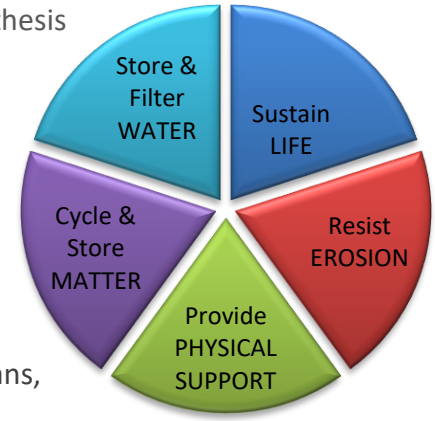
‘THE SCENE OF THE GRIME’ WITH NICOLE MASTERS, INTEGRITY SOILS

A healthy soil is productive, regenerative and profitable. There has been historical degradation of our valuable topsoil and carbon resource (between 30-60% losses since 1940). Resulting in reduced water and nutrient holding capacities, imbalances in nutrients and low biological function. This creates vulnerable land systems with lower resilience and carrying capacities. Carbon is the bank and hospital of your ranch. As we have lost this carbon, we can also get it back! Regenerative producers are able to build healthy soils and carbon quicker than traditionally thought, through harnessing plant growth, photosynthesis exudates and biological activity.

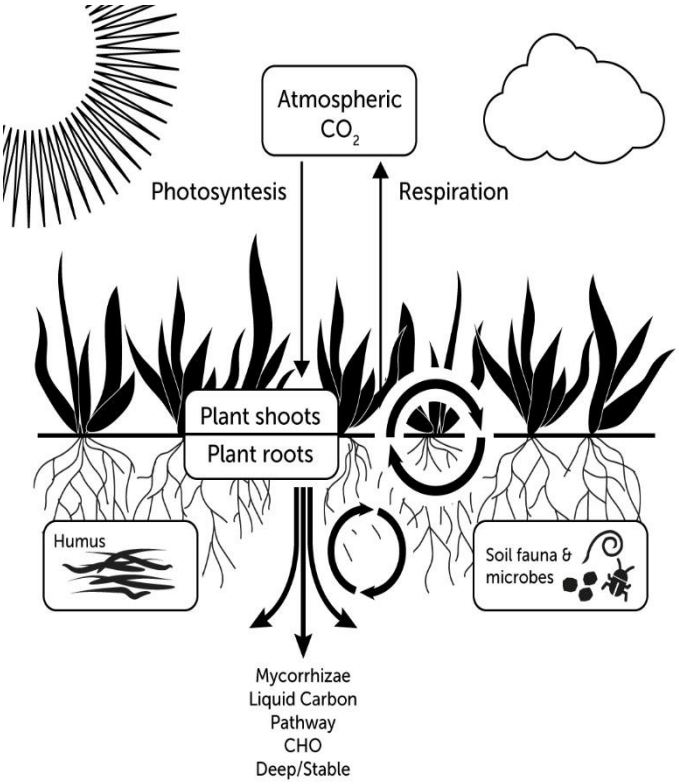


Soil health is the balance of natural soil properties, physical, biological, chemical, climactic conditions, and management practices: **<u>management</u> has a major influence on soil health potential.**

Building Resilience

Regenerative grazing practices increase microbial activity, reduce hardpans, encourage deeper rooting depths and increase plant photosynthesis (Brix).

There are two major soil carbon cycles at work here; the one most studied, is the *short-term decomposition cycle*, whereby organic matter (like leaf litter, manure) become microbial foods. Microbes then respire this carbon back into the atmosphere. The aim of regenerative farming practices is to build more stable carbon forms.

