ing season. Heritage is a broad spectrum, systemic fungicide, while Daconil Ultrex is a protectant fungicide that affects cell membranes. FRAC coding is published annually in *Turfgrass Pest Control Recommendations for Professionals* and can be seen online at **www.GeorgiaTurf.com** and Smartphone application "Turfgrass Management."

Turfgrass cultural practices, including dew removal and thatch build-up reduction, have suppressed the disease by promoting a less favorable environment for infection. It is well documented that removing dew from turfgrass by mowing or dew whipping in the morning can significantly reduce dollar spot infection. Research has shown that dollar spot is more likely to develop if moisture remains on the surface of the turfgrass for more than 12 hours.

Spring and fall nitrogen applications can potentially allow susceptible turfgrass to outgrow the pathogen and promote quicker recovery.

Therefore, reducing the window for infection by watering less in the evening and removing dew first thing in the morning is an important management practice. Thatch accumulation can increase disease incidence by allowing more fungal populations to become available. Dethatching during optimal growing conditions encourages aggressive growth and promotes a healthier disease free turf.

Monitoring fertility is also an important step in control. Turfgrasses that are maintained under low nitrogen fertility are more susceptible to infection, and they are slow to recover from dollar spot injury. Nitrogen fertilization can be an important management tool if applied to coincide with disease outbreaks. Spring and fall applications can potentially allow susceptible turfgrass to outgrow the pathogen and promote quicker recovery from disease injury.

Dollar spot has been an important turfgrass disease for many years, and epidemics continue to create challenges for turfgrass managers. Its unsightly appearance and ability to cause plant death has enabled dollar spot to become one of the most expensive to manage. Without proper management and knowledge, the disease can become a serious problem on golf courses, athletic fields and home lawns.

Dr. Clint Waltz is an associate professor and turfgrass specialist in the Department of Crop and Soil Science at the University of Georgia. He has statewide responsibilities for all areas of turfgrass management, including water issues. J.B. Workman is a graduate research assistant at the University of Georgia, where he is conducting his MS research project on alternative approaches to managing dollar spot. Both are located at the University of Georgia Griffin campus.

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Short-term C-fluxes in Biosolid-Amended Soils During Turfgrass Establishment

By Sabrina Ruis, John Stier and Doug Soldat

In a world increasingly aware of climate change, researchers are evaluating what plant systems are sequestering C released from the burning fossil fuels and C released from soil disturbance. Coupling use of biosolids amendments with sod production may be one way to both enhance sustainability of the industry and sequester C.

Research has evaluated C-sequestration in prairies; agriculture; golf courses; turf systems with biosolids additions; and more. Many of these studies focus on established vegetation or estimates of the change in Soil Organic Carbon (SOC) and not gas exchange measurements.

Sod production is unique, consisting of initial plowing or cultivation followed by seeding and an 18- to 24-month production cycle where at the end, 12-18 mm of soil is removed with the plant material. What happens to gas exchange of CO_2 from the time of plowing, incorporation of biosolids, through full vegetative cover? Our study's objective was to determine gaseous C-flux from biosolids amended and non-biosolids amended soil over the course of preplant cultivation, through germination, and achievement of full turfgrass cover.

The experimental design for a 16-week greenhouse study (January, 10 2010 to May 11, 2010) was a randomized complete block with five replications. Main plots were vegetated and non-vegetated containers, while subplots consisted of 0, 100, 200 and 400 kg Plant Available Nitrogen (PAN) per hectare from biosolids (control, low, medium and high). All containers were thoroughly watered and sown with 35 kilograms per hectare Kentucky bluegrass (*Poa pratensis* L.).

All treatments received 50 kilograms PAN per hectare from urea monthly to ensure N was not a limiting factor. CO_2 flux measurements were collected using an infrared gas analyzer (model LI-6400 XT, LI-COR, Lincoln, Nebraska). CO_2 flux measurements were initially made at frequent intervals to capture any C-flux from container packing, initial watering and seeding.

In the absence of vegetation during the first three weeks, CO_2 flux measurements were confined to dark respiration (Rd) measurements using LI-COR's soil respiration chamber. Once vegetation was present, measurements were collected at two-week intervals using a custom built, clear acrylic chamber with dimensions to match the soil chamber to estimate Gross Primary Productivity (GPP) followed by Rd with the soil chamber. Quality ratings (1-9 scale) and clippings were collected weekly.

