The Michigan Turfgrass Foundation and Michigan State University present:

Turfgrass Field Day

TURF

Robert Hancock Turfgrass Research Center
Wednesday August 10, 2022

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Schedule

<u>Golf Tour Stops 9:00 – 11:00 AM</u>

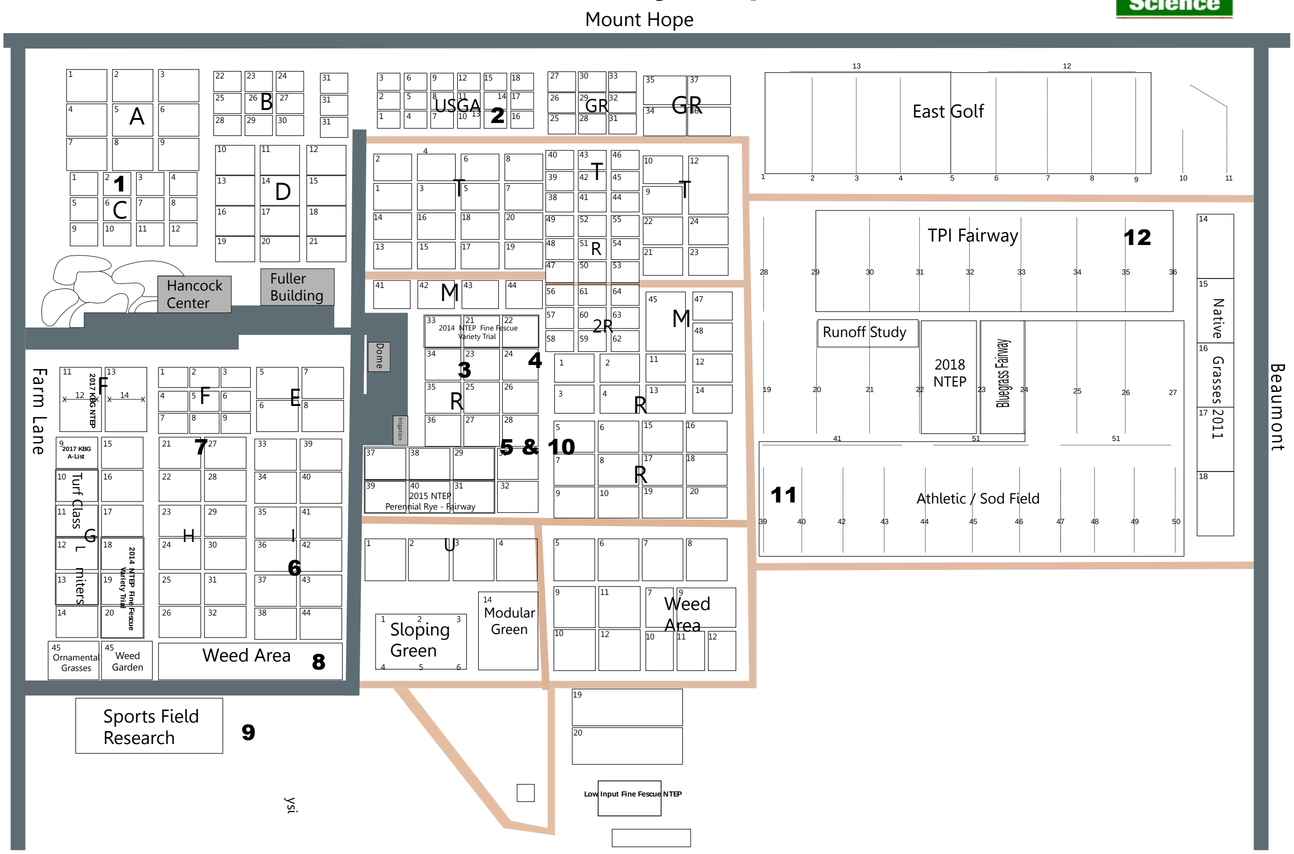
1. Turfgrass Disease Update – Dr. Joe Vargas, Jr. and Nancy Dykema
2. Soil testing & Winterkill reestablishment – Dr. Kevin Frank and Payton Perkinson
3. Turfgrass Physiology & Winterkill Update – Dr. Emily Holm, Kailey Miller, Megan Gendjar, & Michael Itam
4. Plant Growth Regulator Research – Dr. Thom Nikolai
5. Hydroponics and Variable Depth Putting Greens – Mike Rabe and Dr. Thom Nikolai
6. USGA golf ball reaction research update – Evan Rogers and Dr. Trey Rogers

