

The Critical Role of Cover Crops in Soil Health

By: Marlon Winger, USDA-NRCS, Soil Health Division, ID, MT & WY



Restoring health in the soil

Many soil health innovators (producers / educators) realize that cover crops can do more than provide cover; they are biological primers that jump-start the revitalization of a degraded soil ecosystem.

I first heard the concept of biologically priming the soil from North Dakota soil health innovator Gabe Brown.

We are quickly learning that cover crops address many of the core soil health principles, from keeping the soil covered, to increasing plant biodiversity and quickly converting solar energy into dollars if grazed by livestock.

Noted authors Brady and Weil tell us that the second most important biological process that occurs in the soil is nitrogen fixation. But the most important biological function is photosynthesis, carried out by plants growing in living soil.

If we truly want to understand how soil functions, we need to understand the workings of the carbon cycle.

Photosynthesis converts sunlight energy and carbon dioxide into carbohydrates that plants share with microorganisms, providing them with energy to grow and reproduce.

Dr. Don Reicosky has taught that minimizing tillage (no till) will help reduce losses of carbon from the soil.

Cover crops help to fill in the gaps in a crop rotation to keep carbon flowing into the soil to achieve maximum carbon input into the soil ecosystem.

Many producers ask: How fast can I heal or regenerate my soil? The answer: How fast can you implement the principles of soil health?

A soil health management system is the first step in planning for soil regeneration.

Cover crop utilization in the crop rotation is critical to restore the health and functions of the soil.

Questions to discuss when planning cover crops

Before planting everyone's favorite turnip and radish or rye, we should take a minute and design our multi-species cover crop mix to help provide solutions for the resource concerns that have been targeted or identified.

Table 1 provides a short list to consider.

If you select only one resource to address, your mix can be very simple. However, if you want to address multiple concerns or goals, your mix will generally have more diversity.

Let's think for a moment: How does Mother Nature become so resilient to stress? She has a diverse ecosystem.

Jay Fuhrer teaches us that the closer we emulate nature the faster we can rejuvenate our soil ecosystem and make our soil function. Land owners and producers can or should focus on improving the four ecosystem processes.

This includes: the carbon cycle that converts solar energy to chemical energy; improving the bio community cycle, meaning the soil food web, plants and animals in all their diversity; the water cycle, which is directly linked to infiltration and availability of water; and the nutrient cycle where the soil stores, and moderates the release of nitrogen that is converted by microorganisms to plant available sources.

Nutrients can be transformed into available forms, held or stored in the soil or even lost to the air or leached through the soil.

Improving the soil function needs to be understood before conservation planning activities are presented or implemented.

Jon Stika teaches that restoring and maintaining soil health, is about restoring the capacity of your soil to perform all the functions it was intended to perform.

Visit the web link below that shows the USDA-ARS Cover Crop Chart developed by Dr. Liebig and associates in Mandan, North Dakota.

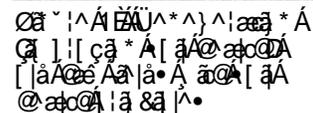
<https://www.ars.usda.gov/plains-area/mandan-nd/ngprl/docs/cover-crop-chart/>

Many NRCS state offices and cover crop councils are developing cover crop calculators. Some of the best calculators are produced by cover crop seed companies.

Table 1:

Resource Concerns

- Increase crop diversity
- Provide surface armor (reduce erosion)
- Build soil aggregates (granular structure)
- Improve water cycle (infiltration)
- Build soil organic matter
- Nutrient cycling (biological)
- Integrate livestock into the crop system
- Air quality
- Enhance pollinator / predator habitat
- Compaction (shallow and/or deep)
- Nitrogen fixation
- Integrated pest management
- Adjust carbon to nitrogen ratios (C:N)



Opportunities to plant?

Some producers are learning to plant green: keeping a diverse living root growing as much as technically feasible. Keith Burns teaches us that "Carbon is the economy of the soil ecosystem."

