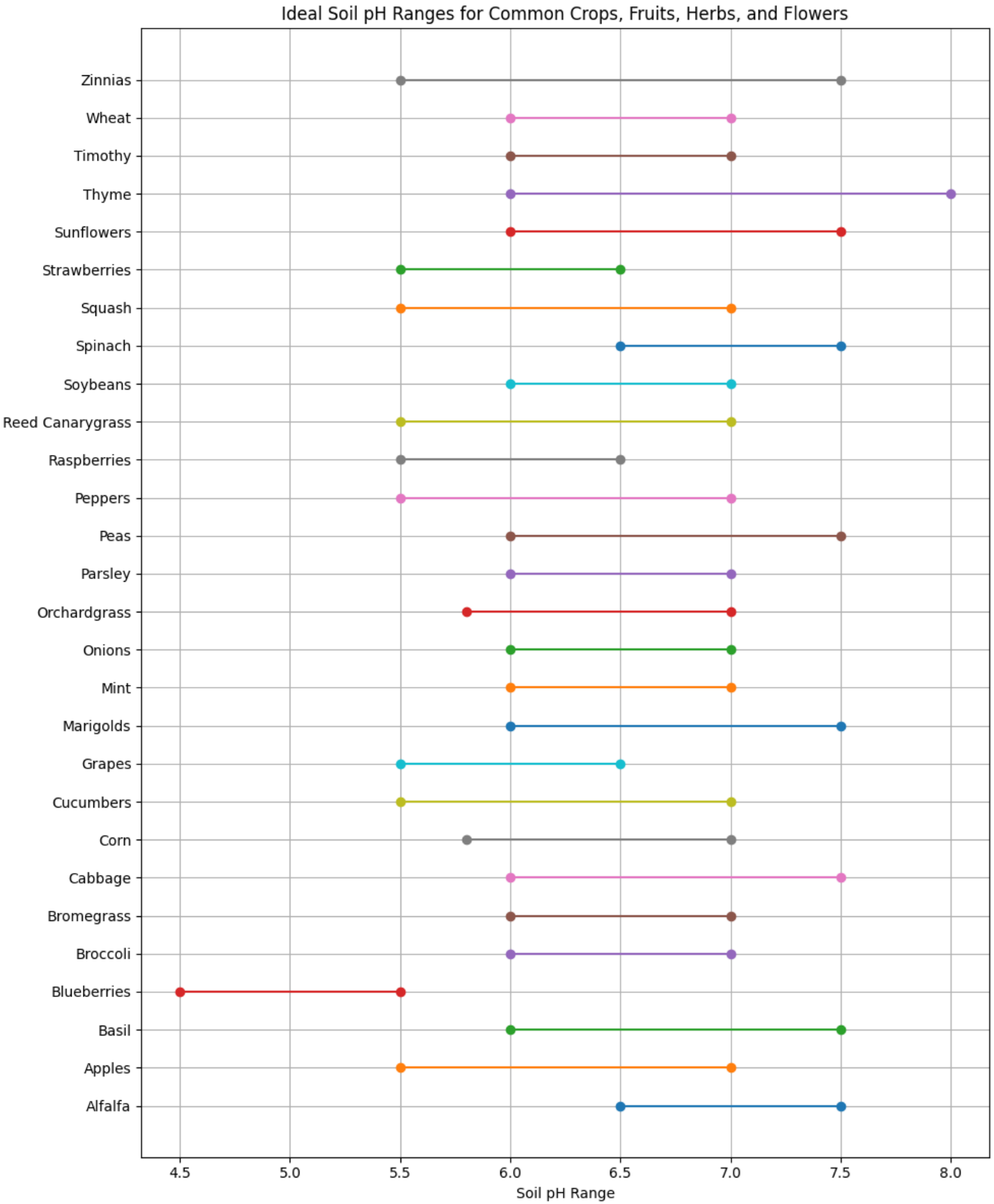
- How well plants can absorb nutrients.
- The activity of beneficial soil organisms.
- The availability of harmful elements like aluminum and manganese- when pH is too low.

Most crops grow best in soil with a pH between 6.0 and 7.0. But some plants prefer different conditions, see chart on next page.