<u>Lawn/Athletics Tour Stops 9:00 – 11:00 AM</u>

7. Perennial ryegrass control in mixed stands of cool-season grasses – Ryan Bearss & Dr. Trey Rogers
8. Crabgrass control – Dr. Thom Nikolai
9. Sod on plastic: establishment and maintenance – Jake Kilby and Dr. Trey Rogers
10. Hydroponics and Variable Depth Putting Greens – Mike Rabe and Dr. Thom Nikolai
11. Turfgrass Disease Update – Dr. Joe Vargas and Nancy Dykema
12. Sod on plastic: establishment practices – Jackie Guevara and Dr. Trey Rogers

Robert W. Hancock Turfgrass Research Center 2022

Field Day Stops



Golf 1. Disease Management for Golf Courses

Nancy Dykema and Dr. J.M. Vargas, Jr.

PYTHIUM ROOT DYSFUNCTION.

With the cool, wet weather we had earlier this season, and the continued rain we've been experiencing as temperatures have increased, Pythium root dysfunction (PRD) on creeping bentgrass has been rampant in Michigan this year, as well as Pythium root rot (PRR) on annual bluegrass. Typically, these diseases are seen infrequently in Michigan, so this has presented a new challenge for turf managers this year. The pathogens that cause these diseases are water molds that infects the roots of the plants. They also form long-term survival structures that can lay dormant for several years if conditions aren't conducive for infection. For PRD, small pale green to yellow patches form initially, and if the disease goes unchecked, these can become dead patches which resemble take all patch. Best management strategies for root Pythium diseases will be discussed.

ANTHRACNOSE.

Anthracnose is a devastating fungal disease caused by *Colletotrichum cereale* which typically infects annual bluegrass, but can sometimes be found on creeping bentgrass as well. It often occurs in turf which is under stress due to low mowing heights, low fertility, and heat stress. It can be particularly problematic when saturating rains or heavy irrigation are followed by high temperatures and humidity. This pathogen can invade the foliage and/or crown of the plants. When the fungus invades the crown or meristem of the turf plant, death or severe injury to the plant usually results. Because of this, management of CRA on a preventive basis is recommended over a curative approach. A crown rot anthracnose trial was conducted this season. Disease is evident in the study, and differences among treatments can be seen.

DOLLAR SPOT MANAGEMENT.

Over the years, research for the management of dollar spot has included a variety of methods including cultural, chemical, biological, and genetic means. In addition to chemical management, practices such as rolling and irrigation programming, as well as the use of cultivar resistance, have been shown to reduce dollar spot. This season, dollar spot pressure has been moderate in our studies. A research project evaluating many facets of dollar spot, including management using combinations of dew removal, cultivar resistance, and a biological control product, has been initiated at MSU in cooperation with several other universities across the country, as well as internationally. This is the first year of this 5-year study with a main goal of learning more about dollar spot and the organism that causes it.

BROWN PATCH.

Brown patch is a disease that develops under warm, moist conditions in the summer, especially when daytime temperatures are in the 80s and nighttime temperatures exceed 68F. When these conditions occur, along with high relative humidity, smoke rings often can be seen in the outer perimeter of the patches. The pathogen that causes this disease is an excellent saprophyte, meaning it can grow and survive well on dead, organic matter. This means that the pathogen can grow, unimpeded and unnoticed for a time, and when conditions are right for infection, the pathogen can attack plants and form brown patches very quickly (overnight, even) that can range in size from a few inches to several feet in diameter. The study shown demonstrates the severity of brown patch, especially when the surrounding, low fertility areas are examined.

