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Livestock as a Tool: Improving Soil Health, Boosting Crops

Integrating livestock with crops is an age-old practice. Unfortunately, in the past 70 years, as farming has become much more specialized, livestock's place in crop production has been reduced and even eliminated by the ready use of synthetic fertilizers. However, current research and practice in soil health has reaffirmed the strategic importance of livestock as a means of cycling nutrients, feeding soil microorganisms, and improving the aggregation and structure of soils. This, in turn, leads to more vibrant crops with less production inputs.

Photo: Kate Vogel, North 40 Ag

The Livestock Advantage

Livestock can perform multiple soil remediation actions:

- Cause cover crop roots to release sugars (exudates) when grazed, building soil humus.
- Cycle 70-80% of what they consume back to the soil in a form that directly feeds both microbes and plants.
- Add microbes from the rumen to the soil. These microbial species are similar to soil species of fungi, bacteria, beneficial nematodes, and protozoa—the workhorses of a functioning soil.
- Trample cover crops into soil for microbes to break down. This feeds microbe populations and cycles nutrients, including carbon, back into the soil.

Notice that no disc, plow, mower, or herbicide spray can replicate three out of four of these unique and essential tasks. Tillage, in fact, can be negative, destroying mycorrhizal fungi in particular. Herbicides, although expedient in termination of cover crops, can also harm soil microbial populations. Let's look more closely at how livestock can be a game changer.

Why Not Just Hay the Cover Crop?

Besides trampling the cover crop organic matter into the soil, what value is there to grazing the cover crop instead of cutting and baling it for hay? In *Progressive Forage Magazine,* Dr. Woody Lane calculates that grazing a grass crop and selling the lambs "removes 88% less nitrogen, 71% less phosphorus, and 99% less potassium compared to making hay from the same field" (2019). That means a huge gain in residual nutrients left in the soil by grazing rather than haying.

Initiating Plant Root Exudates

The mere act of a cow, sheep, or goat biting off the leaf of a forage plant causes sugary exudates to be released from the roots of the plant. These exudates are direct products of photosynthesis, and plants use them for nutrient exchange with soil microbes. Think of it as a giant underground Chicago Board of Trade. Plants offer an essential food to soil microbes (carbon), but only in exchange for essential plant nutrients. Plants are the original experts in the Art of the Deal—no plant nutrient; no deal. There is a primary difference between decomposition of plant material and an injection of carbon via root exudates. The decomposition process, while breaking down carbon, releases some carbon as CO_2 through respiration. On the other hand, the release of root exudates builds complex, stable forms of carbon, or humus. Humus is the main ingredient of healthy, carbon-rich soils. Adding humus increases soil organic matter much faster than tilling in a cover crop, and integrating livestock with crops gets this job done.

Cycling Nutrients

Ruminants are exceedingly inefficient by design. They only utilize 70-80% of the proteins, energy, and minerals that they consume. The rest goes right out the back end. Why? To feed the soil bacteria, fungi, and plants. Much of ruminant urine and manure is in plant-available form. Nearly all of it is readily available for soil microbes to utilize. So, the minerals that the plant originally absorbed from the soil to photosynthesize, build plant tissue, and emit root exudates largely come back to the soil in a readily available form. Nature has it figured out—as long as you use a cow.

Inoculating Soil with Microbes

Bacteria and fungi ingest and capture raw soil minerals. Protozoa and nematodes prey upon the bacteria and fungi and release the captured minerals in plant-available form. Thus, the minerals become available in the soil's chemical composition.

The rumen is a giant vat propagating the very same species of microbes that the soil uses to run its underground world. Ruminants contribute these microbes to soil populations several times a day. It is a self-perpetuating cycle of ruminants feeding the soil that feeds the plants that feed the animals.

Incorporating Plant Residue into the Soil

Finally, there's one thing grazing livestock do that tillage can also accomplish: incorporating plant residue. And yes, tillage can cover significantly more acres in a day than sheep and cattle grazing. However, livestock perform this service for a gain that you can capture. Machines do it for a depreciated loss. Why not look into how you can use livestock to your advantage on at least some of your acreage?

Livestock: Adapting to the Challenges

Integrating livestock into a cropping system requires some rethinking, some letting go, and a lot of adaptation.

Rethinking and Letting Go

If you are intrigued by the advantages of livestock integration, you may have to change your priorities to make it work for you. If you are growing a superabundance of crop species in rotation, maybe logistics will necessitate a slight reduction. You may need to incorporate more species in your cover crop. If you are certified organic, perhaps you could use livestock grazing to push back the number of tillage passes to suppress weeds. How much cover crop seed set can you really withstand? Are you willing to wait for several years for the positive influences of increased organic matter to leverage the advantage of full season covers vs. summer fallow? How about the innovation-stifling aspects of crop insurance? Can you afford to transition some of your ground to full-season cover crops and livestock instead of summer fallow?

Adaptation

One of the first concerns about livestock grazing cover crops is compaction. No-till significantly reduces this concern. Tilled fields will definitely suffer from more compaction because of a lack of soil structure. Also, it has been grazers' experience that cattle or sheep will not increase compaction over the long term if: 1) they are grazed with high densities for short-duration periods; 2) the forage canopy has a minimum of 3,000 pounds of dry matter per acre; and 3) you graze half and trample half. Humus is the main ingredient of healthy, carbon-rich soils. For cover crops with less dry matter, flash grazing with lower stocking densities would be best.

Providing water for livestock is also a challenge. Hauling water is time consuming, so some have solved the problem by drilling wells or dugout ponds and laying pipelines. Graziers also allow livestock to walk as far as half a mile back to the water source.

Fencing for the stock is also a consideration. However, high tensile and airplane-wire electric fencing are providing new opportunities for flexible, temporary grazing.

One of the keys to adaptation is doing what you can as you can. Just because you can't put livestock on 10,000 acres does not mean you cannot try it on 200 to see how it works. Usually doing something sparks innovation to do more.

References

Lane, Woody. 2019. Nutrient loss: hay versus grazing. Progressive Forage. May 1. www.progressiveforage.com

Further Resources

Related ATTRA Resources:

- ATTRA Grazing Planning Manual and Workbook, https://attra.ncat.org/attra-pub-summaries/?pub=577
- Integrating Livestock and Crops: Improving Soil, Solving Problems, Increasing Income, https://attra.ncat.org/attra-pub-summaries/?pub=481
- Managed Grazing Tutorial, https://attra.ncat.org/tutorials
- Nutrient Cycling in Pastures, https://attra.ncat.org/attra-pub-summaries?pub=240

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