

Improving Soil Health

Building a Better Foundation for Plant Growth



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BUILDS ORGANIC MATTER

Supports soil
structure and
nutrient cycling



IMPROVES SOIL STRUCTURE

Promotes airflow,
drainage, and
root growth



HELPS MANAGE MOISTURE

Supports water
infiltration and
retention



SUPPORTS SOIL BIOLOGY

Feeds the living
system beneath
the surface

Healthy plants begin with healthy soil.

Fertilizer supplies nutrients that plants need, but successful plant growth depends on more than nutrients alone. Soil must also provide water, air, physical support, and an environment where roots and soil organisms can function effectively.

Improving soil health means improving the soil's ability to perform all of these jobs together.

What Is Soil Health?

Soil health describes how well soil functions as a living system.

Healthy soil supports plant growth, stores and cycles nutrients, allows water and air to move through the root zone, and provides habitat for a diverse community of organisms.

There is no single measurement that defines healthy soil. Instead, soil health is evaluated through a combination of physical, chemical, and biological characteristics.

These may include:

- Soil structure
- Organic matter
- Nutrient availability
- Soil pH
- Water infiltration and water-holding capacity
- Biological activity
- Root development
- Resistance to erosion and compaction

The goal is not to make every soil the same. Different soils have different textures, mineral compositions, climates, and management histories.

The objective is to help each soil function as effectively as possible.

Organic Matter Plays a Central Role

Organic materials in soil range from living roots and organisms to decomposing plant and animal residues and more stable forms of soil organic matter.

Although organic matter may represent only a small percentage of the total soil, it can have a major influence on soil function.

Organic matter helps support the formation of soil aggregates, which are groups of soil particles held together. Good aggregation creates spaces that allow air and water to move through the soil while providing pathways for plant roots.

Organic materials also serve as a food source for many soil organisms and participate in nutrient cycling as they decompose.

Maintaining or increasing organic matter, when appropriate, is an important part of many soil-health management programs.

Healthy Soil Supports Nutrient Cycling

Plants require nutrients such as nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, and micronutrients.

Some nutrients may already be present in the soil but may not always be immediately available to plants.

Soil microorganisms play an important role in nutrient cycling. As organic materials decompose, microorganisms help transform nutrients into different chemical forms. Some of those forms can then become available for plant uptake.

This biological activity is one reason soil conditions matter when using organic fertilizers.

Temperature, moisture, aeration, pH, and microbial activity can all influence how quickly organically bound nutrients become plant-available.

Healthy soil therefore acts as more than a container for fertilizer. It participates in the processes that make nutrients available to growing plants.

Soil Structure Matters

Soil structure describes how individual soil particles are arranged into larger groups or aggregates.

A well-structured soil contains pore spaces of different sizes. Those spaces allow air and water to move through the soil while giving roots pathways through which they can grow.

Poor structure can contribute to compaction, restricted root growth, slow drainage, poor infiltration, and limited oxygen in the root zone.

Practices that protect soil structure can therefore have a direct effect on plant performance.

The best management approach depends on the soil type and growing system, but minimizing unnecessary compaction and excessive disturbance can help preserve soil structure.

Water and Air Must Be Balanced

Roots need both water and oxygen.

Soil that drains too rapidly may not retain enough water for plants, while soil that remains saturated can limit oxygen around the roots.

Healthy soil helps balance these competing requirements.

Organic matter and good soil structure can improve the soil's ability to absorb and store water while still maintaining pore spaces for air movement.

This does not eliminate the need for proper irrigation or drainage. Instead, better soil structure helps create a more effective environment for managing both.

Soil Biology Is Part of the System

Healthy soil contains bacteria, fungi, protozoa, insects, earthworms, and many other organisms.

These organisms perform numerous functions within the soil ecosystem. They help decompose organic materials, cycle nutrients, contribute to soil aggregation, and interact with plant roots.

Not every soil organism is beneficial, and soil biology is extremely complex. The goal of soil-health management is not simply to maximize microbial activity.

Instead, the goal is to maintain soil conditions that support a functioning and diverse biological system.

Practices that supply organic material, maintain living roots when practical, and avoid unnecessary soil disturbance can help support that biological activity.

Fertility Is Only One Part of Soil Health

Fertilizer plays an important role in supplying nutrients for plant growth, but nutrient availability is only one component of healthy, productive soil.

Adding nutrients cannot correct every soil problem.

A soil may contain adequate nutrients but still have poor drainage, severe compaction, unsuitable pH, or limited root development.

Likewise, applying fertilizer without knowing existing nutrient levels can result in unnecessary or excessive applications.

Good nutrient management starts by understanding what the soil already contains and what the plants actually require.

Start With a Soil Test

A soil test can provide valuable information about the chemical characteristics of the soil.

Depending on the laboratory and test package, results may include:

- Soil pH
- Organic matter
- Phosphorus
- Potassium
- Soluble salts, when included
- Other nutrients or soil characteristics

Testing helps identify whether nutrients are deficient, adequate, or already present at relatively high levels.

That information can help guide fertilizer and amendment decisions.

A soil test does not measure every aspect of soil health, but it provides an important baseline for making informed nutrient-management decisions.

More Fertility Is Not Always Better

Adding more fertilizer than plants need does not automatically improve soil health.

Excess nutrients can create imbalances, contribute to salt accumulation in some situations, or move beyond the root zone where they are no longer benefiting the crop.

The same principle applies to organic amendments.

Compost, manure, and other organic materials can contribute valuable organic matter and nutrients, but repeated applications can also increase nutrient levels beyond what plants require.

The objective is balance.

Soil should receive enough nutrients and organic material to support plant growth without continually adding materials simply because they are considered beneficial.

Practical Ways to Support Soil Health

There is no universal soil-health program, but several general practices can support better soil function.

These include:

- Testing soil before making major fertility decisions
- Applying fertilizers according to plant requirements and product directions
- Maintaining or increasing organic matter when appropriate
- Avoiding unnecessary soil compaction
- Reducing excessive soil disturbance where practical
- Protecting exposed soil from erosion
- Managing irrigation to avoid prolonged saturation or excessive drying
- Maintaining plant cover or living roots when appropriate for the growing system
- Monitoring soil conditions over time rather than relying on a single observation

The appropriate combination of practices will vary according to the crop, soil type, climate, and production system.

Soil Health Takes Time

Soil health is not something that changes overnight.

Properties such as organic matter, soil structure, and biological activity develop over time and respond to repeated management decisions.

Some improvements may become noticeable relatively quickly, while others can take years.

That is why soil health is best viewed as an ongoing management process rather than a one-time treatment.

The Bottom Line

Healthy soil provides the foundation that allows plants, roots, water, nutrients, air, and soil organisms to function together.

Organic matter helps support soil structure and biological activity. Soil organisms help cycle nutrients. Good structure helps water and air move through the root zone. Appropriate fertility provides plants with the nutrients they need.

No single fertilizer, amendment, or management practice can accomplish all of those things by itself.

Improving soil health means managing the entire system.

The better the soil functions, the better foundation it provides for healthy and productive plant growth.

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