Golf 2. The Effects of Soil Test Philosophy Recommendations on Creeping Bentgrass and Annual Bluegrass; Winterkill Reestablishment

Dr. Kevin W. Frank, Payton Perkinson and Jackie Guevara

This study evaluates two soil testing philosophies and fertilizer recommendations, namely Sufficiency Level of Available Nutrients (SLAN) and Minimum Levels for Sustainable Nutrition (MLSN). SLAN is generally considered the more established method for determining fertilizer recommendations while MLSN is a more recent method.

Soil samples were collected in spring and autumn to a depth of 6 inches. The whole plot treatments (MLSN, SLAN and urea only) were split into trafficked and non-trafficked plots. In 2019, nutrient application rate for MLSN was 1.5 lbs N, 0.75 lbs P and 1.2 lbs K per 1000 ft^2; SLAN was 1.5 lbs N, 3 lbs P and 5.5 lbs K per 1000 ft^2; and urea only was 1.5 lbs N/1000 ft^2. In 2020, nutrient application rate for MLSN was 1.5 lbs N, 0.8 lbs P and 1.4 lbs K per 1000 ft^2; SLAN was 1.5 lbs N, 0.6 lbs P and 4.4 lbs K per 1000 ft^2; and urea only was 1.5 lbs N/1000 ft^2.

These treatments were applied on two USGA greens: ‘Penn A-4’ creeping bentgrass (*Agrostis stolonifera* L.) and a mix stand of annual bluegrass (*Poa annua*) and ‘Penncross’ creeping bentgrass. Data such as NDVI, visual ratings of turf color and quality were collected monthly.

<u>Winterkill Reestablishment Study</u>

This spring reestablishment seeding research was conducted at MSU, University of Minnesota, University of Wisconsin, and Iowa State University. On three consecutive weeks in the spring of 2022 four creeping bentgrass cultivars and Two-Putt annual bluegrass were seeded into an existing putting green that was killed with glyphosate the previous fall. The bentgrass cultivars were Penncross, Declaration, Pure Distinction and A4. Previous seed germination research at the University of Minnesota found that some bentgrasses displayed high germination rates at low temperatures while others performed poorly. As a first step in our research we designed a study to compare bentgrass cultivars and Two-Putt annual bluegrass over three seeding dates in the spring in the field. We will answer the questions:
1) Do cultivars differ in establishment rate, especially in a cold spring
2) Should I seed early or wait until it warms up?

This research is the first step in the first year of the WinterTurf grant. In the spring of 2023 we will repeat this trial and expand with additional research that evaluates the effect of covers on reestablishment and other management practices such as nutrient source and rate, and possibly even using pigments to enhance surface warming and germination rates.

Golf 3. Turfgrass Physiology and Winterkill Research Update

Kailey Miller, Megan Gendjar, Michael Itam, and Emily Holm

Project Name: WinterTurf: A holistic approach to understanding the mechanisms and mitigating the effects of winter stress on turfgrasses in northern climates (U of MN lead institution)

Presenter: Emily Holm

Project Description: This is a large, multi-state USDA-SCRI funded project (2021-2025) with broad objectives for investigating strategies to improve turfgrass winter survival. The objectives lead by Dr Holm include 1) developing a method for determination of crown viability correlated with whole-plant survival and 2) identifying physiological and metabolic factors associated with tolerance to anoxia and accumulation of toxic metabolites and 3) a breeding associated objective to screen a perennial ryegrass breeding population for tolerance to ice encasement and identify best research methods for implementing ice encasement treatment.

Methods: For objective 1) The most widely used method of testing cold tolerance using leaf electrolyte leakage is not necessarily correlated with actual crown viability in grasses. Consequently, survival assessments are typically based on whole-plant regrowth that takes a minimum of 2 weeks for accurate assessment. A high-throughput method would increase efficiency of identifying germplasm with improved winter hardiness traits. We will evaluate a widely used cell viability assay, using triphenyl tetrazolium chloride (TTC), and compare cell viability with dyes.

For objective 2) Under prolonged ice encasement, oxygen depletion is one of the most important factors leading to winterkill. The continued consumption of oxygen under ice, due to plant and microbial respiration, results in hypoxia or anoxia. Moreover, the shift to anaerobic respiration leads to changes in metabolism that result in accumulation of toxic fermentation metabolites. The ability to study turfgrass responses to ice-induced oxygen deprivation in both controlled environment and field experiments is complicated by the ability to maintain consistent ice cover. We will expose plants to different durations of anoxia and evaluate various gas treatments to better understand inter- and intra-specific differences in survival under ice for informing phenotyping approaches.

