

SOIL HEALTH TOOLS AND TECHNIQUES FOR FRUIT AND VEGETABLE PRODUCERS

SFA-MN.ORG/SOIL

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This document is part of SFA's overall soil health programming and is meant to assist fruit and vegetable growers of all sizes, from community gardens to larger acreages selling commercially.

Soil at Tim Hendrickson farm, Sebeka, Minn. Photo by Dayle Reinke.

Good Soil Health Indicators

- Ability to infiltrate and store water
- Ability to cycle and hold nutrients – High Cation Exchange capacity.
- High in Soil Organic Matter (SOM) – The “container” for biological activity to occur.
- High microbial activity: soil function is mediated by microbial activity building soil aggregate structure.

Determine Your Soil Health

Use your observational skills and soil tests to get to know your soil and track soil health progress over time.



All of these indicators work hand-in-hand. The five soil health principles highlighted below will help you to achieve healthier soils with these characteristics.

All soils are unique, with unique challenges. Things like the texture of your soil (amount of sand, silt, or clay) are inherent and cannot be easily changed, but any soil can be improved over time with the soil health principles.

Our role as producers is to create a home or habitat that promotes robust soil microbe communities. This is accomplished by addressing the following principles:

HEALTHY VS. UNHEALTHY

What makes good soil?

	
High organic matter content (at least 3-4 percent, ideally higher)	Low organic matter
pH (acidity) around 6-7	pH is too acidic (<6) or too basic (>7)
Soft; not too compact	Hard, crusty
Sweet, earthy smell	No smell at all, or metallic smell
Small breakable particles, no hard clods	Hard clods

1. KEEP THE SOIL COVERED

Avoid bare soil. Living plants and mulch provide a buffer to weather extremes. Use cover crops when you do not have fruits or vegetables growing in the soil.

Choose a cover crop based on your goals. Some cover crops for different soil health goals include:

- Fertility: use a legume like peas, clovers, or vetch.
- Erosion control: oats, rye, winter wheat, sorghum sudangrass
- Breaking up compact soils: Tillage radish, turnip, sugarbeet
- Adding organic matter: Sorghum sudangrass, buckwheat
- Weed suppression: Buckwheat, sorghum sudangrass, rye, oats, winter wheat
- Combine multiple species for multiple benefits.

Next, choose a window of time where you have open fields. Common cover crop windows include planting in the fall after harvest, planting in spring before a fall crop, planting in the late summer after a spring crop, and short summer windows between early spring and late fall crops.

See z.umn.edu/vegetablecovercrops for more information.

SOIL TESTING

A variety of tests can determine soil texture and nutrient levels, and track your soil health over time:

1	2
Soil texture: Is your soil more sand, loam, or clay? Mason jar test, or basic soil test from a lab.	A basic series soil test from a soil testing lab every 2-3 years, including pH, organic matter, phosphorus, and potassium. Additional tests as needed.
3	4
Slake test: tests the aggregate stability of your soil. Can be used to track progress over time.	Haney test: tests microorganism biomass, organic Nitrogen (more common in research, but an option for farmers)



2. MINIMIZE SOIL DISTURBANCE

Tillage is the traditional tool for weed control and preparing seed beds, but it is destructive to the soil. Tillage accelerates decomposition of soil organic matter (SOM). SOM is the food source for much of the soil biological activity necessary for increasing soil health.

Example practices for reducing tillage:

- Fallow fields with cover crops
- Less intensive tillage implements like broadforks and chisel plows
- Strip tilling
- Plant more perennials
- Hugelkultur and deep compost mulch
- Tarps for weed control and terminating cover crops
- Drill large seeded crops directly into residues
- More ideas and examples at z.umn.edu/notillvegetables

No-till drills and other machinery are available for rent in some areas. Contact your NRCS Grazing Specialist or the SFA Livestock and Grazing Specialist for additional information.

3. INCREASE CROP DIVERSITY

Many vegetable producers grow a wide variety of produce and find a diverse crop rotation the most readily adaptable soil health principle. However, some producers focus on only a few products (e.g. pumpkins or sweet corn). In addition to breaking disease and pest cycles, diverse crop rotations can stimulate a wide variety of soil microbes. Rotate fields every 3-4 years between plant families. Some of the major families include:

- **Brassicaceae:** broccoli, kale, bok choy, turnip, radish, mizzuna, arugula
- **Solanaceae:** tomatoes, peppers, eggplant, potato, ground cherry, nightshade
- **Cucurbitaceae:** cucumber, melon, squash, pumpkin, gourd
- **Apiaceae:** carrot, parsnip, coriander, celery, anise, dill, fennel
- **Amaranthaceae:** spinach, beets, amaranth, chard, common weeds

Another way to increase crop diversity is to practice companion planting. Planting herbs and flowers alongside crops, or keeping groups of crops together can support more insect and microbial diversity.



4. KEEP A LIVING ROOT IN THE SOIL

The soil/root interface is an important location for soil microbial activity. Without a living root in the soil we greatly reduce microbial activity. Minimize bare fields as much as possible. Companion plantings, succession plantings and cover crops are important tools to meet this goal.

Adding perennials is another important way to keep living roots in the soil, particularly in areas with steep slopes that are prone to erosion. Perennial strips along waterways and throughout the farm can also absorb excess water during heavy rains, and provide habitat for pollinators and other beneficial insects. Perennials could include fruit trees or bushes, or strips of flowers and native plants.

