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.

Good Soil Health Indicators

- High microbial activity: 90% of soil function is mediated by microbial activity building soil aggregate structure.
- Ability to infiltrate and store water – 50% of our soil should be pockets of air!
- Ability to cycle nutrients – High Cation Exchange capacity.
- High in Soil Organic Matter (SOM) – The “container” for biological and fungal activity to occur.

All of these indicators work hand-in-hand. By helping one, you are helping all of them. The most active thing you can do on your farm is to follow the five soil health principles and build your soil organic matter!

Determine Your Soil Health:
Use your observational skills – a great economical tool to ‘know’ your soil.

<table>
<thead>
<tr>
<th>OBSERVATION</th>
<th>GOOD SOIL HEALTH</th>
<th>BAD SOIL HEALTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Look</td>
<td>Dark/rich color</td>
<td>Light color</td>
</tr>
<tr>
<td>Feel</td>
<td>Small breakable particles</td>
<td>Big or small hard clods</td>
</tr>
<tr>
<td>Smell</td>
<td>Sweet, earthy</td>
<td>No smell; metallic means anaerobic</td>
</tr>
</tbody>
</table>

Other soil tests available to determine soil texture and nutrient levels:

- Soil texture – Is my sand more sand, loam, or clay? Mason jar test!

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:

1) Keep the soil covered. Avoid bare soil. Living plants and mulch provide a buffer to weather extremes. Add - Buckwheat, old garden seed, rye/vetch, mulch

- Broadcast sow oats and daikon radishes or purple top turnips (1-1.5 lbs oats and 1/10 lb brassicas/1,000 square ft. or 50 lbs oats and 2-3 lbs brassicas/acre) following pea harvest mid-July through late August.
SOIL HEALTH PRINCIPLES

1. Keep the soil covered
2. Minimize soil disturbance
3. Increase crop diversity
4. Keep living roots in the soil
5. Integrate livestock

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- Sow cereal rye late August at 4 lbs/1,000 square feet or 75-120 lbs/acre. Following spring scythe rye when seed head has formed and is exhibiting pollen. Plant pumpkins in scythed rye mulch.

- Broadcast crimson clover and/or annual ryegrass into sweet corn when corn is 24-30” at 15-20 lbs/acre ryegrass and 2-3 lbs/acre clover. Sow Mammoth red clover (2-3 lbs/acre) and oats (50-100 lbs/acre) in April or early May for full growing season. Scythe at seed formation.

- Sow a complex cover crop blend that includes 2-4 warm-season annual grasses, 2-3 warm-season legumes and 2-4 brassicas into a pasture or hay field in need of restoration in late June after first crop hay is removed. Sow new pasture mix under a cool season grass “nurse crop” (e.g. oats or barley) the following spring.

2) Minimize soil disturbance. Tillage is the traditional tool for weed control and preparing seed beds. Mulches and a diverse rotation that include perennials can aid in reducing tillage.

Tillage promotes the type of bacterial activity that has a negative impact on soil health by accelerating decomposition of soil organic matter (SOM). SOM is the food source for much of the soil biological activity necessary for increasing soil health.

Examples: Building one or more years of a perennial cover crop such as red or white clover that can be plowed down as a “green manure” for a subsequent crop can be a means of reducing tillage. Directly planting pumpkins into a cereal rye scythed as a mulch can also minimize tillage for weed control.

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) or have pasture dominated by only a few plant species (e.g. Kentucky bluegrass). In addition to breaking disease and pest cycles, diverse crop rotations can stimulate a wide variety of soil microbes. Research has documented increased pasture diversity stimulates future forage production. Many soil microbes are associated with specific plant species. The four major crop types are listed below. Try to utilize at least one representative from each of the major crop types in a rotation. Succession plantings and cover crops can be useful.

MAJOR CROP TYPES AND EXAMPLES

- Cool-season broadleaves: lettuce, spinach, turnips, peas, radish, kohlrabi
- Cool-season grasses: oats, annual ryegrass, cereal or winter rye
- Warm-season broadleaves: squash, beans, sunflower, buckwheat, eggplant, tomato
- Warm-season grasses: sweet corn, millets, Sudan grass, sorghum
No-till drills are available for rent in some areas to interseed grasses, legumes and broadleaf plants into pastures. Frost or stomp seeding legume and broadleaf plants such as chicory can be done on heavier soils using a broadcast seeder. Contact your NRCS Grazing Specialist or the SFA Livestock and Grazing Specialist for additional information.

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 how much of the year a particular plot or bed does not have something growing in it. Companion plantings, succession plantings and cover crops can be useful. Cover crops can be a powerful tool to aid in improving soil health. Cover crops work best in concert with the tenants of soil health. Cover crops may be annuals, biennials or perennials. Cover crops managed like a cash crop will provide the greatest soil health benefits. Complex cover crop blends contain eight or more species and at least one grass, one legume and one brassica.

5) Integrate livestock. All natural ecosystems have associated animal communities. Often, livestock are the primary missing link in soil health.

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:

- 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.

- Hogs can be readily trained to respect simple energized fences or utilize movable pens. Four to six hogs can utilize a 10,000 square foot area for a month with supplemental feed and water.
Sheep and goats can be trained to respect portable energized fences. Ten lambs can graze a 12-inch tall oat, field pea and turnip cover crop mix covering one acre for approximately 10 days. Some producers utilize custom grazing to integrate livestock.

“Custom grazing” utilizes another farmers livestock and cooperates with you on management to meet desired objectives. Utilize a written agreement to maximize this technique.

Cover crops can help integrate livestock by providing grazing; grazing can aid in recouping cover crop expenses.

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

SOIL AMENDMENTS:

- Compost. Utilize generous amounts of compost as available to provide organic matter and nutrients to cash crops.

- Lime and fertilizers. 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.

- Be aware of the harm you can do to your soil health by adding herbicides, fungicides and synthetic fertilizers. Such chemical inputs have devastating effects on soil microbial life.

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RESOURCES

Sustainable Farming Association sfa-mn.org/soil
Midwest Cover Crop Council mccc.msu.edu
Mandan ARS Lab Cover Crop Chart: ars.usda.gov/ARSUserFiles/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 Stika

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.