

Compost and Organic Matter

Building Healthier Soil



LEARNING CENTER

GROWING TIPS

Compost and Organic Matter

How Organic Matter Helps
Build Healthier Soil



COMPOST BUILDS SOIL.
ORGANIC MATTER
SUPPORTS GROWTH.



**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.

Fertilizers supply nutrients needed for plant growth, but plant nutrition does not depend on fertilizer alone. Soil structure, moisture, air movement, biological activity, root development, and nutrient retention all influence how effectively plants can obtain and use those nutrients.

One of the most important components of a healthy soil system is organic matter.

Compost, crop residues, plant roots, organic mulches, cover crops, and other materials derived from living organisms can all contribute organic matter to soil. Over time, these materials are transformed by soil organisms and become part of a complex system that affects the physical, chemical, and biological characteristics of the soil.

Managing organic matter is therefore not simply about adding compost. It is about creating and maintaining a soil environment capable of supporting healthy plant growth season after season.

What Is Soil Organic Matter?

Soil organic matter includes materials that originated from living organisms and are present in various stages of decomposition.

These materials may include:

- Living and dead plant roots
- Crop residues
- Leaves and other plant material
- Microorganisms
- Animal residues
- Compost
- Organic mulches
- More stable decomposed organic compounds

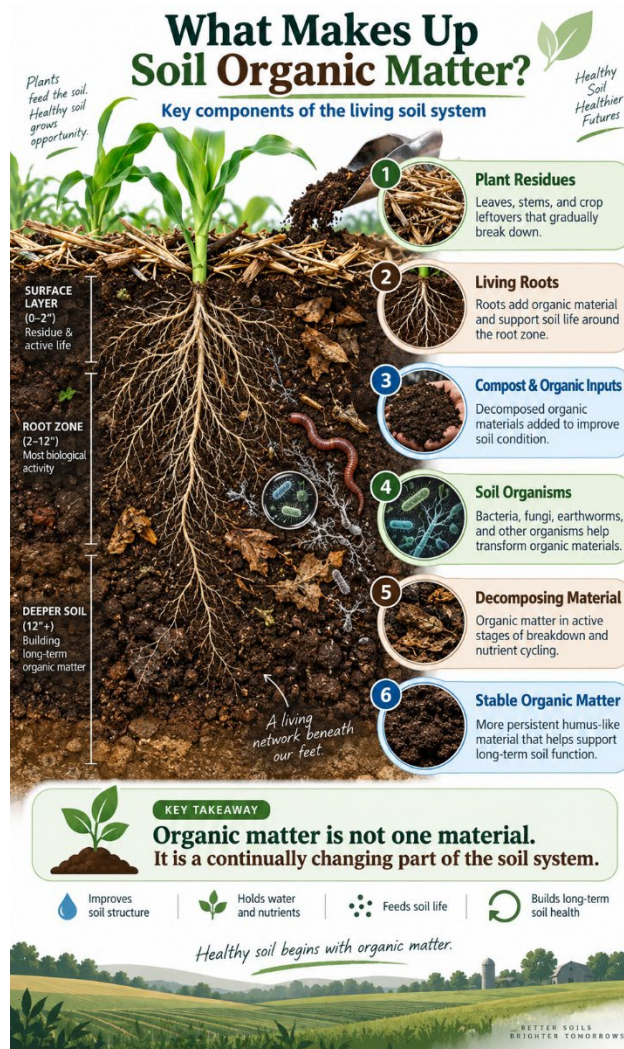
Organic matter usually represents only a portion of the total soil, yet it can have a major influence on soil performance.

Organic matter contributes to soil aggregation, nutrient retention, water infiltration, water-holding capacity, biological activity, and resistance to erosion. USDA Natural Resources Conservation Service guidance also emphasizes the relationship between increasing soil organic matter and improved soil structure, water management, biological activity, and nutrient retention. ([Natural Resources Conservation Service](#))

Organic matter is not static.

Soil organisms continually consume and transform organic materials. Some carbon is incorporated into soil organisms and other soil compounds, while some returns to the atmosphere as carbon dioxide. Nutrients may be temporarily held within microbial biomass and later released again.

For this reason, maintaining soil organic matter is an ongoing process rather than a one-time treatment.



Compost Is One Source of Organic Matter

Compost is organic material that has undergone controlled biological decomposition and has been stabilized sufficiently for use as a soil amendment.

