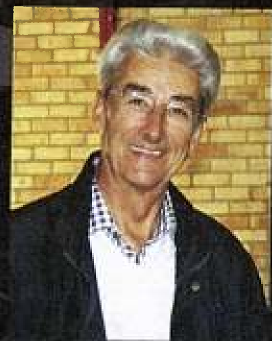
## "Keep the Soil Covered" by Rolf Derpsh, Ph.D, Asunción, Paraguay



The first step towards soil health is to protect your soil with cover or residue, oftentimes referred to as "soil armor". In addition to preventing wind and water erosion, covered soil has far fewer weeds, much higher infiltration, and much lower evaporation.

Rolf Derpsch, one of the fathers of the South American No-till and Soil Health movement, has this to say about Soil Cover:

Not very many farmers understand the true importance of soil cover in the no-till system. Some even wrongly view crop residues as a commodity, waste product, or an impediment to seeding the next crop. A no-till system with low amounts of crop residues, limited crop diversity, and high amounts of soil disturbance will have higher evaporation rates, lower water-use efficiency, and will not attain the full potential of the no-tillage system.

Almost all the benefits and advantages of the no-till system come from the permanent cover of the soil and only a few from not tilling the soil. In other words, it is not so much the absence of tillage, but the presence of crop residues on the soil surface that results in a better performance of no-till in comparison to tilled systems. Failure to pay attention to soil cover has resulted in poor performance of the system (lower yields, increased runoff and erosion, low biological activity, etc.). There is plenty of scientific evidence that no-tillage without soil cover results in poor crop yields.

Contrary to the belief of many US Farmers, there is no need to till the soil every so often after a no-till system has been established. Good examples are South American farmers, who once started, never till the soil again. The best way to avoid compaction is to produce maximum amounts of soil cover and to use cover crops and crop rotations. This way the roots and biological activity, as well as earthworms and insects, etc. will loosen the soil along with substances like Glomalin that bind the soil particles into stable aggregates and result in a beneficial soil structure.

Cover crops and crop rotation play a very important role in a no-till system in order to achieve the high amounts of soil cover needed. The development of cover cropping along with a permanent no-till system has been a major factor in the unprecedented growth of this technology in South America. In drier climates, farmers are often concerned that cover crops will take moisture out of the soil, making it unavailable for the primary crops. This is and should always be a concern in drier climates. Managing cover crops at the right time, in the right way, and using species that use less moisture are ways of getting around this problem. It must be remembered that while the cover crop removes some soil moisture, the additional mulch from the cover crop will improve water-use efficiency later in the cash crop.

#soilarmor

## "Minimize Soil Disturbance" by Keith Berns, Bladen, Nebraska

Soil disturbance can be the result of chemical, biological, or physical processes, but all forms of disturbance diminish habitat for soil microbes and result in a diminished soil food web. Chemical disturbances occur with the over application of synthetic fertilizers and pesticides and when we substitute chemistry for biological functions, we disrupt the symbiotic relationships between fungi, other microorganisms, and plant roots.

Biological disturbances such as long fallow periods and overgrazing, limits the potential and the ability for plants to harvest CO2 and sunlight. When plants are not allowed to function properly, the soil and the soil biology suffers because of increased erosion exposure, increased soil temperature, and decreased root growth and root exudates which build both soil structure and biological communities.

In nature, physical soil disturbance is always the result of catastrophic events such as erosion, earthquakes, or glaciers. In a farming system, tillage is also traumatic as it results in broken, bare, and compacted soil that is destructive and disruptive to soil life. Tillage disturbance can lead to the following negative soil impacts:

### *Erosion*

Broken and exposed soil is susceptible to both wind and water erosion. Tillage not only breaks down soil aggregate structure which leads to erosion, but also severely reduces soil residue cover which further exposes soil to erosion.

### *Compaction*

A typical soil is approximately 45% mineral (sand, silt, and clay), 5% soil organic matter, 25% water, and 25% air. The water and air portions exist in the pore spaces between the soil aggregates. Over time, tillage implements reduce and remove the pore spaces from our soils, restricting infiltration and destroying the biological glues which hold our soils together.