Also, the type of soil matters. Mineral, courser textured soils such as sand, should be kept around pH 6.5. If the pH in mineral soils drops below 5.5, harmful elements like manganese and aluminum can build up and hurt your plants. Organic (muck) soils, fine textured or soils high in organic matter, do better at a more acidic pH , ~5.2.

Lime and Soil pH
Adding lime (a soil amendment) can raise the pH and reduce acidity. Some crops need more lime than others. Lime adjusts the soil pH to be in line with the crops needs. Refer to the soil test to identify the pH then adjust to the plant needs. Most plants do well at a pH between 6.0 and 7.0 but others may need a different pH. Taking regular soil test, every 3-4 years or if you make any management changes, and following agronomic recommendations is critical to maintain soil pH for plant production.

For more information on pH and nutrients effects on plant growth please check out the Nutrient Management Chapter.


Ideal Soil pH Ranges for Common Crops, Fruits, Herbs, and Flowers
Zinnias
Wheat
Timothy
Thyme
Sunflowers
Strawberries
Squash
Spinach
Soybeans
Reed Canarygrass
Raspberries
Peppers
Peas
Parsley
Orchardgrass
Onions
Mint
Marigolds
Grapes
Cucumbers
Corn
Cabbage
Bromegrass
Broccoli
Blueberries
Basil
Apples
Alfalfa
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
Soil pH Range

Primary Considerations

Soil testing is essential to ensure that you have a health crop. Before you send in a soil sample make sure that the lab uses sound scientific protocols for their testing. Certification through Agricultural Laboratory Proficiency (ALP) Program or the Agricultural Laboratory Testing Association (ALTA) is recommended for soil chemistry. There are soil health testing labs however clear standards have not been set for these tests so it is important that you understand how to take a sample and how to read the results. The lab you choose will give you guidance on sample taking and reading your results.

Process for Getting Started

How to take a soil sample:

1. Map your field avoiding field margins and any unfarmed. The field size should not exceed 40 acres. Split field if there are different crops, management or a distinct soil type or topography.
2. Collect soil cores at a depth of 6" in a zig zag pattern throughout the field . You can use a spade or a soil probe. You will take 20 samples in total.
3. Place these samples in a bucket. Mix the soil samples in the bucket—pour the sample onto a newspaper to dry overnight.
4. Fill a sample bag with the dried sample. Be sure to send the amount of soil requested by the lab.
5. Complete any forms for the laboratory and pack the sample. Follow the lab's instructions to send the sample and forms


MICHIGAN STATE UNIVERSITY | Extension

Account Number: 18625

Name of Sender: _____

Sample ID: _____

ACCURACY OF RECOMMENDATIONS DEPENDS ON THE COMPLETENESS OF THE SOIL TEST INFORMATION SHEET.

Send at least 2 cups of soil.

Please put samples in a box for shipping.

Photo Credit: Jeff Vanuga, USDA-NRCS

RESOURCES & PARTNERS

Soil Resources

To explore your soil visit the USDA-NRCS Websoil Survey

https://websoilsurvey.nrcs.usda.gov/app/

"Building Soils for Better Crops". SARE Publication 10

https://www.sare.org/resources/building-soils-for-better-crops/

Soil Health Nexus Toolbox

https://soilhealthnexus.org/resources/soil-properties/soil-chemical-properties/

MSU Extension Resources on Soil Sampling

https://www.canr.msu.edu/resources/the-anatomy-of-a-soil-test-report

https://www.canr.msu.edu/soil_health/uploads/files/Soil%20Sampling%20Guide.pdf

SECTION 3

Soil Biological Properties

Soil Microbiology: Healthy soils are rich with soil microbes. These organisms help break down organic matter, release nutrients for plant use, and create soil that supports life. Soil texture types, (see physical soil properties chapter), impact the amount and type of microorganisms in the soil. Course texture sandy soils cannot sustain as many microorganism as finer texture clay soils. That is why courser sandy soils often have a lower organic matter than finer clay soils. That does not mean that the courser texture soils are not as healthy, it just means that there are different populations of soil microbes. Growers should not make soil health determinations based solely on the biological properties, but they should look at the physical and chemical properties also.