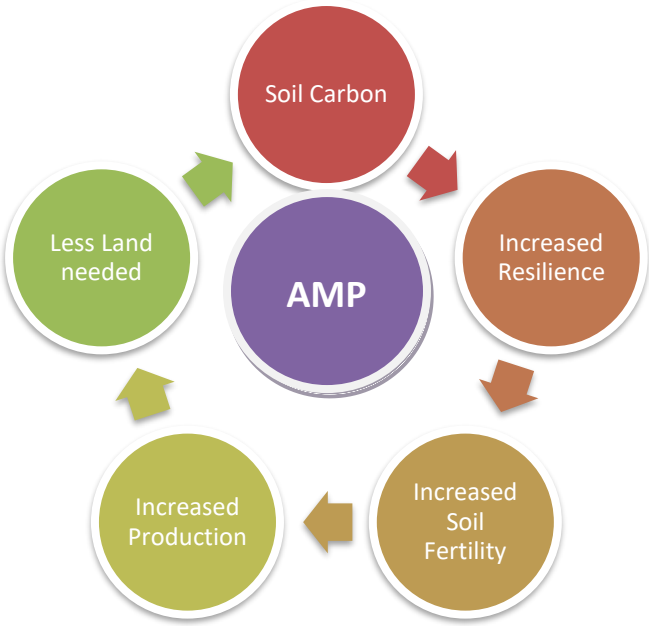


Humification is the process of changing the recognizable pieces of organic matter; roots, leaves, manure and dead critters into the fully decomposed dark uniform material known as humus.

The other important way that stable carbon is delivered from the atmosphere into the soil is through exudates from plant roots. As plant health and photosynthesis lifts, more sugar and other by-products are produced which can be pumped to the microbes. In many palatable grasses, over half of the sugars are sent out the roots as liquid carbon; these are chemically similar to nectar and feed the organisms in the root zone.

Much of this root nectar is held at deeper undisturbed levels in the soil, deposited through the action of mycorrhizal fungi ('myco'=fungus, 'rhizo'-root). All of our rangeland and many of our commercial crops require this fungal relationship to access water and nutrients. These root exudates are the cheapest, most efficient and most beneficial form of organic carbon for soil life.

Organic Matter works like a giant sponge; with a 1% increase (6" depth) able to increase the ability of soil to store water by 24,000 gallons/acre, and worth $680/Ac in NPKS. That's a significant increase, and a significant loss when you consider what historic carbon levels once were. Carbon really is ranching for profit, putting money in your bank.



So, how can you tell if your soil is losing or gaining carbon? One way is to take a soil test which gives you a small part of the picture or take a deep core which will show carbon levels at depth. You will need to take this test very 3-5 years.

Another cheaper and quicker method is to dig a few holes and compare the colour of your topsoil to a hole dug in an undisturbed area nearby which hasn't received fertiliser, been cut for hay, cultivated or been overgrazed. If you see a visual difference and your soil is paler, this can indicate management changes are required.

The benefits of soil carbon and humus on soil properties:

Physical: improves soil structure, increases water storage and buffers soil temperatures

Chemical: increase cation exchange, complexes cations, binds toxins, reduces run-off, filters contaminants, sink for GHG gases, improves nutrient uptake, humus stores anions (N, P, S and Zn), reduces the need for nitrogen and phosphorus fertilisation, and buffers pH

Biological: energy and food for microbes, reservoir for nutrients and increased resilience of the entire soil ecosystem. Increased plant and animal health and performance.

(Note for image above: AMP – Adaptive Multi-Paddock Grazing)