Finished compost may be produced from materials such as:

- Crop residues
- Leaves
- Yard materials
- Food scraps
- Manure
- Bedding materials
- Plant-processing residues
- Other suitable organic feedstocks

The characteristics of the finished compost depend heavily on the original materials and the composting process.

Two products called "compost" may therefore differ significantly in nutrient content, organic matter content, soluble salts, pH, maturity, particle size, and other characteristics.

Compost should be evaluated as an agricultural input, not simply assumed to be beneficial because it is organic.

How Compost Supports Soil Structure

One of the most important functions of organic matter is its influence on soil structure.

Soil particles can associate into larger units known as aggregates. Stable aggregation creates pore spaces that allow water and air to move through the soil while providing pathways for root growth and soil organisms.

Compost and other organic materials can support this aggregation process.



In heavy or compacted soils, improved aggregation can help:

- Increase pore space
- Improve aeration
- Improve water infiltration
- Reduce surface crusting
- Provide better conditions for root development

In lighter or sandy soils, organic matter can help improve the soil's ability to retain both moisture and nutrients.

The result is not that compost magically changes one soil type into another. Instead, organic matter can help improve the way that soil functions.

EPA guidance similarly identifies reduced compaction, increased porosity, better water infiltration, improved water retention, and increased soil organic matter among the benefits associated with compost use. ([US EPA](#))

Better Water Management

Water management is closely connected to soil structure.

A soil with good aggregation and adequate pore space can generally accept rainfall or irrigation more readily than a compacted or poorly structured soil.

Improved infiltration helps water enter the root zone rather than running across the surface.

Organic matter can also increase the amount of water retained within the soil.

This can provide several practical benefits:

- Reduced runoff
- Reduced erosion
- Better use of rainfall and irrigation
- More moisture available within the root zone
- Greater resilience during periods of limited rainfall

These effects can be particularly important in soils that have been degraded, compacted, or depleted of organic matter.

Compost does not eliminate the effects of drought or poor irrigation management, but improving soil water infiltration and retention can strengthen the soil's ability to manage changing moisture conditions. EPA identifies improved water-holding capacity, infiltration, retention, and reduced runoff as significant benefits of compost-amended soils. ([US EPA](#))

Soil Is a Living System

Healthy soil contains an enormous biological community.

Bacteria, fungi, protozoa, nematodes, arthropods, earthworms, and many other organisms participate in the breakdown and transformation of organic materials.

These organisms form an interconnected soil food web.

Organic matter provides energy and habitat for much of this biological activity.

As plant residues, roots, compost, and other organic materials decompose, microorganisms participate in processes that release, transform, immobilize, and recycle nutrients.

This is why healthy soil is better understood as a living ecosystem rather than simply as material that anchors plant roots.



Increasing organic inputs does not guarantee that every soil biological process will automatically improve. Soil moisture, temperature, oxygen, pH, disturbance, pesticide use, crop diversity, and other management factors also affect soil organisms.

The objective is to create conditions that support a diverse and functioning soil system.

Nutrient Retention and Nutrient Cycling

Organic matter can help soil retain nutrients and keep them within the root zone.

Nutrients associated with organic materials are also gradually transformed as decomposition occurs.

Microorganisms play a central role in this process.

They may temporarily incorporate nutrients into their own cells. When those organisms die or are consumed, nutrients can be released and reused within the soil system.

This cycling helps explain why the nutrient contribution from organic materials does not always behave like a conventional soluble fertilizer.

Some nutrients may become available relatively quickly. Others may be released more gradually.

Availability depends on factors such as:

- The organic material used
- Degree of decomposition
- Carbon-to-nitrogen ratio
- Soil temperature
- Soil moisture
- Oxygen
- Microbial activity
- Soil pH

Organic matter management and fertilizer management therefore work together, but they are not identical.

Understanding the Carbon-to-Nitrogen Ratio

Carbon and nitrogen are particularly important in the decomposition of organic materials.

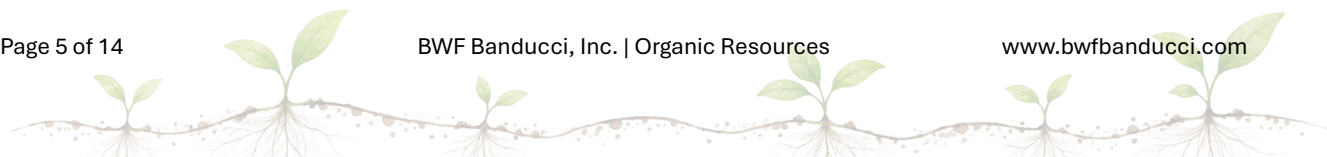
Microorganisms use carbon primarily as an energy source and require nitrogen for proteins, enzymes, and other cellular components.

