Carbon Sequestration in Urban Landscapes

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Turfgrass is widely recognized for its benefits including soil protection, temperature moderation, pollutant filtration, and of course its use for outdoor sports and hobbies. But the portion of turf that does not meet the eye, the roots, also provides a benefit worthy of recognition, carbon sequestration, a buzz word that in a world concerned with carbon emissions takes on a lot of value.

Try remembering way back to your days in school when you sat through a lecture about the global carbon cycle. You may or may not remember seeing a diagram that resembles Figure 1. This interconnected system shows that a change in one carbon pool will have an impact on others. Therefore, decisions made by turfgrass managers alter the carbon cycle. What if turf can be managed to effectively capture some of the carbon out of the air and store it in the soil? Furthermore, what if there was an economic incentive to capturing carbon dioxide? The European Union has established a cap and trade system for greenhouse gas emissions. The idea is to limit the total emissions over time, while allowing the free market to decide how emissions are lowered and who has the permission to pollute. If turfgrass could capture carbon dioxide, it is possible that other industries would pay to 'borrow' it. Growing turf to sequester carbon could have both environmental and economic benefits.

Before we get carried away scheming about getting rich by growing grass, let's take a look at what scientists say about turf management and carbon sequestration. A recent article from the University of California-Irvine showed that turfgrass was actually a source of greenhouse gas emissions (Townsend-Small and Czimczik, 2010a). Like Mike McCarthy on a Sunday afternoon, the red flag was tossed, the play challenged, and the call reversed. Turns out the article had flawed calculations, that when corrected did not show a net emission of greenhouse gasses from turf management (Townsend-Small and Czimczik, 2010b). So what's the real story?

Researchers in the Denver, CO area tracked soil carbon changes at local golf courses (Qian and Follett, 2002). Soil organic matter in putting greens and fairways increased for almost 30 years after establishment of turf before reaching a steady state around 4% organic matter. This

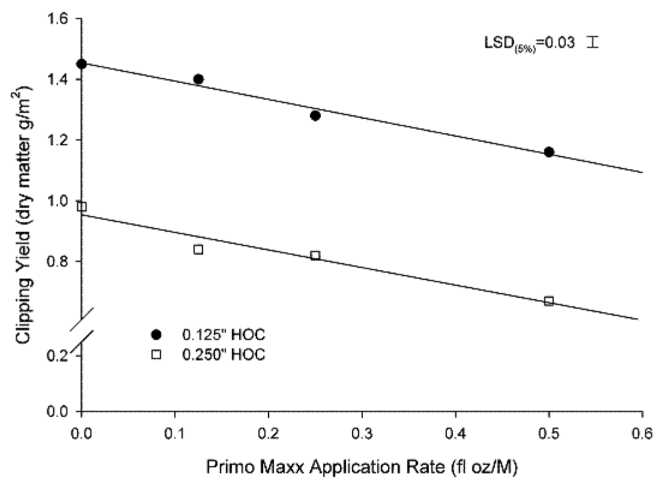

Figure 1. Simplified carbon cycle in a turfgrass system (From Singh (2007))

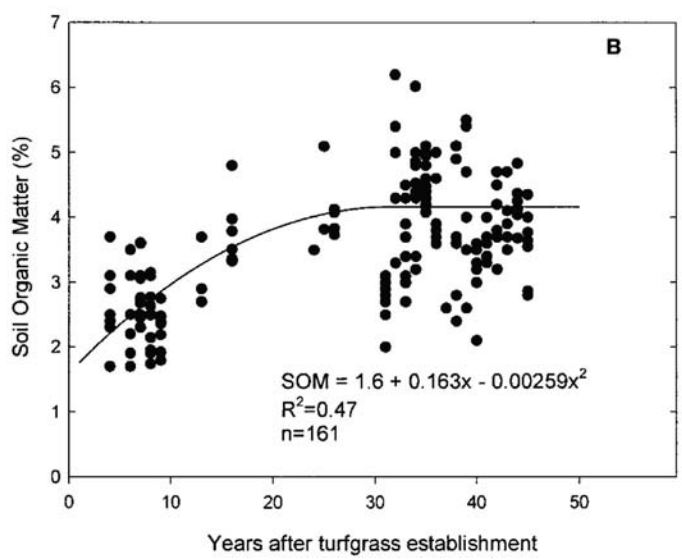

Figure 2. Soil organic matter over time since turf establishment on 13 golf course fairways (From Qian and Follett (2002))

was one of the first reports relating turf in the urban landscape and carbon retention (Figure 2). Computer models have also been used to simulate soil organic carbon in a turf management system over time. Simulations predicted that turf systems would acquire carbon for 30 to 40 years after conversion from native grasslands (Qian et al., 2003a). Furthermore, models estimated that the pool of soil organic carbon would double from 15 tons/acre to 30

