What's New in Soil and Water Research for Golf Turf?

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Each fall, a group of over 300 turfgrass science researchers comes together to share and discuss our latest and research projects. This year the meeting was held Nov. 1-5 in Pittsburg, PA and began with a Sunday tour of Heinz Field and Oakmont Country Club, hosted by Dr. Pete Landschoot of Penn State University. After the fun, the business began on Monday and did not relent until mid-day Thursday. Professors, graduate students, and industry representatives shared results in either 15-minute oral presentations (~100 total) or large four by three foot posters (~100 also) that were displayed on the conference trade show floor.

Although the talks are definitely geared toward scientists (this is our big chance to use phrases like electro-spray ionization mass spectrometry, and morphological development comparisons at adjusted osmotic potentials); the vast majority of the science presented was conducted to solve practical problems in turf management. I think many golf course superintendents would actually really enjoy attending the conference at least once just to see all the innovative work that is happening all over the US (and sometimes world). Tod Blankenship, formerly the superintendent of Big Fish Golf Club in Hayward and now a graduate student at Oregon State University, concurred with this assessment.

Below, I will summarize a just a handful of the talks presented in the area of fertility, soils, and water management. The summaries are mine, and I apologize to the authors of the studies in advance if I have over-simplified their findings.

FERTILITY

Foliar absorption of nitrogen by creeping bentgrass putting green turf utilizing ^{15}N labeled inorganic and organic sources (Chris Stiegler, Mike Richardson, Doug Karcher, and Aaron Patton, University of Arkansas)

Collectively, golf course superintendents spend a lot of money on products that are marketed to give maximum foliar absorption. For some reason, foliar absorption is perceived as being more beneficial than root uptake - this has never resonated with me. The primary functions of roots are to absorb water and nutrients. The primary functions of leaves are to absorb sunlight, carbon dioxide, and prevent desiccation. There is no shortage of theories on why foliar uptake might be desirable, many of which deal with a compromised root system or energy efficiencies; but the logistics of foliar absorption is the 800 pound gorilla in the room.

This research project from the University of Arkansas evaluated the potential for foliar absorption of ^{15}N-labeled inorganic sources (urea, ammonium sulfate, potassium nitrate) and organic sources (three amino acids). They found about that only about 40-50% of N applied at 0.1 lbs N/M of a liquid application was foliarly absorbed 8 hours after application. All sources were similar except the potassium nitrate which had low foliar uptake. In summary, if you apply 0.1 lbs N/M, only 0.05 lbs N/M will be absorbed. If you spoon feed every other week for the entire season, a maximum of 0.4 lbs N will be absorbed through the leaves. Also, why pay a premium for products that are “specially formulated” to increase foliar absorption? Urea worked as well as the other products, and it appears that only a small portion of your total N budget can be foliarly absorbed.

Foliar nitrogen uptake efficiency of creeping bentgrass as affected by spray volume, adjuvants, tank-mixing, and fertilizer formulation (Shelby Henning, Bruce Branham, and Richard Mulvaney, University of Illinios)

Another foliar nutrition study caught my eye from our neighbors to the south. They found maximum uptake of nitrogen occurred after about 6 hours, but a good deal had occurred in 2 hours. Unsurprisingly, lower spray volume led to greater foliar uptake; however, the highest spray volume had uptake of 15% while the lowest had 19%. This seems like a fairly insignificant difference, to me. If fungicides were in the mix, I would choose the higher spray volume.

They tested several adjuvants in different classes (non-ionic, methylated seed oil, kinetic organosilicone, and others) and found that all products tested improved foliar uptake from 20% without an adjuvant to 25% with one; again, not an enormous difference. Because all products tested worked, I wouldn’t be looking to pay a premium for one adjuvant over another.

The Illinois researchers found fertilizer source (calcium nitrate, urea, or ammonium sulfate) did not affect foliar absorption. Also, tank mixes of urea plus Daconil Ultrex, Renaissance (a biostimulant), Tracker (a dye), Primo Maxx, and “the kitchen sink” (all of these mixed together) did not significantly affect the absorption of urea.

In summary, and corroborating the research from Arkansas, foliar uptake potential of a liquid application of 0.1 lbs/M is low. In the case, only about 20% (0.02 lbs/M) was absorbed. This amount can be increased slightly (5%) by using an adjuvant or decreasing the spray volume.

Integration of iron into nitrogen fertility regimes for regulations of fertilizer and water requirements of Penn A-series creeping bentgrasses (Jing Dai, Max Schlossberg, and Al Turgeon, Penn State)

In a *Grass Roots* article, I discussed the use of iron in fertility programs. Dr. Schlossberg and colleagues have been investigating use of iron sulfate for enhancing putting green color without creating unwanted growth. In 2008, they applied iron sulfate at rates of 0.06, 0.1, or 1.4 lbs/M per month along with N ranging from 0.3 - 1.0 lbs N/M per month. They found that the iron affected color about the same as the nitrogen. Stated a different way, you can cut your N rate in half and get the same color response if you add iron at 0.1 lbs/M/month. There results were very similar to those found by Yust et al. in 1984. Take home message: use of iron is great for aesthetics, no need for expensive iron formulations because iron sulfate appears to work well. What more could one ask from a product that affects color as much as nitrogen, but without affecting growth?