TOP LEFT: Strip tilling at Honeyberry USA, Bagley, Minn. Photo by Jim and Bernis Ingvaldson. TOP RIGHT: Radish planted around cucumbers at Solar Fresh Produce, Plymouth, Minn. Photo by Sarah Lindblom. BOTTOM: Multi-species cover crop at Happy Dancing Turtle, Pine River, Minn. Photo by Jim Chamberlin.

SOIL AMENDMENTS

More examples and information about livestock integration can be found at the SFA Soil Health Portal: sfa-mn.org/soil.

Compost: Utilize generous amounts of compost as available to provide organic matter and nutrients to cash crops. Vegetable and animal based composts are very different in composition and nutrient concentrations. Avoid using too much animal-based compost (manure) to prevent the build-up of phosphorus and calcium in your soil. Make additions based on soil tests.

Lime and sulfur: Agricultural lime and sulfur can be used to increase or decrease the pH of soil. These additions should be made based on soil tests.

Fertilizers: In addition to cover crops, compost, and manure, soils often require additional inputs. Low fertility soil may require additional inputs, especially early on in building soil health to provide adequate fertility to promote the plant growth necessary to begin building soil organic matter and stimulating soil biological activity. Apply soil amendments based on soil test recommendations. Additional assistance may be available from university extension, agronomist or crop advisors.

Relying too heavily on herbicides, fungicides, and synthetic fertilizers can have negative impacts on soil health.

ATTRA factsheet on using manure in organic vegetable systems: attra.dev.ncat.org/product/tipsheet-manure-in-organic-production-systems/



5. INTEGRATE LIVESTOCK

All natural ecosystems have associated animal communities. Livestock integration can be as simple as regular utilization of composted livestock manures. However, there are additional benefits from direct integration of livestock including hoof action, insect consumption, glean following harvest, and direct application of manure where feasible.

Examples of livestock integration on fruit and vegetable farms include:

Rabbits and poultry can be introduced using movable pens (e.g. "chicken tractors" or "pasture pens"). Information is available on the internet concerning portable pasture pens. Thirty to 75 meat chickens can occupy a portable pen.

Larger livestock like sheep, hogs, and goats can also be introduced to terminate cover crops and graze fields after harvest.

Start small and work your way up, or consider partnering with neighbor. Livestock require different sets of skills and background knowledge than growing vegetables (e.g. fencing, animal health).

When integrating animals, pay attention to food safety. Pathogens that can cause



TOP: Chicken tractor at North Circle Seeds, Vergas, Minn. Photo by Zachary Paige. ABOVE: Goat at Paradox Farm, Ashby, Minn. Photo by Becca Dilley.

foodborne illness in humans can be found in manure. For example, chickens can harbor *Campylobacter* or *Salmonella*, and cows and goats may carry *E. Coli* O157:H7. Even healthy animals can harbor these pathogenic bacteria, and can shed the bacteria in their manure.

To reduce the risk of contaminating fresh produce, follow the 90/120 day rule from the National Organic Program guidelines for applying animal manure. These guidelines also apply to non-organic farmers. If compost has not been fully treated, wait at least 90 days between application and harvest of the product if the produce is not grown in contact with the soil, like a trellised tomato. Wait at least 120 days if the product is grown in contact with the soil, like melons or lettuce. This will

allow time for many of the potentially harmful bacteria to die off in the soil. Some might persist even after this time period, so continue to use caution and apply the compost so that it doesn't directly touch the edible portion of the crop. Most farms meet the 90/120 day guideline by applying raw manure or grazing animals in the fall. If you graze livestock or apply manure in the spring, ensure that you keep good records and follow the "days to harvest" intervals as outlined above. Note that the 90/120 rule does not apply to fully-treated compost that you purchase from a supplier, like Sustane, or if you make your own treated compost following NOP rules for turning, temping and record keeping.

Check local ordinances regarding livestock and fencing, even if you live in unincorporated areas.



Strip of perennial flowers in vegetable field. Photo by Karin Jokela.

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Visit Lakewinds stores in Chanhassen, Minnetonka or Richfield.

Or, learn more at lakewinds.coop.



IMPORTANT RESOURCES

All these and more can be found at the SFA Soil Health Portal: sfa-mn.org/soil.

Sustainable Farming Association:
sfa-mn.org/soil

Extension fruit and vegetable farming:
extension.umn.edu/fruit-and-vegetable-farming

SFA Beging Grazier Handbook:
sfa-mn.org/soil

Midwest Cover Crop Council
mccc.msu.edu

Mandan ARS Lab Cover Crop Chart:
ars.usda.gov/ARUserFiles/30640000/PDF/CCCv1-2.pdf

Midwest Perennial Forage Working Group: Contract Grazing
greenlandsbluewaters.net/Perennial_Forage/contract.html

"Soil Health and Nutrient Management for Immigrant Farmers" at sfa-mn.org/soil/resources

Haney Soil Test:
www.wardlab.com

Book: "A Soil Owner's Manual" by John Sifka

Broadcast seeders and small implements can often be rented. Search online or the Yellow Pages under Rental Equipment.

Some seed houses and farm stores sell cover crop seed by the pound.

Twin Cities Metro Growers Network:
sfa-mn.org/twin-cities-growers-network