### *Reduced Infiltration*

Tillage physically breaks down soil aggregates and destroys root and earthworm channels which makes it difficult for water to infiltrate and leads to ponding water, excessive surface saturation, and soil surface crusting.

### *Organic Matter Depletion*

Tillage physically mixes soil organic matter (carbon) with excess oxygen and the result is a "burning off" of organic matter and the release of excessive carbon dioxide into the atmosphere. Long histories of tillage have led to significant reductions (50-80%) of soil organic matter levels across the majority of the world's arable land.

Limiting soil disturbance is one of the most important things that any producer can do to protect, improve, and regenerate the soil. As stewards of the soil, it is our job to protect our soils from any unnecessary chemical, biological, and physical disturbances.

#soildisturbance

## "Plant Diversity" by Dwayne Beck, Ph.D, Pierre, South Dakota

Dwayne Beck has had more impact and influence on Plains Agriculture in this generation than anyone else we know. As director of the Dakota Lakes Research Farm in Pierre, SD, Dr. Beck has developed his vision of regenerative agriculture in the field and not in a laboratory or a classroom. His practical approach to systems based agriculture is legendary and his candid style of education is refreshing to anyone who has heard him speak. Dr. Beck writes here about the Power of Plant Diversity:

A diverse crop rotation system consists of growing different kinds of crops in planned sequences to take advantage of the power of diversity and reduce overall risk. One of the most important roles of a crop rotation is to mimic the natural water and nutrient cycle while maximizing the amount of sunlight captured. If this is not done, the ecosystem will degrade quickly (erosion, water quality issues, etc.).

Historically, rotations have been much more diverse than they are at the present time. Most of them included phases with perennial crops like pastures and/or alfalfa. Almost all of them had livestock involved. This loss of diversity was due to a myriad of economic driving factors including farm program characteristics; mechanization, development of nitrogen fertilizer sources and pesticides, and specialization in livestock production. Interest in diversifying crop production systems has increased recently due to many factors. Commodity prices that are low relative to the costs of fertilizer, machinery, labor, and pesticide inputs have led producers to examine means of reducing these costs.

In addition, natural selection pressure resulting from longer histories of tight rotations and monocultures have led to species shifts, resistance, and/or changes in pest's traditional habits that have resulted in yield losses and/or use of higher priced technologies. Proper application of rotational planning can increase yields, reduce costs, and improve soil health and fertility. These positive benefits affect whole farm economics by reducing weed, disease, and insect pressure and resistance; spreading workloads to reduce fixed machinery and labor costs; providing more optimum planting and harvesting timing; and diversifying income and spreading weather risks. Failing to match natural systems has caused much of the environmental issues we face in US agriculture.

It is over-simplistic to classify rotations as good or bad. Rather it is best to think of rotations as having differing characteristics in terms of their impacts on various aspects of the crop production system used by a particular grower in any given environment. Designing appropriate crop rotations is a mix of art and science. Since all aspects (agronomic, environmental, economic, engineering) must be considered simultaneously, a systems approach is required. For any given situation, there will be a range of rotations that will be agronomically appropriate. Within this range are rotations which have differing characteristics in terms of the risk they pose (market availability, labor or machinery requirements, etc.) which may make some more suitable for use in a particular location. Management decisions must be made by individual producers to select the rotation or combination of rotations that is most appropriate for them.

