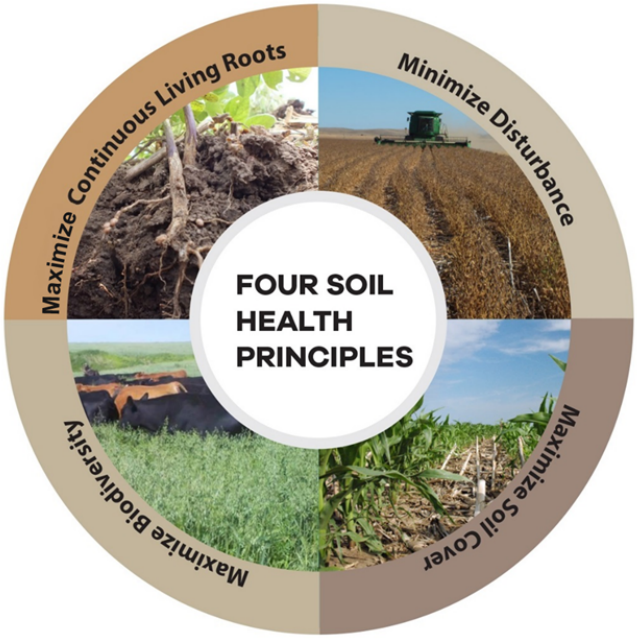
unlock the SECRETS IN THE SOIL

PRINCIPLES FOR HIGH FUNCTIONING SOILS

SOIL HEALTH DEFINED

Soil health is **the continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans**. Only living things can have "health," so viewing soil as a living, breathing ecosystem reflects a shift in the way we view and manage our nation's soils. Soil isn't an inert growing medium, but rather is the home of billions of bacteria, fungi, and other organisms that together create an intricate symbiotic ecosystem. This ecosystem can be managed to support plants and animals, by cycling nutrients, absorbing, draining and retaining rainwater and snowmelt for use during dry periods, filtering and buffering water to remove potential pollutants, and providing habitat for the soil biological population to flourish and diversify to keep the ecosystem functioning well.



KEY SOIL HEALTH MANAGEMENT PRINCIPLES

These principles are represented in the circular diagram to the left to emphasize their relationship as a continuum where each complements the others and also depends on the others.

1. Minimize disturbance
2. Maximize soil cover
3. Maximize biodiversity
4. Maximize presence of living roots

PROTECTING THE SOIL HABITAT

The first two principles, shown on the right side of the diagram above focus on protection of the soil habitat: minimize disturbance and maximize soil cover. Practices that use these principles maintain or increase stable soil aggregates and soil organic matter (SOM), and protect the surface of the soil that is most susceptible to the degrading forces of wind and water. Maximizing soil cover also buffers against temperature fluctuations that stress plants and soil organisms, reduces evaporation rates, and increases the amount of water entering the soil profile from precipitation and irrigation.

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SOM is highest at the soil surface and is critical for stabilizing soil aggregates.

Maintaining SOM helps support additional soil functions including water infiltration, drainage and storage, nutrient-holding capacity and release, and habitat for soil biota.

FEEDING THE SOIL ORGANISMS INHABITING SOIL

The second two principles, shown on the left side of the circular diagram, focus on feeding soil organisms. Maximizing the diversity of food (energy and carbon inputs) and aboveground biodiversity increases the diversity of soil animals and microorganisms. Diversity not only refers to food sources, but also aboveground diversification of plants and animals, and microbial diversification underground. Diversification stimulates a host of additional benefits including breaking disease cycles, providing habitat for pollinators, and stimulating plant growth.

Maximizing the presence of living roots in the soil can be accomplished through eliminating fallow, diverse crop rotation, inclusion of cover crops, and/or through dedicated grasslands (native or pasture). Mixing up which plants are grown during the year or over the course of multiple years may help to break disease/pest cycles.

When these two principles are properly applied as part of a soil health management system, soils can maintain or even increase SOM content as well as enhance nutrient cycling.

Worm being born within the pore space of a well-aggregated soil.

HEALTHY, FUNCTIONING SOILS ARE ABLE TO:

- Cycle nutrients effectively
- Store carbon and nutrients in soil organic matter
- Provide good aeration to promote root growth
- Improve farm and ranch resiliency and profitability
- Improve yield stability
- Reduce runoff and erosion
- Improve water storage and plant available water while protecting water quality
- Be resilient to drought, heavy rainfall events, and temperature extremes
- Reduce disease and pest problems

Soil Health Management Systems Principles can be generally used in all production systems to achieve this. However, the specific practices chosen to implement the principles must be adapted to each production system, climate, ecosystem, and soil to effectively build and maintain healthy, functioning soil.

SOIL DISTURBANCES

Physical disturbances such as tillage or compaction from heavy machinery; Chemical disturbances such as fertilizer and pesticide applications, especially over application or misuse. Biological disturbances, such as over-grazing animals that can lead to compaction and reduction in perennial root systems, introduction of invasive species and/or use of monocultures can cause biological imbalances which all can affect soil functions.

SOIL COVER

consists of two main forms: 1) living plant canopy such as a growing crop, cover crop, or grassland; and 2) mulch, either as dead plant material (e.g. crop residues, prunings from trees and shrubs, thatch in grasslands) or as an amendment (e.g. compost, bark chips).

BIODIVERSITY

is the variation of life forms within a given ecosystem or field. The different life forms include all of the plants, animals and microorganisms, and their secretions. For soil health management systems, biodiversity can be increased through a variety of approaches including: plant diversity through the use of diversified crop rotations, cover crop mixes, diversity through the proper integration of grazing animals (e.g. livestock) into the system and includes animals living within the soils or microbial diversity, as well as direct additions with biological amendments. All four soil health management principles contribute to biodiversity.

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