Soil health is an exciting and popular topic in agricultural circles. While many articles in the agricultural press target larger operations, the principles are the same. Smaller acreage producers have different needs and circumstances, but with the help of some accessible tools can incorporate the fundamentals of soil health into their farming activities. Promoting healthy soils on our farms begins with an understanding of what we mean when discussing “soil health.”

Soil health equals soil function

Soil function is the ability of the soil to capture and store water, and the ability to cycle nutrients. Most soil function (90 percent) is mediated by soil microorganism activity that builds soil aggregate structure. 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 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. Examples of using cover crops:

- Sow 1-1.5 #’s/1,000 square feet or 30 #’s/acre millet or Sudangrass after radish or spinach harvest June 15-July 30.
- Sow oats and daikon radishes or purple top turnips (1-1.5#’s oats and 1/10# brassicas/1,000 square ft. or 50 #’s oats and 2-3 #’s brassicas/Acre) following pea harvest mid-July through late August.
- Sow cereal rye late August at 4 #’s/1,000 square feet or 75-120 #’s/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 #’s/acre ryegrass and 2-3 #’s/acre clover.
- Sow Mammoth red clover (2-3 #’s/acre) and oats (50-100 #’s/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. Strip graze late summer or fall allowing livestock to eat half and trample the rest. Sow new pasture mix under a cool season grass “nurse crop” (e.g. oats or barley) the following spring.

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2) Keep the soil covered.
Avoid bare soil. Living plants and mulch provide a buffer to weather extremes. Soil microbes don’t like it too hot or cold. Cover crops or mulches create a comfortable home for the microbes when a plot or bed is not producing a cash crop. Providing adequate pasture rest and avoiding overgrazing minimizes bare spots and keeps the soil shaded. Keeping the soil covered also helps minimize erosion, suppresses weeds, minimizes nutrient loss, and aids in retaining moisture.

![Chart 1: SOIL THERMOMETER SHOWING DIFFERING SOIL TEMPERATURES ON SAME DAY](image)

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<tr>
<th>No Cover (100 degrees)</th>
<th>Cover Crop (80 degrees)</th>
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3) Diverse crop rotations.
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.

![Chart 2: MAJOR CROP TYPES AND EXAMPLES](image)

- **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) Minimize tillage.
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.

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. 30 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 (http://greenlandsbluewaters.net/Perennial_Forage/contract.html).
- 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.