The relationship between these elements is commonly expressed as the carbon-to-nitrogen ratio, or C:N ratio.

When building a compost pile, a starting ratio of approximately 30 parts carbon to 1 part nitrogen is commonly used as a practical target.

Materials commonly described as "browns" tend to contain relatively more carbon. Examples include:

- Dry leaves
- Straw
- Wood chips
- Sawdust
- Shredded paper



Materials commonly described as "greens" generally contain proportionally more nitrogen. Examples can include:

- Fresh grass clippings
- Green plant material
- Vegetable residues
- Certain manures

If a compost mixture contains too much carbon relative to nitrogen, decomposition can proceed slowly because microorganisms do not have enough nitrogen to support rapid growth.

If nitrogen is excessive relative to carbon, nitrogen may be lost as ammonia, potentially producing odors and reducing the nutrient value of the finished compost.

Cornell composting guidance commonly identifies approximately 30:1 as a useful starting C:N ratio, while noting that the ideal ratio varies with the materials being composted and their biological availability. ([Cornell Composting](#))

Carbon-to-Nitrogen Ratio Also Matters After Application

The same basic relationship can affect what happens when organic residues are added directly to soil.

High-carbon materials such as straw or woody residues may cause soil microorganisms to temporarily use available nitrogen as they decompose the material.

This process is called nitrogen immobilization.

During this period, less nitrogen may be immediately available to plants.

As decomposition continues and microbial populations turn over, nitrogen can become available again.

This does not mean that high-carbon materials are harmful. It means that the type of organic material and the way it is used matter.

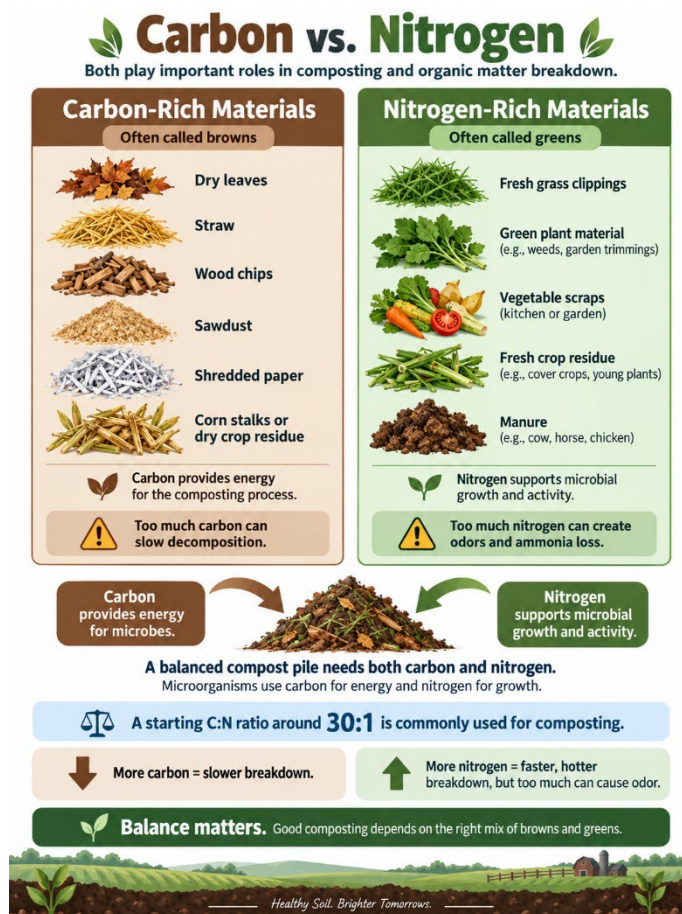
For example, wood chips used as a surface mulch behave differently from finely incorporated high-carbon material mixed throughout a planting bed.

Understanding those differences can help prevent unintended nutrient competition during periods of active plant growth. USDA NRCS guidance specifically notes that high-carbon residues can temporarily immobilize soil nitrogen while lower C:N residues generally decompose more rapidly. ([Natural Resources Conservation Service](#))

Finished Compost Matters

Compost should be sufficiently stabilized before it is applied in situations where immature material could interfere with plant growth.