Generally, for cover crops there are four main time periods to consider when planting a cover crop:

1. Early spring: Planting in early spring to replace the fallow period or as part of a full season grazed cover that could be followed by a warm season mix planted in mid-summer, for example planting a buckwheat and mustard mix that grows fast before the corn crop.
2. Early summer: The easiest is immediately after a small grain harvest for hay or grain, leaving opportunities for cool and warm season species in the mix.
3. Early fall: September if growing conditions are favorable. Consider fast growing mixtures with a few species that can over-winter.
4. Late fall: Selecting species that can over winter like small grains (winter triticale, winter barley, cereal rye, vetch, winter peas, kale, red clover) and be utilized for spring armor, or early feed by livestock or to improve nutrient cycling before a crop like beans or corn.
5. Inserting a full season cover crop mix into the crop rotation

Addressing Resource Concerns

When addressing resource concerns, the more specific your goals or concerns the less diverse your mixes will typically be. Table 2 below provides an example of a warm / cool season mix that could be planted after wheat harvest. Legumes should be inoculated with appropriate Rhizobium species for nitrogen fixation.

There are several rules of thumbs when developing mixes: 1. Plant 30 to 40 pounds per acre, a little lower on low precipitation regions or if mix is dominated by small seeded species. 2. Around 1 million seeds per acre is plenty. 3. Increase overall diversity in the crop rotation. 4. Address as many resource concerns as the producer is comfortable with.

Table 2. Example warm season cover crop mix.

Cover crop species	Spring Pea	Fava Bean	Spring Lentil	Black Oat	Grazing Corn (BMR)	Forage Sorghum (BMR)	Forage Collard	Forage Radish or Turnip	Black Oil Seed Sunflower	Total Pounds/Acre
Pounds/acre	8	6	1	10	7	5	1	1	1	40

It's a Learning Experience

Many producers are learning to insert multi-species cover crop mixes into their crop rotation. Cover crops can be part of the new crop rotation. District Conservationist Keela Deaton and Clint Sell (producer) from Sundance, WY are learning together to improve soil function.

You can learn together one field at a time. Start small so you can sleep at night. They are implementing all principles of soil health as they regenerate old hay fields. Clint sprayed out his old hayfield, seeded a multi-species cover crop mix with a no till drill, and will then winter graze livestock instead of putting up so much hay.

Learning to implement livestock on cropland can become one of the most important principles implemented once the other principles are systematically applied. Eventually, when he feels the soil is functioning better, he will plant the field back into a diverse pasture mix of perennial species.

There are numerous examples in your own neighborhood of progressive producers who have implemented cover crops in their cropping systems. If you think you can, or you can't you are probably right. The principles of soil health are universal. The challenge becomes how you will implement them on your own farm or ranch.

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Producer Implementation

Look for opportunities in the crop rotation and fill it with a living plant. Many producers with livestock enterprises are inserting full season cover crop mixes into their rotation to help reduce over wintering feed costs.

Jerry Doan from North Dakota is a great example of using annual cover crops to over winter cattle. The ranch has reduced putting up winter hay from 5,000 bales to 600. He uses multi-species cover crops as winter feed that is grazed.

There are many variations of cover crop mixes from very basic 3 way to 15 or more different species in the mix.

Improving plant diversity is a common resource concern for many producers.

By utilizing crops in the rotation and cover crop mixes we can learn to add plant diversity by having plants that are in all four quadrants of the table below.

Warm Season Grass	Cool Season Grass
Warm Season Broadleaf	Cool Season Broadleaf

If technically feasible, each quadrant should be filled. Gabe Brown said in a workshop, "If soil health is the goal, crop diversity cannot be ignored or overstated."

Cover Crop Examples

If planned correctly cover crops can be a "win-win" option for producers, who understand and realize their potential to improve soil function and increase farm system diversity. Figures 2 and 3 below show cover crop diversity and a grazing system



Figure 2. Multi-species cover crop mix planted August 10th after wheat harvest in Boise, Idaho



Figure 3. This cover crop mix (Boise, Id) produced over 13,000 pounds of dry matter per acre before grazing started. Notice the warm season species have frozen down but the cool season species in the mix are still actively growing. The stocking rate was 300 cows on 3 acres for one day. The producer used step in posts and one strand poly wire to set up paddocks. Portable water tanks were utilized.

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