

Carbon Sequestration in Turfgrass: An Eco-Friendly Benefit of Your Lawn

Dale Bremer, Kansas State University

Published October 2007 in Turfnews, a quarterly Kansas Turfgrass Foundation Newsletter

Some who read this have no doubt heard of carbon sequestration and may even be well versed on the topic. Others may have heard about it but aren't really sure about what it is or how it happens. Perhaps some haven't the slightest clue about carbon sequestration and others may not even care. After all, what does carbon sequestration have to do with turfgrass and why does it matter anyway?

As it turns out, turfgrass and carbon sequestration have plenty in common, and eventually it may matter more that we now realize. But I will get to that in a moment. First, for those who may be a bit challenged in their understanding of carbon sequestration, let's review a little background on the topic:

Webster defines sequestration as "to set apart" or "to hold in solution usually by inclusion in an appropriate coordination complex." To follow that definition, carbon sequestration means to set carbon apart and to hold it in solution in an appropriate coordination complex. To put it more simply, carbon sequestration is removing, or "setting apart" carbon from the atmosphere (in the form of carbon dioxide) and then holding it in soils, where soils represent the "appropriate coordination complex." I've never before thought of soils as an "appropriate coordination complex", but we can leave that discussion for another day!

Turfgrasses, as well as other crops and plant ecosystems, play key roles in removing carbon from the atmosphere and translocating and storing it in soils. Through the process of photosynthesis, plants absorb CO₂ from the atmosphere and synthesize it into various sugars. Thereafter, some of these "photosynthates" are transported below ground and become a part of the roots, which remain in the soil even after the plant or root dies. Sequestered carbon is primarily a combination of decomposing roots and aboveground plant leaves and stems that have fallen onto the surface and eventually merged or incorporated into the soil.

Most of us are familiar with the appearance of organic matter in the soil, which is typically a dark, rich layer near the surface. That dark color is carbon, which is good for soils in many ways. For example, it improves soil structure (increases water infiltration and effective rooting depth), the soil chemical environment, and soil biodiversity. Greater carbon content in the soil reduces wind and water erosion, which also has benefits for air and water quality (less wind-blown dust particles and runoff into streams and leaching into groundwater).

Turfgrass is a good sequesterer of atmospheric carbon according to research by Yaling Qian and others (some may recall that Yaling was formerly a graduate student at K-State who studied under our own Jack Fry). Yaling's research determined that up to 800 lbs of carbon per acre per year is being sequestered by turfgrass. That is almost a half of a ton per acre, and it is significant. According to her reports, this rate is similar to carbon sequestration in grasslands in the Conservation Reserve Program (CRP), and turfgrasses in the U.S. alone result in 20 million tons of carbon being removed from the atmosphere each year! Rapid urbanization is causing the acreage in turfgrasses to increase even more, which ensures that the total amount of CO₂ sequestered by turf on a regional and global basis will continue to be important.

But why does it matter that turfgrass may sequester atmospheric carbon in soils? To answer this we need to take a step back. A lot has been reported in the news lately about global warming and climate change and the possible catastrophic effects it could have on planet Earth. I would like to address that topic sometime because it has become such a politically charged, emotionally driven, and polarizing topic that it is often difficult to get an objective view. But for now, let's stick to what we know. Concentrations of atmospheric CO₂ have risen by approximately 30%, primarily from the burning of fossil fuels and land use change (disturbing native soils for growing crops, constructing buildings, roads, etc.), since the beginning of the Industrial Revolution and CO₂ concentrations will likely double before the end of this century. Of course, CO₂ is a major greenhouse gas that traps solar heat in the atmosphere and helps to keep our atmosphere inhabitable. The concern is that because concentrations of CO₂ (and other greenhouse gases) are increasing in the atmosphere, too much heat is being trapped by CO₂ and global temperatures are rising.

So now we can connect the dots and see how turfgrasses may play a role in curbing global warming and climate change: 1) Burning of fossil fuels and land use change are causing CO₂ and other greenhouse gases to increase; 2) rising greenhouse gas concentrations may be increasing global temperatures and causing climate change; and 3) turfgrasses may help to mitigate global warming and climate change by removing CO₂ from the atmosphere and thus, slowing the overall rate of increase in atmospheric CO₂ concentrations. Because turfgrasses cover an estimated 50 million acres, which is three times larger than the largest irrigated crop (corn), turfgrass is already a global player.

As with so many other things, it gets more complicated. Atmospheric scientists are not content to know that turfgrasses sequester carbon. They are primarily interested to know if turfgrasses (and other crops) are NET sequesterers, which means that you must also consider all the carbon inputs into turfgrass management (for example, carbon expelled back into the atmosphere from the gas burned for mowing your turf, or from the energy consumed to manufacture fertilizers and pesticides applied to your turf, energy required to pump water for irrigation of your turf, etc.). It may be that even though your turfgrass sequesters carbon, your overall operation may register a net loss of carbon. Measuring carbon sequestration is an inexact science at present, which makes this process more difficult. And estimating the carbon inputs into your operation may be complicated as well.

So how can you as a turf manager increase carbon sequestration in your turfgrass? The good news is that turfgrass tends to sequester carbon under normal management in well-maintained turfgrass. This includes proper fertilization and irrigation, which maximize the health, growth and thus, absorption of carbon from the atmosphere by turfgrasses. Returning clippings when mowing also increases carbon sequestration by as much as 59%. Returning clippings also reduces the nitrogen requirements of your turf, which may help the overall carbon "budget" or your operation AND reduce emissions of another greenhouse gas, nitrous oxide. There may be other management practices that increase carbon sequestration in turfgrasses as well, but up to the present that question hasn't been addressed by science and consequently, not a lot is known about it.

Another important thing to understand before I wrap up is that the greatest carbon sequestration rates occur during the first 25 to 30 years after establishment of turfgrass, after which sequestration rates level off. This is because soils eventually reach a saturation point for storing carbon (like a sponge absorbing water). But disturbed soils, which are typical in

new lawns, are low in carbon and thus, have the potential to absorb and store a lot of atmospheric CO₂.

It is hard to say how significant carbon sequestration will become to turfgrass managers in the future. Conceivably, if global warming were to accelerate or become a more immanent and widely accepted threat, the government could get involved by providing incentives or even enforcing management practices that result in increased carbon sequestration in your turfgrasses. Or not. Only time will tell. But hopefully you now have a better grasp of the topic of carbon sequestration in turfgrasses should it ever rise to the level of impacting you in your normal turf-management operations.