**#diversity**

*This icon represents topics that are available in greater detail on our website. Go to www.greencoverseed.com and enter the topic name in the search box.*

## "Living Roots As Often As Possible" by Jay Fuhrer, Bismarck, North Dakota

Under the direction of District Conservationist Jay Fuhrer, Burleigh County in North Dakota became one of the original epicenters of Soil Health utilization, knowledge, and education in the United States over the last 15 years. Working with innovative farmers and ranchers like Gabe Brown and Ken Miller, Jay led the charge in learning how to improve all aspects of soil health and was an integral part of the acquisition and development of the legendary Menoken Farm. Jay is currently serving as the NRCS Soil Health Specialist for North Dakota and South Dakota and is one of the top Soil Health teachers around. Here is what he has to say about the importance of Living Roots:

There are many sources of food in the soil that feed the soil food web, but there is no better food than the sugars exuded by living roots. Our perennial grasslands consist of cool season grasses, warm season grasses, and flowering forbs. Consequently, adaptable plants are able to grow during the cool spring and fall weather, as well as the summer heat, allowing for a continual live plant feeding carbon exudates to the soil food web during the entire growing season. Our cropland systems typically grow cool or warm season annual cash crops, which have a dormant period before planting and/or after harvest.

Photo by Doug Garrison

Photo by Jimmy Emmons

*Plant root exudates leaking out to feed soil biology.*

Soil organisms feed on sugar from living plant roots first. Next, they feed on dead plant roots, followed by above-ground crop residues, such as straw, chaff , husks, stalks, flowers, and leaves. Lastly, they feed on the humic organic matter in the soil. Healthy soil is dependent upon how well the soil food web is fed. Providing plenty of easily accessible food to soil microbes helps them cycle nutrients that plants need to grow.

Cover crops are able to fill in the dormant period and provide the missing live root exudate, which is the primary food source for the soil food web. Cover crops may be incorporated into a cropping system as annuals, biennials, or perennials. Starting on a small acre scale will allow farmers and ranchers to find the best fit for their operation.

i #menokenfarm

i #livingroots

## "Livestock Integration" by Allen Williams, Ph.D, Starkville, Mississippi

A champion of the grass-fed beef industry as well as cutting-edge grazing methodology, Dr. Allen Williams is driven to build agriculture systems that provide an attractive, profitable, and sustainable future for many generations to come. He is one of the top grazing consultants in the country and is often on the road teaching farmers and ranchers about regenerative grazing systems and soil health.

Soil health, biological activity, moisture efficiency, and nutrient retention can all be dramatically increased through proper integration of livestock and the grazing of cover crops. There are several ways to accomplish this:

**Adaptive Multi-Paddock Grazing (AMP)** is a system allowing for flexibility in grazing methodology based on weather and field conditions, rather than locking fields into a rigid system that never changes. Short-term, high intensity grazing on multiple paddocks can carry more animals, have better forage utilization, have superior wildlife habitats, and improve the overall health of the soil over traditional grazing systems. Research has also shown that AMP grazing increases soil aggregate stability, lowers soil temperatures, and sequesters higher amounts of soil carbon than other methods of grazing or non-grazing. AMP grazing can work in any system whether it is perennial grasses or annual cover crop forages. Adaptive grazing also means being adaptive to the people! You don't have to move cattle everyday; it could be every other day, or once a week - it is what works best for you and what works best for the land.

**Learn more about AMP grazing on page 20 of this resource guide.**

#AMPgrazing

**Winter Stockpile Grazing** is when a grower takes advantage of warm growing season to grow forage for winter grazing and can include everything from perennial forages to warm season and cool season cover crops for winter grazing. It a very simple way to move cattle through an area in a high- density manner through the winter months, as well as to have the animals self-apply manure and urine in a very even distribution during that time period.

**Bale Grazing** is a winter practice where hay bales are placed in a field in a checkerboard fashion, about 30 feet apart. Cattle are controlled with a single strand of electrified poly wire and manure and residue is left behind in the fields as the animals dismantle and feed on the bales.

Poor grazing management practices that result in excessive plant leaf and tissue removal and excessive trampling create conditions conducive to soil loss. It has been documented that bare ground experiences a significant decrease in soil microbial activity, a loss in soil organic matter, and subsequent increase in erosion. When poor soil management practices are employed, either through poor grazing management or conventional farming, soil degradation increases due to increased soil compaction and bulk density, resulting in elevated water penetration resistance and reduced soil aggregate stability.

## *"Living Roots As Often As Possible" by Jay Fuhrer, Bismarck, North Dakota*

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**i #menokenfarm**

**i #livingroots**