The Circle of Life

Allen Williams & Russ Conser

July 10, 2017

Lion King, as with all Disney movies, has a great plot and some catchy tunes, but also a deeper moral to the story. In this case – it is about the "circle of life." Circles have no beginning or end. If we start anywhere on a circle, and follow it around, we end up in loop coming back to where we started. The Lion King circle was about the big loop of life and death, and so it is with the circle of life in your pastures.

Our kids learn about natural circles in school – for example, the water cycle. The big idea of the water cycle is that the rain falls somewhere, then evaporates back into the air, before it again comes down as rain somewhere else.

But in spite of some simple training in such circles, most of us unknowingly learned to think in lines. Lines are easy. In world of lines, something goes in, magic happens, then something comes out. In a linear world, we fail to see the connection between precipitation and evaporation. In our pastures, line-based thinking leads us to the overly simplistic understanding of processes. For example, we might think N-P-K goes in, magic happens, and growing grass comes out.

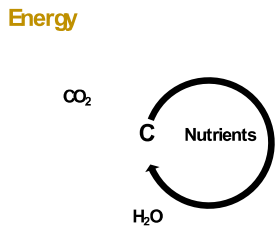
Without knowing it, any of us that went to college, deepened our linear thought process. We learned more and more about narrower and narrower parts of nature's circles, and unwittingly came away with an unconscious belief that by understanding parts of lines, we understood the circle.

It's time to leave our linear-based thinking behind and to start thinking in circles again. Thinking and doing in circles is complex, but rewarding. In circle thinking, the outputs of one part of a cycle are inputs to another. Inputs cost money, so reducing them saves you real dollars.

The key circle in your pastures is the carbon cycle. The carbon cycle has three interconnected loops: plants, grazers and soil.

Plants

Let's start with plants. All carbon starts in the air as the C in CO_2. You may remember from high school that photosynthesis is the process that takes the carbon from CO_2 in the air, combines it with hydrogen from water (H_2O) in the soil, and using energy from the sun, makes sugar (CH_2O). Rather than being left with a puddle of sticky sugar on the ground, the plant's metabolism takes that sugar and makes all of the complex molecules organized into the thing you recognize as a plant. Much of the mass of the plant ends up as complex molecules you've probably heard about like cellulose and lignin. In reality, any plant has 100's and even 1000's of complex compounds actively moving around at any given time.



Soil

Water from the soil is the source of hydrogen in all plant molecules, and cools the plant as it grows. Just like it takes nails to build a house made of wood, other elements and minerals are required to grow plants. All of those non-carbon elements and minerals come from the soil cycle.

Whereas we might have once thought that these mineral fractions were just sitting around waiting to be taken up by the plant, we now know that it is the microbiological system in the soil that brings the nutrients to the plants. The key concept to understand is that growing roots actually leak –- sugars that is. In short, the plant 'pays' the microbes with some of its sugars to go out and bring back the nutrients the plant needs to grow.

It is very important to understand that this interface between the plant and soil cycles is the result of a growing plant, not a dead one. Whereas biology can and will break down dead biomass like plant litter, the system thrives when one growing cycle (the plant) feeds the other (the soil). Root death occurs when more than 50% of the plant leaf biomass is removed, so the magic in keeping the roots growing and pumping out sugars to feed microbes is to never graze more than 50% of the above ground biomass. If we do this, we will keep pumping a continuous stream of sugars into the soil and fuel the "miners" (soil microbes) to keep a continuous stream of nutrients funneling back to the plant.

There is one important sub-cycle to make note of at the plant/soil interface – the nitrogen cycle. Nitrogen actually makes up a very small fraction of a plant's total mass (~0.1-0.2%), but everyone knows it's critical for growth. This is because although air is highly abundant in nitrogen (~80%), plants are completely unable to make use of it directly.

But plants grew before synthetic fertilizer was invented. Plants grew because microbes in the soil had the machinery to convert the inert form of nitrogen (N_2) into a plant accessible form of ammonia (NH_3). Whereas nitrogen-fixing microbes are notorious for being symbiotic with legumes (e.g. soy, alfalfa), other microbes in a rich and diverse soil microbial culture are also capable of this magic. In healthy soil, microbes are not only mining the minerals from the 'dirt', they are pulling the critical element of nitrogen quite literally out of thin air.