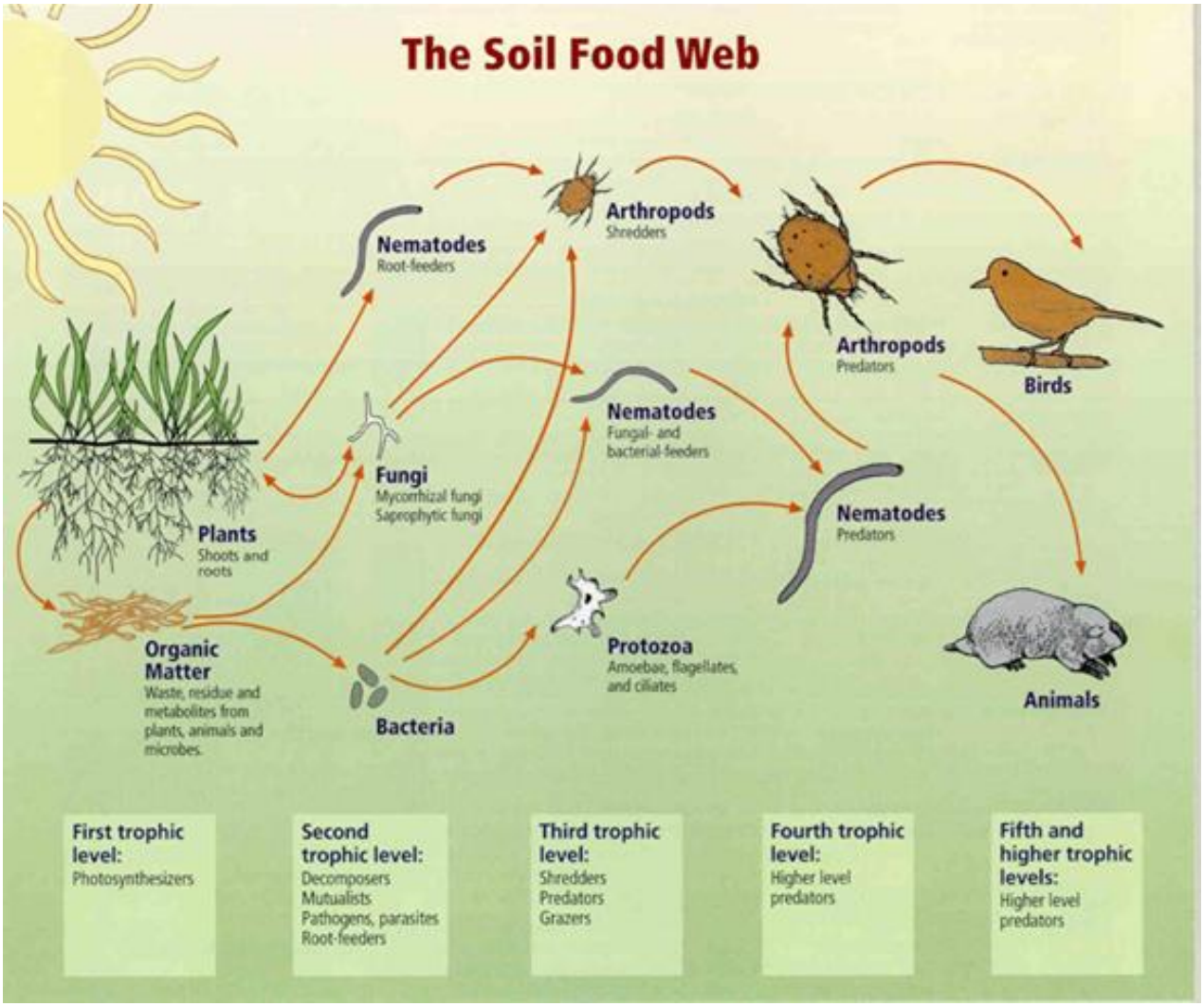
Microorganisms like bacteria, fungi, protozoa and nematodes are key to nutrient cycling-helping nutrients to become available to plants by soil microbes feeding. Bacteria decompose organic material and recycle plant nutrients, while fungi also help break down dead matter. Of course, some soil microbes can cause plant diseases. Protozoa and nematodes feed on microbes and release nutrients in plant-available forms. Mycorrhizae are beneficial fungi that team up with plant roots to improve water and nutrient uptake.

Larger soil animals, including invertebrates like earthworms, centipedes, and insects, tunnel through soil, mix materials, and feed on organic matter. Even vertebrates such as moles and mice influence soil through burrowing and feeding.

