

Summer Meeting NCERA Old 221
North Shore Country Club

A. Welcome and meeting organization – Tom Voigt

-NCERA will be in place for 5 more years.

-Introductions

-Chris Williamson – 2016 National Turfgrass Entomology Workshop;

August 21-22, Univ. of Wisconsin; <https://wisconsinturfgrassassociation.org/2016-national-turfgrass-entomology-workshop/>

B. Brief History of Noteworthy Chicago-Area Golf Events and Activities (Tom Voigt)

-Powerpoint presented

C. Potential weed and species activities

1. Regional Weed Control Publication – Aaron Patton

Publication has been useful to several states. Therefore, it will become a regional publication. States participating will have their name on it. Purdue will handle printing, and distribute at just above cost to all states for states to sell in extension stores. A comprehensive list of weeds was handed out. Steps for moving forward for those with interest was also provided.

2. Organic weed control – Bruce Branham

Increasing interest in organic weed control. Possibly do a trial of all products available across the region to produce a publication. Could involve commercial and homeowner products. Bruce will send an email to the group, and those interested can respond. Likely will begin in September 2016.

3. Evaluating cool-season grasses in Un-mowed roughs – Tom Voigt

Tom has evaluated 20 cool-season grass monostands and mixtures since 2013 as low maintenance rough. Discussion about a potential group project. Tom will throw out some ideas to the group, and those interested can respond.

D. Updates:

a. NTEP Update – Eric Watkins provided a written update – included.

b. Regional Roadside Turfgrass Testing Program (Written update emailed by Eric Watkins) **Pooled Fund Roadside Testing Update**

At the 2015 NCERA-221 meeting, we described a regional roadside turfgrass testing program that could be funded by state DOTs. We were able to convince four state DOTs to be involved (Minnesota, Wisconsin, New Jersey, Michigan) and received approval for funding this past spring. We are now finalizing the work plan and budget. The trial will consist of about 50-60 entries planted at 8 locations (2 per state). Each location will have three replications. Plots will be established and data taken through spring 2018. If successful, this should be a model for future regional roadside turfgrass research projects funded by state DOTs.

c. GCSAA update – Aaron Patton provided an update on GCSAA and some of their initiatives – Research funding, Rounds 4 Research, etc. C5 leaders continue to keep communication open with GCSAA, and invited their CEO, Rhett Evans, to attend this year's meeting in Phoenix.

d. Growth Potential Model Validation Project – Bill Kreuser

Bill showed a powerpoint to provide an update on the growth potential project. Clippings are being collected under irrigation throughout the region to determine growth curves. Relating clippings to environmental data and N mineralization. Kansas State, Minnesota, Nebraska, Purdue, and Wisconsin are involved. Grant funding using preliminary data was discussed.

e. Publication update – Qi Zhang led the research effort on the multi-state trial on creeping bentgrass cultivars and dollar spot resistance. A manuscript was submitted to the ITSRJ this summer: **Dollar Spot Susceptibility and Quality of 25 Creeping Bentgrass Cultivars Maintained under Golf Course Putting Green and Fairway Conditions in the Central United States. Authors –**

Qi Zhang, Cole Thompson, Megan Kennelly, John Stier, Christopher Blume, Nick Christians, Kenneth Diesburg, Kevin Frank, Brad Fresenburg, Jack Fry, David Gardner, Dennis Martin, Keith Rincker, Derek Settle, Douglas Soldat, and Xi Xiong

f. It was decided to hold the 2017 NCERA meeting at the ITS Conference in New Jersey (all but one were in favor). Jared Hoyle will seek permission for the meeting, and also provide an update on the NCERA project before October 1 (can be done through the web – questions go to Chris Hamilton (female, WI) NIMSS – contact Chris, not Roch). Fry will contact Bruce Clarke to find availability for a meeting room on Sunday evening before ITS conference starts.