Active composting involves intense microbial decomposition.



If material is still actively decomposing, it may continue consuming oxygen, generating heat, releasing ammonia, or undergoing other biological changes.

Mature compost has progressed beyond the highly active phase and is more stable for use in soil.

Visual appearance alone does not always confirm compost quality.

Commercial growers or operations applying significant quantities of compost may benefit from information such as:

- Feedstock materials
- Compost maturity or stability
- Nutrient analysis
- Organic matter content
- Carbon-to-nitrogen ratio
- pH
- Soluble salts or electrical conductivity
- Moisture content
- Screening or particle size
- Relevant pathogen or contaminant testing

The importance of each factor depends on how and where the compost will be used.

Compost and Soil Type

Compost can benefit many soils, but not necessarily in exactly the same way.

Sandy Soils

Sandy soils generally contain large pore spaces and drain quickly.

They may also have relatively limited capacity to retain water and nutrients.

Adding organic matter can help improve moisture retention and nutrient-holding capacity while supporting biological activity.

Clay and Heavy Soils

Fine-textured soils can hold substantial amounts of water and nutrients, but they may become dense, poorly aerated, or difficult for roots to penetrate when structure is poor.

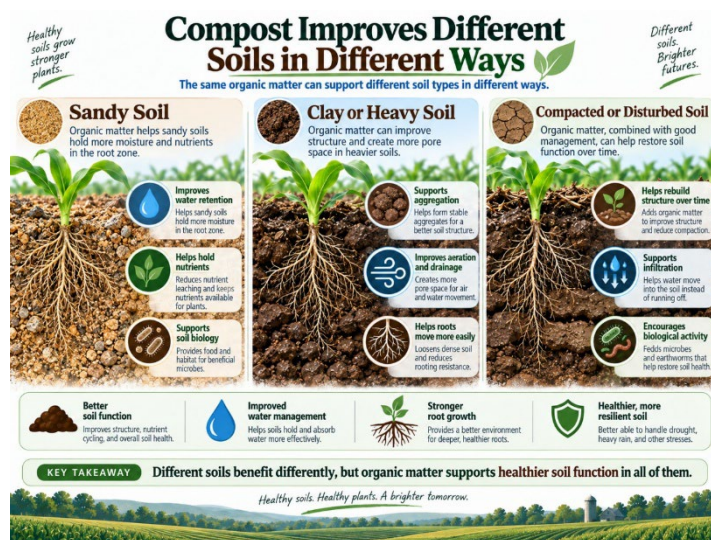
Organic matter can help encourage aggregation and improve pore development, infiltration, and aeration.

Compacted or Disturbed Soils

Construction activity, intensive traffic, repeated tillage, and other disturbances can damage soil structure.

Organic matter combined with appropriate physical and biological management may help rebuild soil function over time.

The appropriate strategy still depends on the specific soil.



A soil test and observation of drainage, compaction, rooting depth, and crop performance are much more useful than assuming every soil requires the same compost application.

Compost Is Not a Complete Fertility Program

Compost can supply valuable nutrients, but nutrient content varies considerably.

A compost made primarily from plant residues may differ greatly from a manure-based compost or a compost produced from mixed agricultural materials.

The quantity of nutrients present also does not necessarily equal the quantity immediately available to plants.

For that reason, compost should not automatically be treated as a substitute for a crop fertility program.

Crops may require nutrient quantities or nutrient timing that compost alone cannot provide.

A productive fertility program may include:

- Soil testing
- Crop nutrient requirements
- Compost or other organic amendments
- Organic fertilizers
- Supplemental nutrients when needed
- Tissue testing where appropriate
- Monitoring crop performance

Compost and fertilizer perform related but different functions.

Compost primarily contributes organic matter and helps improve the soil environment.

Fertilizer is generally used to supply specific plant nutrients in quantities and formulations designed to meet crop requirements.

EPA likewise notes that compost contains plant nutrients but may not always provide enough plant-available nutrition to satisfy the requirements of actively growing crops. ([US EPA](#))

More Compost Is Not Always Better

The benefits of compost do not mean that unlimited application is desirable.

Repeated heavy applications can cause nutrients to accumulate.