WATER

Metabolic responses of transgenic creeping bentgrass for a cytokinin biosynthesis gene to drought stress (Emily Merewitz, Bingru Huang, and Thomas Gianfagna, Rutgers University)

This work out of Rutgers is on the long-term end of the spectrum, but extremely interesting nonetheless. The genetically modified creeping bentgrass to internally produce more cytokinins (an important plant hormone). In drought conditions, the genetically modified grass had higher leaf water content, more chlorophyll, greater photosynthesis, and more antioxidants than the unmodified creeping bentgrass. Previous plant improvements were done the hard way, by finding grasses that appear to survive better in tough conditions. These new genetic techniques allow us to customize the exact traits desired in a grass. Some people are frightened by this power, but for me it's an opportunity to improve our continued efforts to reduce inputs and improve economic and environmental sustainability. Without a doubt, these genetically modified grasses will need to be studied thoroughly before they are released. In the debate about potential invasiveness of genetically modified plants, I've always thought that a grass tolerant to round-up was a red herring (just kill it with another herbicide), but enhanced tolerance to environmental stresses may confer greater potential for invasiveness.

SOILS

Biochar as an organic amendment alternative in sand-based turfgrass sites or golf course putting greens (Mark Slavens, Marty Petrovic, Johannes Lehmann, and Karen Heymann, Cornell University)

Biochar for sand-based rootzone modification (Shane Brockhoff and Nick Christians, Iowa State University)

The biofuels movement of the past few years has created a new and exciting soil amendment called biochar. Biochar is produced by pyrolysis (burning a source like switchgrass in the absence of oxygen). The main co-products from this product include bio-oil (a bio-fuel), bio-gas (methane), and biochar. Biochar is chemically stable, and won't decompose like peat moss. It has a high water holding capacity and also can be a source of nutrients itself and increases the cation exchange capacity of the soil.

Researchers at Cornell actually made biochar out of grass clippings from the Cornell University golf course and used that biochar in a study to demonstrate its beneficial properties. Similarly, researchers at Iowa State conducted laboratory studies for a switchgrass biochar and identified that the best incorporation rate for sand root zones is 5 to 10% by volume. Unlike peat moss and inorganic amendments, biochar is likely to be inexpensive, and widely available in coming years.

Lawn turf color and density in relation to soil nitrate concentrations (Xingyuan Geng, Karl Guillard, and Thomas Morris, University of Connecticut)

Temporal variation of amino sugar nitrogen in turfgrass soils (Dave Gardner, Ohio State; and Brian Horgan, University of Minnesota)

Finally, researchers at Connecticut and Ohio State are working towards developing a nitrogen test for soil. We are probably dozens of years away from a reliable, accurate soil test for nitrogen, but it is nice to see that steady progress is being made. I hope to contribute to this area in the near future.

UNIVERSITY OF WISCONSIN RESEARCH

Our turf team made eight presentations at the conference, I won't attempt to summarize them here because you are likely familiar with our work or will be in the near future through conferences and field days. Brad DeBels (Soils graduate student, and recipient of the Kurth Fellowship) won third place for his presentation on drip irrigation. He was competing against 43 other grad students from all over the country, so this is a truly impressive feat. Way to go Brad!

Nitrogen effects on quality of velvet bentgrass grown on sand and soil putting greens (Ben Pease, Eric Koeritz, John Stier, and Doug Soldat)

Evaluation of depth and spacing of subsurface drip irrigation emitters for turfgrass irrigation in a silt loam soil (Brad DeBels, Doug Soldat)

Use of a growing degree day model to schedule trinexepac-ethyl applications to creeping bentgrass golf putting greens (Bill Kreuser, Doug Soldat)

Determining fungicide degradation on golf course turfgrass under winter conditions using commercially available ELISA kits (Paul Koch, Jim Kerns, John Stier)

Response of creeping bentgrass to fall-applied nitrogen on sand and soil putting greens in the Upper Midwest (Dan Lloyd, Doug Soldat, John Stier, Brian Horgan, Andy Hollman)

Golf courses as a source of potentially invasive grasses (John Stier, Mark Garrison, Ed Luschei, Mike Cassler)

Logistic regression modeling of dollar spot epidemics using weather variables as inputs (Jim Kerns, Damon Smith)

Deschampsia as a native, shade tolerant turfgrass (Jason Kruse, John Stier)

REFERENCES

Yust, A. K., D. J. Wehner, and T. W. Fermanian. 1984. Foliar application of N and Fe to Kentucky bluegrass. Agron. J. 76:934-938.