Together, this underground ecosystem keeps the soil alive and productive—an essential foundation for any successful farm.

Soil Biological Properties

Soil life—mammals, plants, insects, microbes—must stay balanced to grow healthy crops. Tillage or flooding of the soil boosts bacteria and reduces fungi. Acidic soils (low pH) favor fungi and lower bacteria. Knowing these shifts helps farmers manage soil for plant



Graphic Courtesy: USDA-NRCS

Soil Biological Properties

Organic Matter

Soil organic matter (SOM) is a key biological indicator of soil health. It's measured as a percentage of the soil's weight, typically ranging from less than 1% in sandy soils to over 5% in loamy soils. While SOM may seem like a small part of the soil, its impact is significant. SOM directly influences the soil's physical and chemical properties, making it an essential concept farmers to understand and manage.

Types of Soil Organic Matter

Scientists classify SOM into three categories: **Living**, **Labile** and **Stable**. Soil types play an important role in the amount of each in a field. The balance between these types offers valuable insight into the overall health and function of the soil.

Type of Organic Matter	Description	Key Components	Dominant Environment	Farm Management Impact
Living	Includes living organisms and decomposing materials	Bacteria, fungi, earthworms, plant roots, compost, manure	Bacteria dominate in tilled fields; fungi in forest soils	Microbial communities and residue composition reflect tillage and other practices
Labile	Recently decomposed residues; fuels microbial life	Plant, animal, fungal residues; glomalin which are like soil glues that make up soil aggregation	Found in active soil layers. Highest impact on soil health for production agriculture	Sensitive to change; reduced inputs lower levels; cover crops, compost, and reduced tillage help rebuild it
Stable	Long-lasting, well-decomposed material called Humus	Humus	Present in all soils, especially those with long-term organic inputs. Provides stable environment for microorganisms.	Less affected by short-term changes; long-term practices influence its presence

Primary Considerations

Building and maintaining soil biology is an important part of ensuring that you have good, healthy soil to support growing crops.

Process To Get Started

Roof: Chemical Properties
- Nutrient Levels
- pH Balance

The roof regulates what comes in. Feeding the soil and plants. A balanced roof ensures nutrients are available and not lost to leaching or toxicity.

Walls: Physical Properties
Soil Texture (Clay, Sand, Silt),
Structure,
Porosity, and Water Holding Capacity
These Determine:
- How air and water move
- How roots grow
- How plants anchor

Foundation: Biological Properties
- Microorganisms
- Earthworms
- Fungi
- Other living organisms

These lifeforms build and support the soil structure. Breaking down organic matter, nutrient cycling, and create stability for everything above.

Primary Considerations

Measuring soil health and any changes that your fields are going through is a good way to determine if the practices on your farm are improving or destroying soil health. There are several labs that test for soil health but yet there are no standard testing protocols for soil health. Labs use different protocols and testing measures to determine the health of your soil. Also, unlike chemical testing, a soil health test should be conducted in one spot in the field and only represents that one spot under the soil conditions on the day of testing. To that end, many prefer in-field sampling to measure changes in soil health.

Process for Getting Started

How to take an infield soil health test.

1. Download a copy of the Michigan Soil Health Card
2. Conduct the in-field assessment as instructed.
3. Repeat annually and try to sample the same time each year.

Photo Credit: https://www.ndsu.edu/soilhealth/?page_id=420

RESOURCES & PARTNERS

Soil Resources

To explore your soil visit the USDA-NRCS Websoil Survey

https://websoilsurvey.nrcs.usda.gov/app/

"Building Soils for Better Crops". SARE Publication 10

https://www.sare.org/resources/building-soils-for-better-crops/

Soil Health Nexus Toolbox

https://soilhealthnexus.org/resources/soil-properties/soil-chemical-properties/

MSU Extension Resources on Soil Sampling

https://www.canr.msu.edu/resources/the-anatomy-of-a-soil-test-report

https://www.canr.msu.edu/soil_health/uploads/files/Soil%20Sampling%20Guide.pdf

Photo Credit: Steve Culman

RESOURCES & PARTNERS

MSU Extension Resources on Soil Sampling

Michigan Soil Health Progress Report

https://www.canr.msu.edu/resources/michigan-soil-health-progress-report

Curriculum for Beginning Farmers-Testing your Soil

https://www.beginningfarmercurriculum.org/soil-health