If one soil characteristic were to be named which most affects soil quality, health, and productivity, it would probably be soil organic matter. The physical, chemical, and biological condition of soil may be enhanced or degraded by land management practices which either create or destroy soil organic matter. Increasing soil organic matter content on ordinary crop or pasture land often takes years to accomplish, and if the soil surface is left exposed during a heavy rain, productive topsoil can be gone in a matter of hours, even minutes.

**General Facts about Soil Organic Matter (SOM)**

- Soil organic matter arises primarily from decomposed plant matter, but decomposed animal and soil microbial tissues also contribute.
- The soil microbial community is responsible for converting plant and animal tissue into humus, another name for stable forms of soil organic matter.
- In order to increase SOM, soil nitrogen (N), phosphorus (P), and sulfur (S) concentrations must be sufficient to support a healthy soil microbial community.
- As SOM increases, soil nitrogen concentration normally increases, as do levels of other nutrients required for plant growth. There is greater soil storage capacity for these valuable nutrients, as well as water, as SOM levels increase.
- Soil organic matter is approximately 58% carbon.
- Soil organic matter is the substance that gives most rich, productive soils their dark color.

**Soil Organic Matter: Cropping Benefits**

- Improves water infiltration and reduces the likelihood of runoff, soil crusting, and soil erosion.
- Improves soil air flow and increases plant available water, which can reduce drought stress.
- Decreases soil bulk density and penetration resistance, improving the ability of root systems to grow and develop.
- Increases the content of water stable soil aggregates in soil. Most soils are crumb-like after cultivation and have high levels of SOM.
- Improves soil fertility by adding nutrients to soil as residues decompose, and by supporting a healthy soil microbial community, which converts some nutrients to plant-available forms.
- May reduce the need for pesticide applications as the soil food web diversifies and populations of beneficial organisms increase.
- Improves ground and surface water quality by improving the filtering capacity of soil.
Soil organic matter probably has as much impact on soil fertility and productivity as any measured soil property. Maintaining or increasing its level in your soils is akin to using coupons at the grocery store or keeping your vehicle running properly. These practices either directly save money now or limit how much you spend later on, and managing SOM is also a money-saving endeavor. In pastures and grassland, SOM may increase more rapidly than on hayed land, because of nutrient redistribution in the field.

**Increasing Soil Organic Matter Increases Soil Fertility**

- SOM effectively works like a bank for plant nutrients. The higher its content, the more potential for nutrient “investments,” and the more “tellers” there are to distribute nutrients to plants as they need them. On soil test reports, this activity is referred to as CEC (cation exchange capacity). Mineral soils with high SOM generally have a higher CEC.

- Organic forms of N and P naturally found in SOM are routinely changed to plant available forms by soil microorganisms. The SOM to nitrogen (N) ratio for many soils is around 20:1, and the top 6 inches of an acre of soil is often calculated to weigh around 2,000,000 pounds. Using these estimates, increasing SOM content from 2% to 3% could yield an additional 1,000 pounds of total N per acre, some of which would be plant available.

- Some studies show intensive grazing techniques can improve pasture SOM as much as 0.35% each year.

**Increasing Grassland Productivity**

- Creating or enhancing mixed grass/legume stands enhances soil microbial diversity and soil health, rendering the soil more capable of cycling nutrients between soil and plant and increasing productivity of the land. Soil microorganisms obtain much of their energy from SOM.

- Pay attention to manure deposits. Heavy manure deposits in a loafing area are not an efficient return of nutrients to the pasture. Valuable N and P may accumulate to extreme levels and be lost due to leaching through the soil or as runoff during storms. Significant amounts of N can also be lost as a gas into the atmosphere when N is over-applied and soils remain wet.

- Creating a grazing plan in which you control where the cattle spend their time, and in turn deposit their manure, is an effective nutrient management and redistribution plan.

- Maintain an appropriate stocking rate. A classic forages textbook recommends “take half and leave half” of the forage produced. Overgrazing damages and can kill established grasses and legumes.

- Fence cattle out of ponds and streams, while providing alternative sources of clean water. This practice can help prevent erosion and degradation of adjacent grazing land.

In cropland, conservation tillage and other SOM-building practices have been the backbone of some farm management plans for years. In a series of essays,
U.S. and Canadian farmers explained their commitment to land management practices that increase SOM and soil carbon. The following are direct observations made by these individuals, regarding both the challenges and benefits associated with limited tillage.

**Challenges Created by No-Till or Reduced Till:**
- weed control; shift to perennial weed species
- increased soil compaction initially
- reduced yield between years 2 and 5 after changing to no-till
- increased tire wear, particularly with corn and bean stubble
- cooler soils; affecting planting date, variety selection, and creating pest problems (animals, insects, disease)
- heavy residue can limit creating a good seedbed
- starter fertilizer program needed to ensure seedling vigor

**Economic Benefits of No-Till or Reduced Till:**
- fewer and smaller tractors required
- less wear on equipment; fewer trips across field
- both above yield reduced fuel consumption
- reduced labor cost
- reduced time in the field
- can enter wet fields earlier
- more consistent yields; dry years are better
- crop stubble protects seedlings

**Soil and Environmental Benefits of No-Till or Reduced Till:**
- increase in soil organic matter up to 0.5% each year
- reduction in bulk density
- greater water infiltration
- reduced soil crusting, runoff, and erosion
- improved soil condition
- moisture conservation and reduced irrigation needs
- long term fertility programs become more stable
- water quality can be improved, as long as nutrient management is adapted to avoid accumulation of phosphorus, particularly at the soil surface if fertilizer and/or manure continues to be broadcast. Injection or shallow incorporation of added fertilizer nutrients should be encouraged to avoid nutrient enrichment of surface runoff.
- **improved wildlife habitat**
Conclusions

Implementing farm management strategies which allow plant residues to remain on the soil surface or in the root zone have been shown to increase SOM levels. Soil quality is improved as SOM increases, resulting in increased soil productivity, and increases in SOM enhance cropping sustainability, resulting in a soil whose physical, chemical, and biological condition favors crop growth with each new season.

“The success of generational farming relies solely on the stewardship of the present generation. Soil health is our primary concern, and we are constantly looking for methods of ‘growing’ our soils to higher levels of biodiversity. In other words, to work in harmony with natural processes, versus trying to subdue and control them with commercial heavy iron, will keep more of our natural resources in place for the next generation.”

— Kenneth J. Cain, Darlington, Indiana


Vigorous pasture growth satisfies the nutritional needs of grazing livestock. The extensive root system of pasture grasses release carbon-rich compounds into soil and eventually die and decompose, thereby increasing SOM levels. Overgrazed, sparsely vegetated pastures tend to have lower SOM. Photo by Lynn Betts, USDA Natural Resource Conservation Service.