For objective 3) a perennial ryegrass population is being screened by multiple methods such as in vacuum seal bags in the freezer, in a growth chamber under ice, and treatment of individual tillers. If variation in ice encasement tolerance is revealed, genetic information is available to be able to link potential genetic regions to ice encasement tolerance for breeding purposes.

Expected results - These studies will provide fundamental information to facilitate breeding efforts for improved winter survival through the identification of mechanisms/traits associated with enhanced tolerance to ice encasement and freezing. We will also develop and implement an improved crown viability assay to enhance screening efficiency of other physiology and breeding studies. Information generated from the above studies will also provide information to better inform management practices associated with winter preparation in fall months as well as winterkill mitigation strategies (e.g. defining critical gas concentrations or byproducts to trigger ice removal; risks of post-anoxia injury following ice or cover removal).

Project Name: Influence of fall mowing height changes on winter survival of annual bluegrass putting greens

Presenter: Kailey Miller

Project Description: In theory for perennial species, the accumulation of sugars from photosynthetic leaf tissues that can go into storage as starches is very important for winter survival and the quantity stored could be influenced by mowing height. The carbohydrates are largely transported from the leaves or root system and stored in crown or other overwintering structure. Theoretically, if annual bluegrass is allowed to develop more leaf surface area for photosynthesis, more carbohydrates could be stored and used for regrowth in the spring; however, annual bluegrass's unique genetics and flowering capacity calls into question whether annual bluegrass will benefit from increased mowing heights and extra storage carbohydrates. Golf course superintendents may be reluctant to raise cutting heights of putting greens due to slower green speeds and the demand to maintain optimal playing conditions as long into the fall as weather permits play. Typically, if superintendents raise cutting heights at all it is when play is declining. Raising the mowing height would be a viable and cost-effective practice to adopt. But first, superintendents need more information on at what level and on approximately what date the mowing height needs to be raised to for seeing any increase in winter survival. Perhaps there is a minimum height that would photosynthetically compensate for the fact that superintendents would prefer to wait very late in the season to raise the mowing height. Thus, the objective of this study is to determine the effect of mowing height on winterkill survival of annual bluegrass putting greens. We hypothesize that raising mowing heights in September from a 0.125 inch standard height to higher levels of cut will reduce winterkill associated with ice cover on annual bluegrass putting greens.

Methods: Research plots at the Hancock Turfgrass Research Center of annual bluegrass putting greens will be mowed at 0.125 inch mowing height until the following treatments with 4 replications begin. Control treatment: Standard mowing height without adjustment, 0.125 inch. (Mowing will cease in Nov after no noticeable clippings are detected from plots during a mowing event or weather precludes mowing) Raised mowing height treatments: 2) 0.125 to 0.150 inch starting on Sept. 1. 3) 0.125 to 0.175 inch starting on Sept. 1. 4) 0.125 to 0.200 inch starting on Sept. 1. Turfgrass quality, normalized difference vegetative index, leaf area index (LAI), and chlorophyll index (CHL). Turf plugs 4 inch in diameter will be taken from each plot after winter season, starting in March once snow melts and brought into a low temperature growth chamber (-4°C). During spring de acclimation, the standard mowing height (0.125 in) was on all the plots starting on 4/15/2022. The last snow recorded during measurements was on 04/20/2022.

Growth chamber methods. For ice treatment, plants will be misted under low temperature to develop an ice layer of 1.27 cm depth. Plants will be exposed to two ice treatments 1) no ice 2) ice cover (1.27 cm deep). Plants will be sampled at 0, 20, 40 and 80 days of ice cover. Lights in the chamber will be set to simulate an overcast winter day in Michigan (200 µmol m^{-2} s^{-1} with 10 h day length). Thus, a total of 128 turf plugs will be taken (4 replications x 4 mowing height treatments x

2 ice treatments x 4 sampling dates). On a given sampling day, turfgrass plugs will then be cut in half. Half of the plugs will go towards a regrowth assay in a greenhouse (plants will be de-acclimated for one week in at 4C prior to transferring to the greenhouse) and percent regrowth will be documented weekly or on an as needed basis. Half of the turfgrass plug will be used for ice stress tolerance characteristics such as TNC and antioxidant assays.