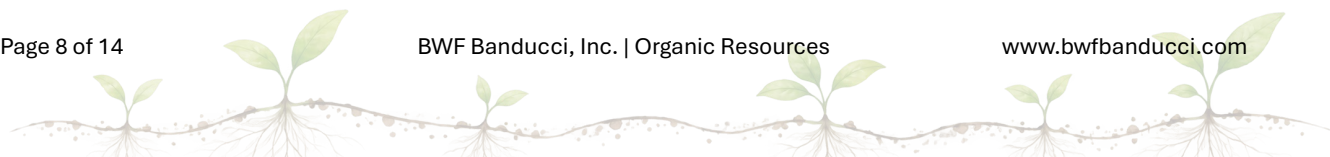
This concern can be particularly important with manure-based composts that contain substantial phosphorus.

Over time, soil phosphorus may rise well above crop requirements.

Excessive nutrient accumulation can:

- Create nutrient imbalances
- Increase the potential for nutrient losses
- Affect water quality
- Waste money and material
- Complicate future fertility management

Compost may also contribute soluble salts, depending on its source materials and processing.



The objective should therefore be to apply compost for a defined agronomic purpose, not simply to maximize soil organic matter or apply as much material as possible.

Soil testing becomes increasingly important where compost or manure has been applied repeatedly over several years.

Organic Matter Comes From More Than Compost

Compost is an important tool, but it is only one part of organic matter management.

Organic material can also be returned to soil by:

- Leaving appropriate crop residues
- Growing cover crops
- Maintaining living roots
- Using organic mulches
- Returning composted plant material
- Using diversified crop rotations
- Reducing unnecessary soil disturbance
- Managing grazing to maintain plant cover and root growth

USDA NRCS soil-health guidance emphasizes practices such as cover crops, diverse rotations, reduced disturbance, and maintaining plant residues because they continually contribute carbon and biological activity to the soil. ([Natural Resources Conservation Service](#))

The Importance of Living Roots

Living plants contribute to soil organic matter in ways that are easy to overlook.

Roots release carbon-containing compounds into the soil and support microbial communities around the root zone.

Roots also eventually die and decompose, becoming an additional source of organic material.

Keeping living roots in the soil for more of the year can therefore support soil biology and contribute to longer-term soil health.

This is one reason cover crops can provide benefits beyond simply protecting bare soil.

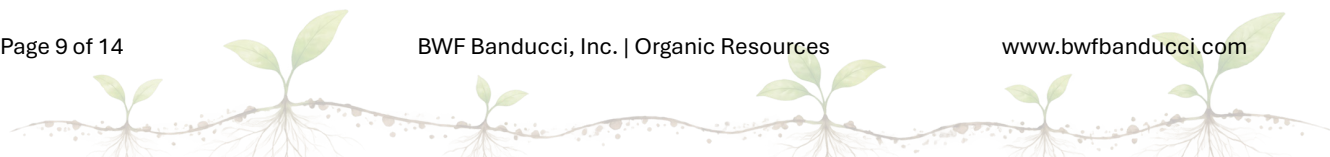
Depending on the crop and management system, cover crops may also:

- Reduce erosion
- Capture residual nutrients
- Add biomass
- Improve soil structure
- Increase biological activity
- Improve water infiltration
- Provide nitrogen when legumes are used appropriately

Not every cover crop performs every function, so species selection should match the goals of the operation.

Organic Mulches

Organic mulches such as straw, leaves, wood products, and compost can protect the soil surface while gradually contributing organic material.



Surface mulch can:

- Reduce evaporation
- Moderate soil temperature
- Reduce erosion
- Suppress some weeds
- Protect the soil from rainfall impact
- Provide material for soil organisms as decomposition occurs

Woody mulch used on the soil surface should not automatically be treated the same as material incorporated deeply into the root zone.

Management matters.

Disturbance and Organic Matter Loss

Organic matter is continually being formed and decomposed.

Management practices can influence the balance.

Frequent or intensive soil disturbance can accelerate organic matter decomposition by exposing previously protected organic material to oxygen and microbial activity.

It can also disrupt soil aggregates and biological habitat.

This does not mean that all tillage is inappropriate.

Cultivation may be necessary for specific crops and production systems.

The practical objective is to avoid unnecessary disturbance and use the amount of soil manipulation needed to accomplish the agronomic task.

Over time, combining reduced disturbance with continued organic inputs can help improve soil structure and organic matter retention.