E. “Creeping bentgrass growth in sand-based rootzones amended with biochar and various composts (Steve Vaughn, USDA).” Powerpoint presentation.

Wednesday, June 22
Crowne Plaza Hotel

A. Welcome, Tom Voigt

-Roch Gaussoin (admin.) commended the Illinois team for the wonderful meeting at NSCC. Tom Voigt gave credit to Dan Dinelli and his staff.

B. State Reports

Illinois (Bruce Branham)

annual bluegrass control; starting long term nitrate leaching study; discussed PoaCure registration

Indiana (Aaron Patton)

fertility; adding 2nd rainout shelter; switchgrass; billbugs; white grubs; pollinators; fungicide efficacy; water quality and herbicide efficacy—hardwater antagonism; herbicide resistance; turf doctor app; 25 undergraduate students, some pressure from provost on teaching low enrollment classes, i.e., less than 15 students, they decided to let each college make their own rule

Wisconsin (Paul Koch)

pollinator work; potassium; PGRs on sports turf; fungicide resistance with snow mold; disease modeling for dollar spot; pesticide impacts on soil microbe biome; intro turf class is fully online, no F2F version. There is a separate lab that is F2F; they have 5-6 undergraduates in turf

Ohio (Dave Gardner)

brush effects on bentgrass; bentgrass recovery after methiazolin; John Street retired, unsure of position status; Zane Raudenbush hired at Wooster campus; Dave Shetlar retired, position not to be refilled; 25 undergraduates; turf faculty teaching almost half of dept. hort classes (inc. non turf); Pam S. named Agronomist for Major League Soccer

Iowa State (Nick Christians)

Nick retiring in about 3 years; others in turf group also close to retirement; new faculty coming on board: Adam Toms. Will concentrate in sports turf; Nick's technician retiring; 5th ed. Of Nick's textbook coming out, Aaron Patton and Quincy Law joining as co-authors, with new chapters; about 35 undergrads, 50% are sports turf now; natural product research; discussed golf economy and whether it will recover; lots of sports turf jobs/internships, not enough students to fill

Kansas State (Jack Fry/Steve Keeley)

-buffalograss traffic tolerance and divot recovery; herbicide work; new zoysia release, 0802, cold hardy and fine textured; zoysia/tall fescue mixtures; disease work; drought and cart traffic under drought; N2O; small unmanned aircraft; enrollments at 35 golf/sports turf, 15 land. Maintenance; discussion of low enrollment courses; welcome to my office video for recruitment

Nebraska (Bill Kreuser)

-new faculty (Cole Thompson), replacing Zac Reicher; on campus research area being developed; lots of extension activities; increased video presence, e.g., video field day and make available online. Hired video production assistant; over 40 undergrads, about half from out of state; 6 grad students; 6 faculty with some turf appointment; winterkill desiccation physiology; iron; yellow nutsedge physiology; buffalograss; GDD work

North Dakota State (Deying Lee)

-budget situation not good, operating at 90%, might go to 80%; 3 turf faculty; turf no longer a program, now an option, hard for students to find turf; 15 students (high was 46 at one point); Deying working on turf, but Qi Zhang and Alan Zuk working in non-turf areas for research; salinity in Kentucky bluegrass; most undergrads are out of state (MN and WI, they have a tuition agreement)

Maryland (Mark Carroll)

-new faculty, Joe Robbins (sp?); fungicide efficacy trials; organic lawn care; compost topdressing, compost tea and topdressing; storm water issues; 5-10 students in undergrad program in recent years; 10-15 in 2 yr program; teaching some classes with very low enrollment; Kevin Matthias (sp?) is 2 year program coord. And will be retiring. Not likely to replace him.