Results – In the summer of 2021 prior to the start of mowing treatments, NDVI and LAI on all plots were not significantly different. During mowing treatments and fall acclimation, the highest mowing height (.200cm) had the highest NDVI, LAI, and chlorophyll content and the lowest .150 height had the lowest values for these parameters. This indicates that our mowing treatments were altering canopy characteristics as desired.

All treatments fully recovered after 0, 20, 40, and 80 days of ice encasement however, the rates at which the plots were covered were different. There were no differences in the rate of recovery among mowing treatments following ice encasement periods of 0 and 10 d. After 20 of ice encasement, the higher mowing heights (0.2 and 0.175) recovered faster than the 0.125 and 0.5 heights. This still needs to be confirmed with field results from fall-winter 2022. We can tentatively conclude that raising the mowing height in the fall may help improve spring recovery rates of putting greens.

Project Name: Soil water content and ethylene effects on annual bluegrass winterkill

Presenter: Megan Gendjar

Field Study

Project Description: Winterkill damage to annual bluegrass putting greens and fairways is a significant issue in the turfgrass industry, costing millions of dollars annually in northern temperate areas. Turfgrass managers have expressed a large need for scientifically based management strategies that can reduce winter damage associated with ice and other stresses. Covers and other current management strategies often result in inconsistent protection or are not feasible on large areas. Our research aims to identify the importance of soil moisture content on annual bluegrass survival of winter and chemical management strategies to improve annual bluegrass survival of winter conditions that can be applied broadly and cost effectively. The methods will include field-based treatments of chemicals and natural acclimation during the fall followed by turfgrass plugs being transferred into controlled environment low temperature growth chambers to evaluate low temperature and ice in a controlled way. This combined research approach has allowed for successful field evaluation in the fall and spring as well as consistent ice and low temperatures during the winter months in previous research.

Methods: *Plant material and experimental design.* A two-year combined field and growth chamber study of annual bluegrass maintained at putting green height will be conducted. The field is a native soil putting green with approximately an inch of sand topdressing in the profile. Chemical field treatments will include 2 to 3 rates of 2 ethylene inhibitors (AVG and Retain) at varying rates and frequencies compared to other plant growth regulators implemented late summer through fall based on previous research Laskowski et al (2018). Retain is a commercially available plant growth regulator that is used typically for tree fruit and AVG is the active ingredient within Retain that regulates ethylene. If these treatments are effective for winter preparation, chemistries or products could be developed and marketed for use on turfgrass species. Treatment 1) Civitas (Petro-Canada) will be applied at a label rate of 40.6 L ha^{-1}, 2) mefluidide (Embark T&O, PBI-Gordon Corp.) at a rate of 1.6 L ha^{-1}, 3), propiconazole (Banner Maxx, Syngenta Crop Protection) at a rate of 6.4 L ha^{-1}; 4) ethephon (Proxy, Bayer Environmental Science) at a rate of 7.96 L ha^{-1}, 5) a commercially available ethylene biosynthesis inhibitor containing AVG (ReTain, Valent BioSciences Corporation, Libertyville, IL at a rate of 226 g ha^{-1} and 6) 350 g ha^{-1} 7) the pure form of AVG (Sigma Aldrich, St. Louis, MO) at a rate of 50 µM and 8) control untreated. Therefore, a total of 8 chemical treatments will be used. All products will be applied weekly for roughly 6 weeks, beginning in early Oct. Representatives from each company will be consulted to ensure adequacy of treatment rates and frequencies.

Soil moisture content was maintained at 20% (overwatered), 12% (optimal) and 8% (dry) during the onset of fall and acclimation via manual monitoring using a soil moisture meter using time domain reflectometry at a 3.8 cm depth. With 6 chemical treatments and 3 moisture level treatments and 4 replicate plots, a total of 72 plots will be used for the study.