Grazers

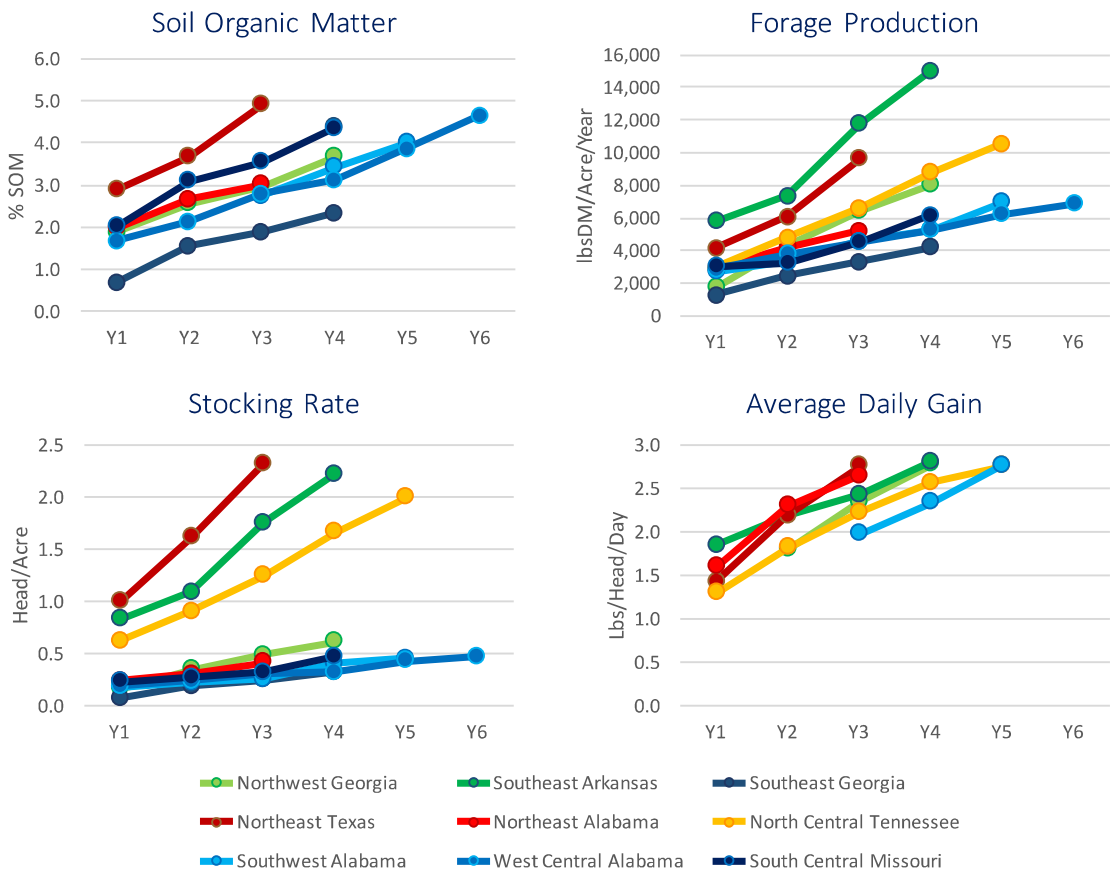
The final magic of the carbon cycle, and the part you have the most opportunity to impact, is grazing. As noted, most of the biomass in grass or any other plant is tied up in complex polymers like cellulose and lignin. This large stockpile of stored solar energy is completely inaccessible to humans, but is also inaccessible to your cattle – at least not directly. What enables the cattle to access that energy are the microbes in their rumens. Microbes in the rumen break down grass into fats that the animal can then make use of.

A ruminant is a solar-powered grass harvesting and processing miracle. If you manage it to move across all of your land and eat no more than half the grass, leaving partially digested biomass (manure) and nitrogen-rich urine spread evenly in its trail across your landscape, what wasn't used for locomotion, growth, or maintenance is cycled right back to the soil to help do it all over again. What gets left behind is everything the grass needed to grow in the first place – a sort of customized fertilizer.

Together, the cycles of plant, soil and grazer form the carbon cycle in your pasture. The carbon enters the cycle by way of the leaf of a plant, then circles round and round through animal and soil in way that grows more and better grass.

Hopefully you now start to see the true magic of this cycle – the periodic pulsing action of a cow eating grass drives this combined cycle of plant, soil and grazer faster and faster with each trip around the circle. It's powered by sunshine, but enabled by a complex and inter-connected circle of cycles where biological life does all the hard work, so you don't have to. With each turn of the cycle, more carbon builds below the ground and microbes mine more nutrients to fuel plant growth. This increasing biomass is also more nourishing because it had access to more nutrients. In practical terms, by tapping this cycle, your costs go down and your productivity goes up.

The power of tapping this carbon cycle is very significant. Below is a panel of four charts illustrating this circle in action on nine different ranches in the southeastern US. Here it becomes clear that by tapping this cycle to build carbon rich soil organic matter, we grow more grass, and this allows us to carry more cattle and put weight on them faster. In each case, the grazer is managing the circle of life between plant, soil and grazer to spin the carbon cycle faster and faster each year. No two ranches are the same, but all improve very significantly as the carbon cycle spins better each year.



Although somewhat loathe to use the illustrated mechanical metaphor of gears for a biological system, one thing about it works well – if any cog in this cycle gets stuck, the whole system grinds to a halt. Although perhaps obvious that the plants can't catch the sun without nutrients and water from the soil, it's also important to understand that without the grazer, the carbon gets stuck above the ground. If stocking densities are low, or cattle stay in one place for too long, they graze too much of the plants they like and not enough of the ones they don't. This means the roots die back on the desirable plants, but not on the undesirable ones, so guess what – you get more weeds. Weeds are sign that your carbon cycle is stuck, and not spinning. They are there to fix a problem.

Finally, although we used the case of cows eating grass and microbes eating what leaks from roots, anytime one thing in the circle of life eats another, the carbon is moving. Therefore, the bigger story isn't *just* about cattle, grass and soil, but about all layers of life in an ecosystem. Ecosystems are all about niches. The more niches or layers of enterprise you can get spinning on your farm, the faster the cycle will spin and the better your business will get.

In the end, your objective as a farmer or rancher is to keep this cycle going over and over. Don't let carbon get stuck above the ground or below. Keep it moving. Don't break it. Grazing drives the circle of life.

Russ Conser is a Partner in Standard Soil and works in regenerative agriculture. His contact information is 832-474-4764 or email him at russ.conser@standardsoil.com.

Allen Williams is founding partner of Grass Fed Insights, LLC, a partner in Soil Health Consulting, LLC, and in works extensively in regenerative agriculture. His contact information is 662-312-6826 or allenwilliams@joyce-farms.com.