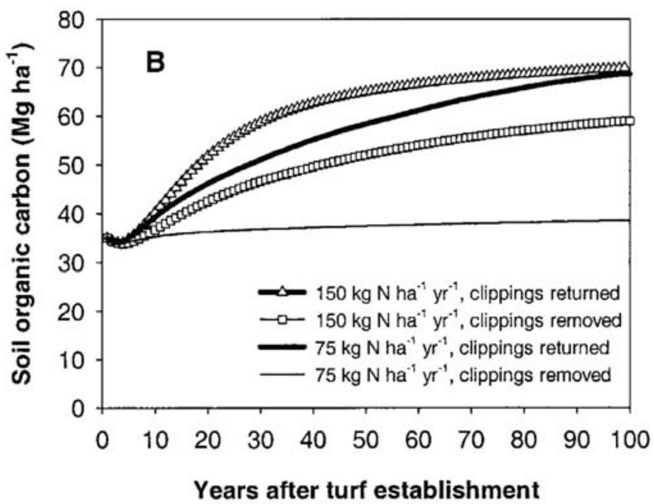

Figure3. Soil organic carbon predicted from CENTURY model over time since turf establishment (From Qian et al. (2003b))

tons/acre. Carbon sequestration by turf was confirmed in Ohio on a stand of Kentucky bluegrass with variable management regimes (Singh, 2007). The average net carbon sequestration over a 12 year period was 10 tons/acre.

So as a turfgrass manager what can be done to promote carbon sequestration? Research performed at the Ohio State University showed various management strategies to increase sequestration (Singh, 2007). They include (1) Limiting pesticide applications (2) Lowering annual nitrogen rates, particularly when stand is mature (>10 years), and (3) Using organic fertilizers. Generally speaking, fewer inputs result in less carbon required for production, transportation, and application. Now let's face it, lowering inputs is not always an option when exceptional quality is required. But management plans can still be tailored to apply inputs less frequently, purchase items in bulk, or use organic products when feasible.

Other strategies to decrease carbon emissions also exist. Monitor soil moisture and apply water only when necessary because the irrigation system uses electricity. Tune up those old mowers and consider purchasing new ones that are fuel efficient. A final and often overlooked way to help capture carbon is to return clippings whenever it is possible. Not only has this been shown to increase the rate of carbon sequestration but it cuts back on annual fertility requirements too (Qian et al., 2003b).

To make a long story short, turf in the urban environment has the potential to sequester carbon. This is an important benefit that should not be overlooked. Turf managers can tailor their plans to make turf even more effective at capturing carbon. Not only is it the right thing to do for the environment, but it may help with the budget too.

References:

Qian, Y.L., and R.F. Follett. 2002. Assessing soil carbon sequestration in turfgrass systems using long-term soil testing data. Agron. J. 94: 930-935.

Qian, Y.L., W. Bandaranayake, W.J. Parton, D.S. Ojima, and R.F. Follett. 2003a. Estimation of soil organic carbon changes in turfgrass systems using the CENTURY model. Agron. J. 95:558-563.

Qian, Y.L, W. Bandaranyake, W.J. Parton, B. Mecham, M.A. Harivandi, and A.R. Mosier. 2003b. Long-term effects of clipping and nitrogen management in turfgrass on soil organic carbon and nitrogen dynamics: The CENTURY model simulation. J. Environ. Qual. 32: 1694-1700.

Singh, M.H. 2007. Soil organic carbon pools in turfgrass systems of Ohio. PhD Dissertation.

Townsend-Small, A., and C.I. Czimczik. 2010a. Carbon sequestration and greenhouse gas emissions in urban turf. Geophysical Research Letters. 37:L02707, doi:10.1029/2009GL041675

Townsend-Small, A., and C.I. Czimczik. 2010b. Correction to "Carbon sequestration and greenhouse gas emissions in urban turf". Geophysical Research Letters. 37:L06707, doi:10.1029/2010GL042735.