Building Organic Matter Takes Time

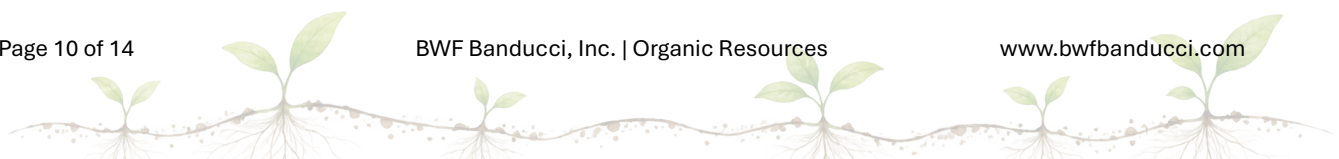
Soil organic matter is not usually transformed by a single application.

The rate at which organic matter accumulates or declines depends on:

- Climate
- Soil type
- Temperature
- Moisture
- Crop production
- Residue management
- Tillage
- Cover crops
- Organic amendments
- Biological activity

Warm, moist conditions can support rapid decomposition.

Cooler or drier environments may decompose organic material more slowly.



Soils also differ in their ability to protect and stabilize organic carbon.

For this reason, there is no universal application rate or timetable that will produce the same change in every field or garden.

Soil improvement is a management process.

Evaluating Compost Before You Buy or Apply

Not every compost product is appropriate for every use.

Before applying compost, consider what the material was made from, how thoroughly it was composted, and whether analytical information is available. Feedstock, processing method, maturity, nutrient content, soluble salts, pH, particle size, and moisture content can all influence how a compost performs once it is applied.

A compost intended for field application may have very different characteristics from one designed for container production, transplant media, landscaping, or vegetable beds. The same material may perform well in one situation and be poorly suited to another.

When evaluating compost, consider asking:

- What materials were used to make it?
- Is the compost mature and stable?
- Is a nutrient analysis available?
- What is the carbon-to-nitrogen ratio?
- What is the pH?
- What is the soluble salt level?
- What is the moisture content?
- Has it been screened?
- Is information available regarding pathogens, weed seeds, or contaminants where relevant?
- What application rate is appropriate for the intended use?

Also consider what you are trying to accomplish. If the objective is to improve soil structure or add organic matter, the preferred material and application rate may differ from a situation where compost is being used partly as a nutrient source.

For larger or repeated applications, it can also be useful to compare the compost analysis with current soil-test results. This helps reduce the risk of applying nutrients that are already present at adequate or excessive levels.

The goal is to match the compost to the soil, crop, and intended purpose rather than assuming that any compost will provide the same result.

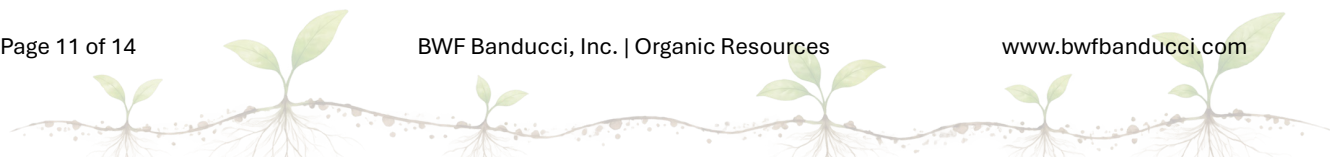
A compost suitable for landscaping may not automatically be the best choice for seedlings, greenhouse media, vegetable production, or large-scale agricultural application.

When possible, keep records of the compost source, analysis, application rate, and date of application. Over time, that information can help you compare soil-test results, crop response, and future compost needs more accurately.

Match Compost to the Intended Use

The amount and type of compost that makes sense depends heavily on why it is being applied.

If the primary goal is to improve soil structure or increase organic matter, the application strategy may be different from a situation where compost is being used partly as a nutrient source. A material with a relatively



high nutrient analysis may require a lower application rate than a compost being used mainly for soil conditioning.

The crop and production system also matter. Vegetable beds, orchards, field crops, landscapes, container production, and newly disturbed soils can have very different requirements. Compost that performs well in one setting may be inappropriate in another because of nutrient concentration, soluble salts, particle size, moisture content, or application method.

Timing should also be considered. Applying compost well before planting may allow time for incorporation and biological activity, while surface applications around established plants may serve a different purpose. In perennial systems, repeated smaller applications may sometimes be more appropriate than occasional heavy applications.