MICROBES AND THEIR ROLES

ORGANISM	DESCRIPTION	ROLE IN SOIL	FOOD/ INNOCULATION
Bacteria and Archaea	These are the oldest, the simplest, and the most numerous forms of life.	Disease suppression, make the smallest microaggregates **NUTRIENT RETENTION** Decomposers.	Aerobic compost tea, good compost. FEED: green plant materials. Simple sugars, simple proteins, simple CHO, molasses, fruit juice, seaweed, urine, manure, fulvic acid
Actinomycetes	Long chains of bacteria	Produce antibiotics; disease suppression, nitrogen cycle, humus formation, give soils their 'healthy smell'.	Consume difficult substances such as chitin (e.g. insect shells) and cellulose. FEED: mussel shells, woodier plant materials
Fungi 2 main types: **Saprophytic** =decomposers. **Mycorrhizae (AMF)** (*=Fungus root)* plant symbiote.	Grow from spores. Contain long strands of various lengths = hyphae. Food digested externally. Over 90% of all plant species depend upon an AM relationship for health and survival.	Fungi (and bacteria) are the primary decomposers of organic matter. Disease suppression, **NUTRIENT RETENTION** (esp. Ca), make macroaggregates – hold soil together = **EROSION CONTROL** Aggregation creates conditions for **N cycle.** Fungi produce acids to extract 'locked up' minerals.	FEED: Carbon: white wood*, paper, cardboard. complex sugars, complex proteins, fish oils, fish hydrolysate, biochar, cellulose, humates & humic acids (soft brown coals) *white woods= aspen, poplar, willow, birch, beech, elm.
Protozoa	Single celled organisms. 3 gps: Flagellates, Amoebae Ciliates	Consume bacteria - cycle nutrients. Make air passageways. Important food source for micro-invertebrates. **NUTRIENT CYCLING**	Aerobic compost tea, good compost, straw infusions.
Nematodes	Non-segmented worms. One of the simplest animal groups. Most are beneficial.	Nematodes generally eat bacteria, algae, fungi, protozoa and each other. **NUTRIENT CYCLING.** Release N, P, S and micronutrients during their digestive process.	Aerobic compost and compost teas. Vermicast. Encourage good diverse bacterial/fungal populations to feed nematodes.

SUMMARY: Without bacteria and fungi – most inorganic nutrients added will just wash away!
Without protozoa and nematodes – nutrient cycling from bacteria and fungi to the plant will not occur.
How about the microarthropods, dung beetles and earthworms? Diversity is KEY.

10 STEPS TO OPTIMAL SOIL HEALTH AND RESILIENCE

1. **Avoid costly production losses through building on local knowledge** - Find a mentor: a successful rancher/farmer, biological consultant or join a discussion group.
2. **Benchmark:** measure where you are now; soil mineral, biology, leaf tests and photographs.
3. **First do no harm:** reduce and then eliminate products that blow the microbial bridge; soluble N and P, glyphosate, fungicides. Buffer chemicals with microbial foods (e.g. humic/fulvic acid)
4. **Observe:** pests, weeds and diseases are all indicators for imbalances.
5. **Implement** practices that increase photosynthesis (brix), rooting depths and soil carbon. Management is KEY, increase number of paddocks, decrease number of mobs, increase recovery time and impact.
6. **Address major limitations;** air, water, foods and minerals: 1. Infiltration 2. Soil structure 3. decomposition 4. Review soil chemistry.
7. **Apply** broad-spectrum products which feed biology and address major nutrient deficiencies
8. **Health:** Ensure crop and animal health needs are being met, if not, use free choice minerals and foliars
9. **Monitor and observe changes:** Brix, EC, pH, photographs. Adjust programme as required.
10. **Encourage biodiversity above and below ground:** optimal grazing, leys, cover crops.

Management Considerations

Grazing— this is your number one tool. Potentially many grazing landscapes are **only using 40% of their effective land** due to poor animal distribution! What would be possible if you could increase that? Invest in infrastructure and/or range riders to bunch and move cattle and/or use mineral/salt to draw cattle to increase grazing coverage. There are new technologies- virtual grazing systems to improve grazing efficacy.
Bare ground & compaction – bare soil is one of the most damaging practices for your long-term soil health, putting microbes on a starvation diet, reduces water cycle and releases soil carbon to the atmosphere.
Bio-stimulants and trace elements -If you're grazing optimally and the system is slow to respond, often all that is missing is the spark to kickstart soil health. Biostimulants include foods or inoculants such as compost and vermicast (worm castings). These compost extracts contain the quorum signals, that can switch biology on at parts per billion. These are cost effective and easy to apply. Take a plant tissue test to check and see if you have a trace element issue holding up the quality of your grass.

SOIL HEALTH IS NOT AN END IN ITSELF

The ultimate purpose of building soil health is not to achieve high aggregate stability, biological activity, or some other soil property. The purpose is to protect and improve long-term ranch resilience and productivity as well as water quality, and habitats of all organisms, including people. We use soil characteristics as indicators of soil quality, but in the end, soil quality must be identified by how well soil performs its function.