Measurements

Field evaluations. Turfgrass quality, normalized difference vegetative index (NDVI), canopy height, root length, and root biomass will be measured in plots on a weekly basis starting in the late summer, through fall mowing treatments, and in the spring for winter survival ratings. NDVI will be measured with a turf color meter and a multispectral radiometer. Root length and biomass will be measured by taking 1 inch in diameter plugs of turf on a biweekly basis. Turf plugs 4 inch in diameter will be taken from each plot in mid-November prior to soil freezing and brought into a low temperature growth chamber (-4°C). They will be exposed to light conditions typical of a Michigan overcast winter day. Canopy temperature depression will also be monitored weekly and weather conditions will be recorded daily. Crown hydration or relative water content of crown tissues will be taken on a weekly basis from 1 inch plug samples.

Growth chamber methods. For ice treatment, plugs will be taken from the field to include enough plugs for multiple time point samplings. Sod plugs will be planted in 4 inch pots and will be transferred to a low temperature growth chamber. When ready for ice treatment, plants will be misted under low temperature to develop an ice layer of 1.27 cm depth. Plants will be exposed to two ice treatments 1) no ice 2) ice cover (1.27 cm deep). Plants will be sampled at 0, 40, and 80 days of ice cover from select rates of each inhibitor based on turf performance measurements throughout the fall. Lights in the chamber will be set to simulate an overcast winter day in Michigan (200 µmol m^{-2} s^{-1} with 10 h day length). Thus, approximately 300 turf plugs will be taken to accommodate 2 ice treatments and 3 sampling dates. On a given sampling day, turfgrass plugs will then be cut in half. Half of the plugs will go towards a regrowth assay in a greenhouse (plants will be de-acclimated for one week in a refrigerator prior to transferring to the greenhouse) and percent regrowth will be documented weekly or on an as needed basis. Half of the turfgrass plug will be used for ice stress tolerance characteristics.

Ice tolerance measurements. This will include a determination of antifreeze protein content, total nonstructural carbohydrate content (TNC), fructans, and fatty acid profiles. Plants will be separated into leaf, crown, and root tissue for each analysis. Method for antifreeze proteins will be the same as in Yu et al 2001. TNC will be performed by the methods of Huang and Gao (2000). Fatty acid profiles will be evaluated as in Xu et al. (2011).

Results – For the field study, in the summer of 2021, all measured parameters (NDVI, LAI, CHL, and TQ) were equivalent before treatments. During and after PGR and watering treatments, chlorophyll content was lower in the Ethephon treatment compared to Civitas, ReTain and the control treatments. TDR measurements did show a significant difference between the low and optimal fields for Ethephon, Civitas and control treatments. During spring recovery in the field, initial readings of NDVI, LAI, and CHL showed that Ethephon treated plots were lower for these values than other treatments. For plugs that were taken from the field in the spring and evaluated for ice encasement tolerance, all treatments fully recovered after 0 and 20 days of ice encasement, but the rates of recovery were different between chemical treatments after 20 days under ice. ReTain and control treatments overall experienced higher recovery rates compared to Civitas and Ethephon, respectively. Plots that had a high soil VWC with ReTain and plots that had low soil VWC with control treatment had the highest rate of recovery.

Growth Chamber Study

Growth Chamber Study

Plant Material and Water Treatments - Annual bluegrass plugs were collected from the field in 2021 and were potted into Deepot conetainers (6 cm by 35 cm) on August 6, 2021 and acclimated in a 18C growth chamber to simulate a fall acclimation period. During this time, volumetric water content (VWC) was analyzed for each and maintained at 8%, 12% and 20% for 17 replicates of each. VWC was maintained for two months (from August 13, 2021, to October 15, 2021) for the fall acclimation period then day zero samples were taken and the remaining conetainers were divided into ice and no ice treatments.

Ice Encasement Treatment - Containers were put into –3 ºC growth chamber after the fall acclimation period and randomized then separated into ice and no ice treatments within the chamber. Ice encasement started by misting with deionized water every 30 minutes until an ice layer was formed. The ice layer was maintained for the duration of the study. After 40 days half of the conetainers were taken out of the growth chamber and acclimated at 4 ºC for two days. Samples were halved again and went to regrowth analysis and the remaining were destructively sampled and immediately frozen in liquid nitrogen. Tissues were separated into crown, leaf and root tissues and stored in –80 ºC freezer until further analysis.