The objective is to use enough material to accomplish the intended soil-management goal without creating unnecessary nutrient accumulation or other problems.

Define the purpose first, then select the compost and application rate that fit that purpose.

Use Soil Testing to Guide Management

Soil testing is one of the most useful tools for determining whether an organic matter or fertility program is moving in the right direction.

Testing can help identify:

- Soil pH
- Nutrient levels
- Organic matter trends
- Excess phosphorus
- Salinity concerns
- Other soil characteristics important to fertility management

No single number tells the entire story.

Combine soil-test information with observations of:

- Root development
- Drainage
- Soil aggregation
- Compaction
- Water infiltration
- Crop vigor
- Yield
- Nutrient deficiency symptoms

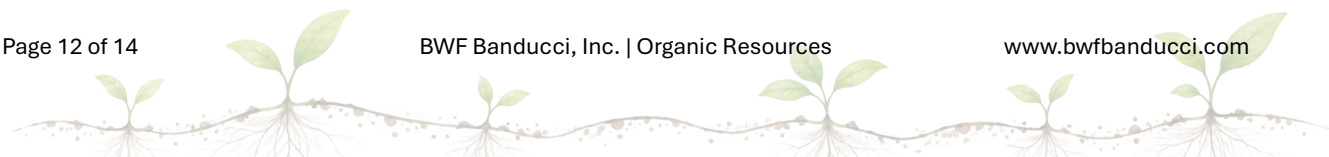
Healthy soil management combines measurements with what is actually happening in the field.

Build Soil, Not Just Fertility

Fertility and soil health are closely connected, but they are not the same thing.

A soil can contain adequate nutrients and still have poor structure, limited infiltration, compaction, low biological activity, or weak root development.

Likewise, a soil with substantial organic matter may still lack a nutrient required by the crop.



That is why a complete program considers both.

Fertilizer helps address the nutrient requirements of the crop.

Organic matter management helps maintain the soil system in which those nutrients, water, roots, and biological processes interact.

The strongest programs recognize the value of both.

Think Beyond a Single Growing Season

Building healthy soil rarely happens through one compost application, one fertilizer application, or one growing season.

Organic matter is continually being added, transformed, consumed, and recycled.

Maintaining it requires a long-term approach that protects soil structure, supports biological activity, returns organic material, and supplies nutrients according to crop requirements.

Over time, those practices can help create soil that:

- Accepts and retains water more effectively
- Supports deeper and healthier roots
- Retains and cycles nutrients
- Resists erosion
- Supports active soil biology
- Performs more consistently under changing growing conditions

The objective is not simply to feed the plant growing today.

It is to maintain a functioning soil system capable of supporting healthy plant growth season after season.

Improving soil is cumulative. The benefits of compost, living roots, residue management, reduced disturbance, and other soil-building practices develop gradually as physical structure, biological activity, and nutrient cycling respond over time. Progress may be incremental from one season to the next, but consistent management can produce meaningful improvements in water movement, root development, nutrient retention, and overall soil resilience. The most effective approach is to evaluate soil conditions regularly, adjust practices when needed, and keep building on the gains already made.



The Bottom Line

Compost and organic matter play an important role in building and maintaining healthy soil.

Their greatest value is not simply the nutrients they contain.

Organic matter influences soil structure, water movement, nutrient retention, biological activity, root development, and the long-term functioning of the soil system.

Compost can be an effective tool for adding organic matter, but it should be selected and applied with the same care used for other agricultural inputs.

More is not automatically better.

A balanced approach combines appropriate organic inputs, soil testing, crop nutrient management, reduced unnecessary disturbance, living roots, residue management, and other practices suited to the soil and production system.

Healthy soil is built over time.

The goal is not simply to add organic matter.

The goal is to create a soil environment in which water, nutrients, roots, and biology can work together to support productive plant growth.

Healthy soil is not built through a single product or practice. It develops through consistent management that protects soil structure, supports biological activity, and continually returns organic material to the soil system.

Disclaimer: This material is provided for general educational purposes only. Growing conditions, soil characteristics, crop requirements, application rates, and regulatory requirements vary. Always follow product label directions as well as all governmental and safety regulations or recommendations, and consult appropriate agronomic, regulatory, or crop-management professionals when making site-specific fertilizer or soil-management decisions.

To learn more about BWF Banducci's fish-based organic fertilizer products, visit **bwfbanducci.com**.

