Greenhouse Gas MITIGATION
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The give and take of sequestering carbon

Carbon sequestration doesn't happen continuously in forage systems, but productive grass stands are important to economics and the environment.

While producing and maintaining good quality forage stands is important to sequestering carbon in the soil, there is a natural ebb and flow to the process, says an Agriculture and Agri-Food Canada (AAFC) researcher.

Much like the average personal savings account, sequestering soil carbon is an ongoing process of deposits and withdrawals, says Dr. Vern Baron, a specialist in forage physiology and agronomy at the Lacombe Research Centre in central Alberta. The upper limit is influenced by soil, climate and crop production factors.

"There are a lot of misconceptions about what happens with carbon," says Baron. "Carbon is always in a state of flux. Sometimes it is being stored or sequestered and sometimes it is being released. Nature's goal is to reach equilibrium–strike a balance to match the amount of carbon being stored with the amount being released. That would be a success."

A pristine stand of native grassland, for example, has likely reached that equilibrium, which means carbon credits and debits are about equal over the calendar year. At the very least, over several years the carbon account will balance with a net loss in one year, offset by net gains in the next.

Major greenhouse gas

Carbon sequestering is one of the often talked about pillars in reducing greenhouse gas emissions. Carbon dioxide in the atmosphere is captured by plants and stored as carbon in plant tissue and in the soil. If there is a net carbon gain over a year, the crop-soil continuum is a carbon sink.

Healthy, vigorous forage stands, annual crops and land that is not cultivated have the greatest potential to store or sequester carbon, says Baron. Overgrazed pastures, for example, and traditional summerfallow will release more carbon to the atmosphere than is saved and are known as carbon sources.

"But even vigorously growing forages and crops will also release carbon during the year" he says. "There is a continual respiration process from plants and the soil throughout the growing and dormant seasons. What really counts in any given year is the net carbon sequestration."

While plants potentially store carbon while they are actively growing, greatest carbon loss occurs during the dormant period and even through winter. "Carbon is given off through the respiratory process of soil micro-organisms and plants themselves," says Baron. "Respiration losses come from vegetation, roots, soil organic matter and from litter on the soil surface. It's a natural process."

Target equilibrium

The goal is to manage resources so carbon withdrawals (losses) don't exceed deposits (sink), or at least balance out. "We have to keep in mind that nature is always working toward that equilibrium," he says.

Several factors affect the amount of carbon returned to the atmosphere. Soil moisture and temperature, length of the dormant period and health of the plant stand are all part of the equation, he says.

Field cultivation, pastures that are continuously overgrazed, or forage and crop stands under drought conditions are prime for net carbon respiration. "One of the greatest contributors of carbon sources is overgrazing," says Baron. "If range and pastureland is overgrazed and has a poor crop canopy then it is predisposed to be an emitter of carbon dioxide in the same order as summer fallow."

Improved forage and grazing management often increases the equilibrium point for carbon storage or the amount the carbon account can hold. Sequestration rates increase for a period of years until a steady state carbon-equilibrium is reached.

Dormant season

"The real issue is the length of the dormant season," says Baron. "Whether you end the year with a net sink or net source depends on the year, the length of the dormant period, moisture and temperature. Losses during the dormant period, compared to gains during the growing season, determine the net amount of carbon sequestered or lost."

The ebb and flow of carbon levels over the year doesn't discount the value of producers optimizing forage, crop and pasture growth. Properly managed forages and annual crops are more productive and more profitable, and provide the best opportunity to sequester carbon, he says.

Some farming practices over the past 100 years have resulted in overgrazing of pastures and rangelands and cultivation of marginal lands, all of which can lead to soil carbon loss and add to atmospheric carbon dioxide levels.

Adopting new management practices that maintain healthy and productive forage stands will reverse that trend over the next half century, he estimates.

"Small improvements to carbon sequestration rates over the large area of pasture and rangeland in Western Canada could have a large impact. We will still be gaining and losing carbon on an annual basis, but over the long haul we will reach that higher "soil-carbon equilibrium."

The Greenhouse Gas Mitigation Program for Canadian Agriculture, an Agriculture and Agri-food Canada initiative delivered by the Canadian Cattlemen's Association (CCA), funds demonstration and communication projects which increase producers' understanding of management practices which reduce or remove atmospheric greenhouse gases.

For more information contact the CCA, visit the Web site at www.cattle.ca or contact Pat Walker, Beef Project Coordinator at 403-601-8991 or email pgwalk@shaw.ca.