Michigan State (Kevin Frank)

-student numbers 35 4 yr, 65 2 yr; program with China universities has evolved into just getting Chinese students on campus, about 5000; David Gilstrap teaches 1 credit "World of Turf" with 1000 students; 90 students in turf short course, generated \$30,000 revenue, offered in December; pollinator research; creeping bentgrass cultivar released: Flagstick; nitrate leaching; winterkill/ice management on poa annua

Missouri (Lee Miller)

-hydrophobicity/LDS; billbug lifecycle and insecticide efficacy; warm-season turf diseases- large patch, spring dead spot (looking at effects of fraze mowing, and other things); extension: working on guide for home lawn pest management designed for lco's to carry with them, blog; teaching: 14 students

CDGA (Ed Nangle)

-wetting agent research; Ron Townsend M.S. research; iron effects on dollar spot; Civitas; Ed Nangle going to Ohio State ATI (Wooster)

C. Website update (Aaron Patton)

-NCERA221 web site: ncera221.blogspot.com; info. Related to the group

D. Historian report (Nick Christians)

-meetings: 2017 in conjunction with ITS at Rutgers Univ., 2018- Kansas State, 2019- Missouri, 2020- Minnesota, 2021- Nebraska, 2022- N. Dakota - Information attached

E. Administrator report (Roch Gaussoin and Tom Voigt)

-Roch: renewal will be official in October, 2016

-Tom: station reports need to go to Kansas State rep. and also to Aaron Patton for the website

NTEP report for NCERA-221

Submitted by Eric Watkins, NCERA-221 representative to the NTEP board

The current NTEP board members are: David Kopec, Bill Dunn, Ryan Jeffries, Gary Wilbur, Kevin Morris, Mike Kenna, Mark Johnson, Steve Reid, Eric Watkins, Scott Ebdon, and Jason Kruse

The annual board meeting was held in San Diego, CA on Feb. 12-13, 2016.

1. **Finances:** NTEP is in improving financial health. Current and future trials will bring in more than they cost. The 2015 low-input trial was successful financially and is a model for future trials. A conference call is schedule for July to review the budget. As in the past, there was discussion about other ways to fund NTEP (seed commissions, fees on seed sold, etc.) but these all would be very difficult to implement.
2. **Recent Trials:** The 2015 Low-Input Trial contained single cultivars, blends, and mixtures (including non-grass species). A total of 23 entries were submitted for testing
3. **Upcoming Trials:** There will be several trials established in 2016.
 - a. *Perennial Ryegrass:* The perennial ryegrass advisory committee is currently finalizing locations and recommendations for this trial. There is some discussion of having the trial planted “blind” (identities of entries would not be revealed until 1-2 years after the trail starts; no decision has been made on doing this)
 - b. *Fairway Overseeding Trial:* Planned for 2016; 10 locations; \$2,000 per entry/year for two years
 - c. *Warm-Season*
 - i. St. Augustinegrass - 24 paid entries at 10 locations, mailed to locations June 21-22
 - ii. Seashore Paspalum - 10 entries over 8 locations, mailed to locations June 14
 - d. *Drought/Water Use* (co-sponsored by USGA--they are contributing 500K total spread out over 5 years) (2 trials). NTEP would like to seek some type of a certification program such as the EPA Water Sense certification (similar to Energy Star) and this trial could provide the data needed to do that.

- i. Drought-Rainout shelter: This trial will be done under a movable rainout shelter at several locations and the goal will be to determine how much water is needed to maintain a prescribed level of green turf. For all locations, NTEP/USGA will provide funding so that all locations are using the same shelter. Locations: West Lafayette, IN; Griffin, GA; Fayetteville, AR; Amherst, MA; College Park, MD
 - ii. Drought-Controlled irrigation: This trial will have irrigation blocks that water plots at four different rates of ET. For all locations, NTEP/USGA will provide \$15,000 for installation of irrigation zones. Locations: St. Paul, MN; Corvallis, OR; S. California ; New Mexico; Another location (?)
 - e. *For 2017:* Low input warm-season trial (spring), Kentucky bluegrass (fall)
4. **Website and Data Visualization:** Many of you may be familiar with the NTEP data visualization work done by Bruce Jump at Winfield. