MSU Turfgrass Research Update 2017

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Turf Pathology Research Update

Dr. J. M. Vargas, Jr., Nancy Dykema, Ron Detweiler, Adam Palmatier, Anna Stouffer-Hopkins

Dollar spot continues to be among the most important diseases on golf course turf in terms of the percentage of golf course pesticide/fertilizer budgets that are spent to control it. Since the disease disrupts the putting surface, tolerance for it is very low at all levels of golf courses, regardless of budget. As a result of the importance of this disease, several different research projects have focused on the management of this problematic disease.

Flagstick, a new dollar spot resistant creeping bentgrass cultivar.

A significant milestone was reached recently in our turf pathology lab with the development of a creeping bentgrass cultivar which is resistant to dollar spot. This cultivar, called Flagstick, was developed in a partnership between MSU and Seed Research of Oregon, a subsidiary of Pickseed USA. Flagstick represents a great improvement in dollar spot resistance among commercially available creeping bentgrass cultivars. Researchers across the US have praised the performance of this new creeping bentgrass cultivar for its tremendous improvement in the standard for dollar spot resistance. There is ample supply of seed for this season. The importance of the first truly dollar spot resistant commercial turfgrass is enormous. Most of the fungicide applications throughout the season in the Northeast and Midwest are for control of dollar spot. Having a dollar spot resistant cultivar on golf course greens, tees and especially fairways, which encompass numerous acres of turf, will result in financial savings to golf courses in addition to reduced environmental impact due to fewer fungicide applications being made.

Irrigation programming and cultivar resistance to manage dollar spot.

In another research project, a combination of irrigation programming and the use of resistant creeping bentgrass cultivars was investigated as a means of managing dollar spot. In an effort to manage this disease, the effects of irrigation frequency and timing on susceptible versus resistant creeping bentgrass cultivars were studied to determine their effect on dollar spot incidence. Irrigation applications made on a daily basis in the morning or at night or twice weekly at night were compared for all cultivars. All plots received the same total weekly volume of water. Results of this research indicate that irrigation programming and host resistance impact dollar spot development. When irrigated at 10:00 pm daily, all cultivars tested developed significantly less dollar spot than when irrigated at 10:00 pm twice weekly.

Field testing of fungicides.

Each year, agrichemical companies solicit our expertise in the field testing and comparison of both experimental and commercially available pest control products, especially fungicides. Our field trials are conducted annually on a variety of diseases including dollar spot, anthracnose, summer patch, take all patch, summer decline, fairy ring, and red thread, among others. With the lack of consistently sustained hot, humid weather during the summers in Michigan, it can be challenging to conduct research trials on some of the warm temperature and high humidity diseases. In 2015, we

purchased and built a greenhouse structure in which we can maintain high temperatures and humidity levels to better conduct research trials on diseases such as such as brown patch, bacterial diseases and Pythium blight. Our field trials also include investigations in the management of algae and moss, products which improve rooting and localized dry spots, as well as many specialized trials.

Impacts of Nematicides on Microbial and Nematode Populations on Golf Greens in Michigan

A survey of golf greens conducted in Michigan in 2017 indicated nematode numbers often exceeded damage threshold levels. Golf course superintendents are now more aware of nematode problems on their greens and are more likely to treat them with nematicides. This research should provide them useful information on the impacts of these products on target and non-target organisms. Research plans are to investigate the impacts of two nematicides on populations of plant-parasitic nematodes of importance on turfgrass, selected beneficial animals found on golf greens, as well as prokaryotes. Additionally, experiments to determine whether the age of a golf putting green affects the numbers of these organisms will be conducted.

Another facet of this research will involve studying the infestation rate and development of two cysts nematodes, *Heterodera ustinovi* and *Punctodera punctate,* on *Poa annua* and *Agrostis stolonifera*. Since there is very little known about these potentially important nematodes and their effect on these important turfgrass species, research efforts will focus on their migration through the soil to feeding sites, initial feeding habits, and potential detrimental effect on the turf. Attempts will be made to quantify the impact of these nematodes, if any, on the infected plants by analyzing clipping weight, root length, and rate of photosynthesis.

Turf Physiology Research Update
Dr. Emily Merewitz

Plant pathogen and plant physiological interactions

Plant-bacterial interactions and the environmental factors that play a role in disease incidence are not well understood. It is important to understand these complex interactions in order for integrated sustainable management strategies. This is particularly true for bacteria diseases, which are not resolved by pesticide applications. For instance, in *Acidovorax avenae* subsp. a*venae* (*Aaa*), a bacterial pathogen of creeping bentgrass and annual bluegrass, we have determined that *Aaa* can produce the plant hormones gibberellic acid isoforms (GA1, GA3, GA4) and indole-3-acetic acid (IAA). High temperature conditions can increase the production of these hormones in some bacterial isolates of *Aaa*. We have also determined significant differences in plant hormone responses in bacteria sensitive vs. tolerant cultivars of creeping bentgrass. We are using the knowledge of these hormone changes to determine whether plant growth regulators or endogenous plant hormones can be used to manage bacterial diseases in turfgrass species.

Winterkill stresses of putting greens

Golf courses in Michigan can be subject to extremely cold temperatures and snow/ice cover for long durations during the winter months, which could cause significant winterkill damage to a substantial portion of putting greens or fairways. Our research aims to determine whether fungicides, plant growth regulators, or other cultural practices or environmental conditions may play a role in ice sensitivity of annual bluegrass or if they can be used to promote plant tolerance of ice cover. We are also trying to understand how fall management practices may affect annual bluegrass acclimation characteristics such as carbohydrate allocation, viability of crowns, fatty acid content, and other physiological traits. Our most recent project has investigated whether ethylene regulation could play a role in annual bluegrass tolerance of low temperature and ice conditions. We now have results that suggest ethylene inhibition may promote annual bluegrass tolerance of winter conditions and treatments that increase ethylene, such as ethephon, may have negative effects on winter survival. Additional research will be performed to better understand how ethylene relates to winter performance of annual bluegrass.

Phytobiomes of turfgrass systems

In conjunction with multiple turfgrass research universities across the Northeast U.S., our lab is involved in experiments to better understand how management practices and environmental factors can play a role in altering the composition of microbes in and around turfgrass systems. Currently, we are investigating whether organic fertilizer amendments may alter rhizosphere microbiomes.

Abiotic and management stress tolerance of turfgrasses

Turfgrasses are subject to dynamic environmental and management stress changes throughout a year. Our research aims to better understand how important turfgrass species respond to such stress and how management strategies can be used to enhance plant stress tolerance. Specific projects include evaluating physiological,

biochemical and molecular changes associated with heat, drought, shade or salt stress in combination with plant growth regulator application, in response to mowing regimes, and other management practices.

Field, growth chamber, and greenhouse testing of specialty turfgrass products

We are actively involved in conducting trials for various turfgrass chemical production companies. Our lab has been instrumental in demonstrating whether certain products have plant physiological effects under optimal or stress conditions. These products may contain hormones, may regulate endogenous plant hormones, or may contain other metabolites or plant protective agents.

Turfgrass Establishment Research
Jacob Bravo, Dr. Jim Crum and Dr. Trey Rogers

The Effect of Dazomet on Accumulated Annual Bluegrass Seed and Newly Seeded Creeping Bentgrass

When considering golf course renovations, soil sterilization is a great way to begin the project with a blank slate, eradicating existing annual bluegrass (ABG) seeds within the soil. This sterilization process would usually be accomplished with the use of the fumigant methyl bromide (MB); however, MB was phased out by the EPA in 2005. With MB no longer available, dazomet (Basamid) is the only available soil sterilant to be used in a renovation setting. Fumigants are often applied using a plastic covering to seal the treated surface and improve efficacy, however covering many acres of golf course fairway is not a practical option. Furthermore, in the interest of re-opening the course as soon as possible, it is important to determine how soon after treatment can creeping bentgrass (CBG) be established without suffering negative residual effects. A research project took place in the summers of 2016 and 2017, at the Hancock Turfgrass Research Center (East Lansing, MI) to examine efficacy and post-treatment seeding effects of dazomet on renovated turf surfaces. Data was collected on the number of ABG and CBG plants that germinated as well as the percent area covered by CBG and percent area unaffected by the dazomet treatment. Fairway height results showed no negative residual effects on the newly seeded CBG. Control of ABG was not considered sufficient in fairways, likely due to the lack of an impermeable cover and also due to the incorporation method. Greens height results also suggested that there are no negative effects on seeded CBG regardless of dazomet rate or seeding date. Data from the greens height study showed exceptional control of annual bluegrass, further solidifying the essential function of an impermeable cover for this sterilization procedure. 2018 research will evaluate the combination of dazomet and fraze mowing (partial tillage, for increased dazomet soil incorporation) for increased ABG control efficacy in fairway turf.

Golf Course Management Research
Dr. Thomas A. Nikolai and Aaron Hathaway

The impact of putting green management on visible wear caused golf cleat/sole designs

At the request of the GAM, Michigan State University (MSU) has been performing golf shoe cleat studies since the mid 1990's. Early research on alternative cleats focused on visible wear on the putting surface (green friendliness), traction under various conditions, and impact on infrastructure in comparison with metal spikes. Since the demise of the metal spikes around the turn-of-the century research has primarily been driven by manufacturers (primarily FootJoy) desiring data regarding the green friendliness of their prototypes among current lines of their and competitor models. In recent years certain golf cleat/sole designs have caused some golfers and superintendents to note that many new designs are too aggressive on their putting surfaces to the point of believing banned metal spikes caused less visible wear. For However, superintendents in similar regions are not concerned with the indentations caused by newer golf cleats/soles and do not perceive them to be a problem. Because MSU has been performing these studies longer than any other institution the USGA approached us and asked to perform a 2-year study regarding golf shoe cleat/sole designs. The objectives of proposed research are to:

1) Identify particular components of golf cleat sole designs that result in the least to greatest perceived differences in regard to green friendliness.
2) Identify putting green management practices that minimize or negate the visible damage caused by trafficking several turfgrass species with the most intrusive and/or destructive of current golf cleat/sole designs identified in 1 above.

Lightweight rolling collar research

Research efforts at Michigan State University led to surge in lightweight rolling on putting surfaces. The benefits on the practice are well documented, however, some golf courses experience thinning of the collars from roller use. This study will perform a survey through the MiGCSA to determine how widespread the problem really is and then a study will be initiated to determine the impact of plant growth regulators on collar density under a heavy green rolling program.

Lightweight rolling establishment study

In a study performed at MSU in 2005 it was apparent that lightweight rolling increased the density on newly seeded putting surfaces, however, no data, except images, was collected. This year a study will examine the best timing and frequency of rolling following seeding collecting data regarding percentage cover over time.

Selective perennial grass control in Kentucky bluegrass

Tenacity and Pylex are both carotenoid biosynthesis inhibiting herbicides that cause bleaching of weeds. Tenacity has shown great promise for creeping bentgrass (CBG) control while Pylex has provided excellent Bermudagrass (BMG) control in recent trials. Both of these herbicides are very safe in Kentucky bluegrass (KBG) making each great candidates for home lawns, athletic fields, and KBG fairways and

roughs. These trials investigated fall-applied treatments with short application intervals. Results from these trials will be revealed as green-up continues this spring.

Triplex green mower triplex ring study

This study will utilize 4 triplex mowers and will evaluate which mower(s) results in the least amount of scalping while making a clean-up cut on the putting surface and which mower(s) if any result in the most visible damage to the putting surface. This trial will be held season long so weather conditions and recuperation may come into play.

NCERA-221 Multi-Site Organic Grass and Broadleaf Weed Control Trial

This multi-site trial will be conducted spring and fall of 2018. Applications will be applied at for optimal spring broadleaf control, i.e. sometime in May and mid-September to mid-October for fall treatments in East Lansing, MI. Four replications plots (25-50 ft^2) will be treated on sites at lawn height with typical broadleaf weeds, i.e. dandelion and white clover. The objective is to determine if any organic broadleaf weed controls that are on the market perform adequately well to suppress or kill broadleaf weeds.

Flowerbed wood mulching study

The objective is to gather data (numerical and with photographs) on weed encroachment, temperature, soil moisture holding capacity, and crop growth (annual flowers) among different colored wood mulch applied at different depths (1-3 inches) with and without a pre-emergent weed control product applied a top the wood mulch.

Turf Nutrition Research

Dr. Kevin W. Frank and Aaron Hathaway

Refining phosphorus recommendations for turfgrass grown on sand based rootzones

A prior fertilizer program research trial on an A4 creeping bentgrass putting green resulted in soil phosphorus deficiency levels in a USGA specification sand based rootzone. Phosphorus deficiency symptoms have been observed since 2013 and soil-testing levels are classified as very low and recommend a phosphorus application. What is unique about our previous research on this green is phosphorus soil test values from a urea nitrogen only treatment were 3.2 ppm and displayed phosphorus deficiency but a methylene urea nitrogen only treatment had a phosphorus soil test value of 4.2 and displayed no deficiency. Proper turfgrass fertilization produces a healthy turfgrass stand that sustains surface and ground water quality. Our research will verify if current MSU soil testing guidelines for phosphorus applications to turfgrass are accurate. If the phosphorus guidelines are too high, our research will result in recommendations that will result in a reduction of phosphorus applications thereby saving costs and also minimizing potential off-site phosphorus movement via leaching or runoff. If the current recommendations are accurate, our research will provide verification that phosphorus applications to turfgrass based on our soil test recommendations are appropriate and valid.

Twenty years of nitrogen leaching

Nitrogen leaching research was initially conducted at Michigan State University in 1991. The initial research conducted from 1991 through 1993 indicated that there was minimal risk of nitrate-nitrogen leaching from turfgrass. Subsequent years of research on the same lysimeters indicate the risk of nitrogen leaching changes as the turf ages. Since the summer of 1998 percolate samples have been collected from the same monolith lysimeters and analyzed for nitrate-nitrogen.

From July 1998 through 2002, lysimeters were treated annually with urea at a low N rate 2 lb. N/1000 $ft.^2$ and a high N rate 5 lb. N/1000 $ft.^2$. In 2003 the N rate was reduced to 4 lb. N/1000 $ft.^2$ for the high N rate while the low N rate remained at 2 lb. N/1000 $ft.^2$. During the first year (2003) of reducing nitrogen application rates from 5 to 4 lb. N/1000 $ft.^2$ there was no reduction in nitrate-N concentrations in leachate. However, after 15 years of annual 4 lb. N/1000 $ft.^2$ applications there was a significant and sustained reduction in the amount of nitrate-N leaching to the point that the mean leaching concentrations are now approximately equivalent to when the research was initiated in 1998.

July 2018 will mark the beginning of the 20^{th} consecutive year of leachate collection and 28 years since turfgrass was established on the lysimeters. It has been 20 years since the high N rate of 5 lb. N/1000 ft.2/yr was initially applied and resulted in high levels of NO_3-N leaching at ten years after turf establishment. Following the N rate reduction, leachate NO_3-N concentrations declined over an approximately 15-year period. The turfgrass growing on the lysimeters is now 28 years old and our objective is to determine if a high N rate of 5 lb. N/1000 ft^{-2}/yr will produce a similar result in NO_3-N leaching as measured at 10 years after turfgrass establishment.

In addition to concerns about nitrate contamination of ground water sources, phosphorus pollution of ground and surface water from fertilizers applied to turf

continues to be a subject of great debate. Throughout the Great Lakes region states have passed fertilizer ordinances that restrict phosphorus fertilizer applications to turfgrass. Phosphorus has low water solubility and limited leaching potential in most turf systems, with the exception being sand based rootzones. Phosphorus leaching is only one concern related to phosphorus fertilizer applications as runoff losses are often implicated as a potential source of phosphorus contamination of surface water bodies. Data on phosphorus leaching from mature turf growing on native soils is generally lacking. Data that would indicate the propensity for phosphorus to leach from established turf sites that have moderate phosphorus levels, 17 ppm, such as our lysimeters is critical and will provide scientific rigor to this ongoing debate.

National Turfgrass Evaluation Program Trials and Roadside Turf Evaluation

The National Turfgrass Evaluation Program (NTEP) is designed to develop and coordinate uniform evaluation trials of turfgrass varieties and promising selections in the United States and Canada. Test results can be used by national companies and plant breeders to determine the broad picture of the adaptation of a cultivar. Results can also be used to determine if a cultivar is well adapted to a local area or level of turf maintenance. Currently at MSU there are 6 NTEP trials: creeping bentgrass putting green and fairway, fine leaf fescue fairway and lawn, perennial ryegrass fairway, Kentucky bluegrass athletic field, and low input sustainable turf. In the fall of 2018 we will plant a tall fescue test. The trials cover a broad range of conditions and management from the relatively high maintenance of creeping bentgrass putting green to the lowest maintenance of only mowing for the low input sustainable turf trial. The results from these trials can be found at www.ntep.org. All of the trials are available for view at the Michigan Turfgrass Field Day on August 15, 2018. If you are interested in viewing them at any other time during the growing season just contact me and we can make arrangements to provide plot maps.

We established a roadside turf evaluation project in the fall of 2016 in cooperation with researchers at the Univ. of Minnesota, Nebraska, Wisconsin, and Rutgers. This research is funded through a grant from the Michigan Department of Transportation. The objectives of this research are (1) institute a multi-state roadside turfgrass testing program, (2) develop a data collection and reporting system that provides the most recent research results to state DOTs in a timely manner, (3) increase collaboration between university research programs that work on roadside turf. The primary emphasis of this project is to determine what grasses can establish and persist in roadside environments typically characterized by poor soils and road salting. We established 60 different ‘entries’. These entries included single species/cultivars and mixtures. Entries included alkaligrass, tall fescue, hard fescue, Kentucky bluegrass, sheep fescue, common department of transportation mixes and several other mixtures and species. We established trials on I-96 adjacent to the Williamston rest stop and on the east edge of campus on Hagadorn Rd. Plots will be evaluated through 2018.

Turfgrass Entomology Research
Dr. Dave Smitley and Terrance Davis

Status of new turf pests

Japanese beetle is now causing turf damage on golf courses as far north as Traverse City, Grayling and Tawas City. Particularly hard hit are golf courses located near Mount Pleasant, Pinconning, Tawas City, West Branch, and Houghton Lake. Many golf courses in these areas are now applying chlorantraniliprole (Acelepryn), imidacloprid (many products), clothianidin (Arena) or thiomethoxam (Meridian) in spring or early summer to fairways, tees and greens. In southern Michigan, south of Bay City, St. Johns, and Muskegon, Japanese beetle populations are declining with some locations down as much as 75% from what it was like 15 years ago. Some golf courses in those areas no longer need to all fairways for Japanese beetle.

European chafer continues to spread northward throughout the lower peninsula and as far west as Marquette in the upper peninsula. European chafer does not survive well in daily-irrigated turf, and is the biggest problem on dry, sandy sites or slopes. Golf course roughs and home lawns have been hit hard for the first time by European in many locations north of Standish, Clare and Ludington. Unfortunately, European chafer outbreaks are most intense for about 10 years after the first grub damage is observed. After that some of the natural enemies begin to catch-up and infestations begin to decline. Damage to home lawns can usually be avoided with irrigation or watering during dry periods, standard fertility and raising the mowing height to at least 3 inches.

European crane fly continues to spread outward from the Detroit area and Grand Rapids. The crane flies are most likely to become a problem in irrigated or moist turfgrass. Initially the damage looks grub damage, where the turf becomes thin in late fall or early spring. A soapy water flush or insecticide drench can be used to bring the leather jackets (crane fly larvae) to the surface. Insecticides applied in spring for grub control may not last long enough to prevent crane fly damage in October, so for lawn care companies or superintendents with a European crane fly problem it is better to wait until late July or early August to apply imidacloprid, clothianidin or thiomethoxam for grub control. Chlorantraniliprole should be applied in late June to protect against both grubs and crane flies. Other insecticides like carbaryl (Sevin and others) and indoxacarb (Provaunt) can be used when European crane fly damage is discovered in late September, October, April or May. Home lawns can usually avoid damage by irrigating or watering during dry periods, standard fertility and raising the mowing height to at least 3 inches.

Biological control of Japanese beetle with Ovavesicula

Research on the introduction of a natural pathogen of Japanese beetle was initially supported by the Michigan Turfgrass Foundation, GAM and AgBioResearch. Your support was critical to obtain initial results that provided the foundation for a USDA NIFA farm bill grant in 2017 and 2018. Following the introduction of *Ovavesicula* to golf courses in southern Michigan, we have seen populations decline by 75% since 2001. Some golf courses in southern Michigan no longer need to treat their fairways for Japanese beetle. In 2017 we started a series of experiments to better understand the impact of *Ovavesicula* on Japanese beetle. We are also working with USDA APHIS and other states to determine if they have the pathogen, and to provide dead infected

beetles to locations where it is absent. It takes 5 – 10 years after the initial introduction for the pathogen to spread and build-up to levels that will begin to control Japanese beetle, but once it is established it will be there forever. No commercial products are available with this pathogen, and MSU is leading the research, world-wide, on introducing *Ovavesicula* for biological control. Japanese beetle has recently become established in Italy, meaning that most of Europe is now at risk of becoming infested.

Home lawn grub control

The Home Lawn Grub Control extension bulletin was updated in April for 2018. It explains how to avoid grub damage with cultural practices, how to diagnose grub injury, and when an insecticide product may be helpful. In recent years it has consistently been one of top three most viewed MSU Extension bulletins. In the last two weeks I have had phone calls about this bulletin from Ohio, Pennsylvania and Kansas. You can find it by Googling 'Home Lawn Grub Control', then scrolling past 3 or 4 advertisements to the MSU site, or by entering this address: http://msue.anr.msu.edu/news/how_to_choose_and_when_to_apply_grub_control_products_for_your_lawn