Biosolids rate significantly affected preplant Rd between the control and high rate of biosolids. Rd for the high rate was nearly double that of the control (data not shown). Post-plant Rd nearly quadrupled with vegetation by the end of the study as the plants grew and matured while the non-vegetated treatment remained relatively steady throughout the study (data not shown). Post-plant Rd was affected by biosolids rate and date due to some significant differences between the control and

FIGURE 1

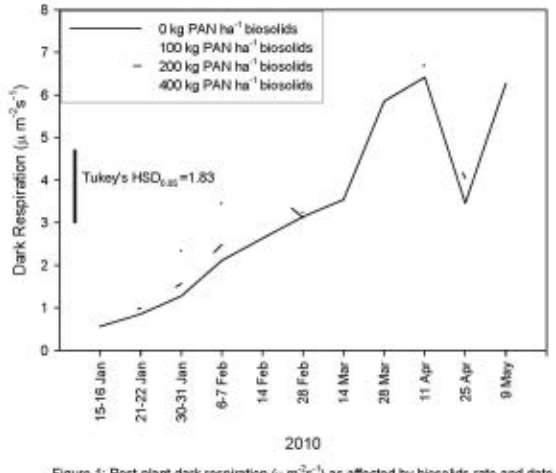

Figure 1: Post-plant dark respiration ($\mu m^{-2}s^{-1}$) as affected by biosolids rate and date over the course of the 16-week establishment study. Respiration readings taken at two-week intervals after first month. Biosolids rates: 0, 100, 200, and 400 kg Plant Available Nitrogen (PAN) ha^{-1}.

FIGURE 2

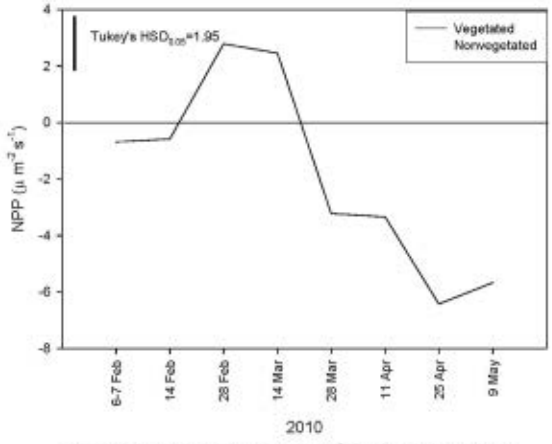

Figure 2: Net Primary Productivity (NPP) ($\mu m^{-2} s^{-1}$) as affected by vegetation and date over the course of the 16-week establishment study. Readings taken at two-week intervals after first month.

FIGURE 3

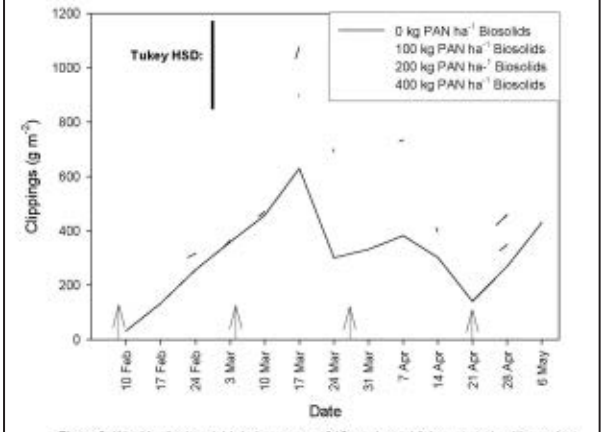

Figure 3: Weekly clipping yield during course of 16-week establishment study with preplant biosolids application rates of 0, 100, 200, and 400 kg Plant Available Nitrogen (PAN) ha^{-1}. Arrows indicate leaching events (dotted arrow) or fertilization with urea at 50 kg PAN ha^{-1} (solid arrow). Statistically significant day*treatment interaction ($P<0.0000$). Tukey's HSD=330.

high biosolids rate on a few days (Figure 1).

GPP was affected by both vegetation and date. GPP rate increased during the time of rapid growth relatively early in the study and decreased about midway through the study possibly due to supraoptimal temperatures for Kentucky bluegrass (data not shown).

Net Primary Productivity (NPP) was affected by vegetation and date. NPP increased as vegetative cover developed for several weeks following germination (Figure 2).