Regrowth Analysis - Turfgrasses planted within pots were taken after 40 and 80 days respectively of control and ice encasement treatment and low, medium and high volumetric water content. Conetainers were acclimated to 4C for two days then transferred to a greenhouse maintained at 24C. Photos were taken during the regrowth period to determine percent regrowth. Canopeo software was used to determine the percent recovery. Readings were taken for day 40 from January 4, 2022, to March 3, 2022, for a total of 43 d after treatments concluded. Day 80 was similar, and readings were taken from February 22, 2022, to April 4, 2022, for a total of 41 d after treatments concluded.

Total Nonstructural Carbohydrate Analysis - Turfgrass tissues previously separated into crown, leaf and root tissue were put into microcentrifuge tubes and put into the freezer. These tissues will be analyzed for total nonstructural carbohydrate analysis based on methods from Chatterton et al. (1987) and Westhafer et al. (1982).

Results – During the simulated fall acclimation period within the growth chamber in 2021, VWC treatments were at the desired levels (8, 12 or 20%) and maintained until ice encasement treatment began. All plants were fully recovered after 0, 40, and 80 days under ice, however rates of recovery varied between treatments. After 80 days under ice, turf plants that had received the low VWC treatment in the fall recovered faster than turf plants that had received the optimal and high VWC for both ice covered and no-ice treated plants. Total nonstructural carbohydrates decreased by 52.9% in leaf tissues and 67.02% in crown tissues after 80 d of prolonged ice encasement treatment. After 80 days under ice, low VWC treated plants had a higher concentration of TNC in leaf and crown tissues compared to high VWC treated plants. This experiment will be repeated again in 2021, but at this time we can roughly conclude that drier fall conditions may reduce the incidence of annual bluegrass winterkill due to ice encasement.

Lawn & Athletic Fields 11. Disease Management in Lawns and Athletic Fields

Nancy Dykema and Dr. J.M. Vargas, Jr.

Several diseases will be viewed in the field so participants can learn how to identify them as well as practices or conditions that may worsen each disease. Management strategies will be discussed which will include IPM methods.

LEAF SPOT.
This disease is characterized by thin, withered grass when an epidemic is severe. Leaves display small purplish spots with tan-colored centers. The spots can expand and yield straw-colored blades. The infection can continue down the leaf to the crown of the plant in hot, humid weather. Leaf spot is more severe in areas lacking adequate fertility.

DOLLAR SPOT.
Another disease of home lawns and athletic fields is dollar spot. To the untrained eye, this disease may resemble red thread in that 3-5” spots or diffuse areas of blighted turf may develop. With dollar spot, upon close inspection of the turf, one notices white to straw-colored lesions on leaf blades, usually bordered by a reddish-brown perimeter. In times of heavy dew formation, fluffy, white, cottony fungal mycelia may be observed on the turf in the mornings. This is a simple diagnostic means to identify dollar spot. The disease is worse on slow-growing, drought-stressed turf. This disease can be spread from infected clippings, turf equipment such as mowers or aerifiers, or from plant to plant growing in close proximity.

RED THREAD.
This is a disease of undernourished, slow-growing turf. It is characterized by the appearance of pink to red, thread-like fungal structures (stromata) protruding from leaf blades. These look gelatinous under wet conditions and become thin and thread-like as they dry. The disease can spread from plant to plant by the growth of the stromata. Pink, cottony tufts can sometimes be observed in red thread patches under high humidity. As the epidemic progresses, the turf takes on a withered, dry appearance, often resembling dollar spot.

NECROTIC RING SPOT.

This is a disease of Kentucky bluegrass that forms patches in the turf. The fungus attacks the roots of the Kentucky bluegrass plants. The infection takes place in the spring and fall in cool, wet weather, but the symptoms are usually not observed until the summer when the turf goes under drought stress. However, if you look close enough in the spring and fall you can observe red and purple blades of grass in the outer areas of the rings.