NPP declined as the plants matured and temperatures increased above optimum for Kentucky bluegrass. Clipping yield was highly dynamic, peaking after N-fertilization events and tending to decline after thorough watering events. The period of high growth during the weeks of February 14 through March 14 when NPP was positive is evident in the clipping yield during those same dates by continued increases in clipping weights each week. The high rate consistently produced more clippings than the other treatments, and was statistically different on a few separate dates, but that was primarily between the control and high rate (Figure 3).

Turf quality increased for all treatments through mid-April; however, at this time, powdery mildew development greatly decreased the quality of the high biosolids rate while the other treatments saw continued increases in quality (data not shown).

Biosolids amendments to sod fields increased pre-plant Rd; increased post-plant Rd in some instances; increased clipping yield; and increased quality until disease pressure was too high. NPP was not affected by biosolids but declined once turf began to mature and as temperatures increased above optimal, indicating there may be conditions under which turfgrass systems may serve as a source of CO_2 emissions. The conclusion of whether or not turfgrass or a turfgrass system amended with biosolids is really sequestering an ecologically important quantity of C cannot be answered by gas-exchange data alone and would need supporting data on C content of the soil, plant tissue and dissolved organic C in leachate. Sample analysis of all these factors is in progress with this 2010 study as well as a 2011 run of the study to examine year to year differences.

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It's Time for the Leaders to Lead

GOLF'S LEADERS SAYING IT'S NOT THEIR DUTY TO DEFEND THE GAME ONLY CONFIRMS THAT THEY'RE GOOD AT ABDICATING RESPONSIBILITY.

BY GEOFF SHACKELFORD

Golf will always be on trial. No matter how many success stories we tell, how many educational seminars we teach, how many frost-filter 30-second spots run during majors or even how fast and firm our courses get, the game will forever face scrutiny due to the scale and resources needed to maintain a golf course.

In fact, the more talented superintendents have become at maintenance and the more able designers have gotten at rearranging the earth, the unintended consequence has become increased hostility toward our sport for its reckless disregard of resources. On occasion the extremists have a point (earthmoving for the sake of earthmoving), but most times they simply are unwilling or unable to look at the majority of positive benefits outweighing the negatives that a golf course brings.

But humor me for a minute, and try to take a truly objective view — throw in the image of fat cats, country club excess and other golf stereotypes, then throw in a down economy — you can understand why there will always be folks putting the game on trial. Shoot, when you've listened to golfers moan about the color of divot replacement sand or a cart path crack, you've probably had days where Ted Kaczynski starts to make sense. Yep, you begin to see yourself sending long diatribes about the evils of committees from your remote cabin, all so you can ultimately self-publish a manifesto titled "How Technology Compromised the Greatest Game and Other Neurotic Quibbles as Seen From Eastern Montana Where it's Really Cold in December."

This is not to say you should go the Unabomber route. Nor is this an indictment of the impressive "rebuttal" stories in this issue, which are in no way a waste of time. Far from it. They are the stories of people sticking up for the game. These are the stories of the many remarkable people who open the doors each day to the world's most amazing arenas: golf courses.

Sadly, the same can't be said for the folks paid lavishly at some of our biggest non-profit organizations, who do not feel the same sense of purpose to take problem solving more seriously. The abdication of responsibility starts with the USGA and R&A's refusal to slow down the distance chase, leading to longer, acreage-eating courses. However, the average environmentalist hasn't a clue about that issue. Instead, environmentalists look at green striping or unnaturally lush grass or other quirks of the modern golf course, multiply them by 20, and soon have themselves convinced that they'd rather take a barefoot stroll around Chernobyl than play a round of golf.

The overpaid "leaders" of the game will say it's not their duty to defend golf. Their lack of action confirms one thing: They are good at abdicating responsibility. I know because right now there is a Ground Zero for golf and the trial is about to begin. It's called Sharp Park. It's an affordable Alister MacKenzie design just south of San Francisco. A group of certifiable, anti-human environmentalists are so determined to get rid of the place and the local politics are so wacky, that they may just win. It'll be the darkest day yet for golf, and while I salute the folks sticking up for this truly perfect public golf facility, I abhor the people in golf leadership circles who do not understand that this is the trial of golf's life.

Reach Shack, Golfdom's contributing editor, at geoffshack@me.com. Check out his blog — now a part of the Golf Digest family — at www.geoffshackelford.com.

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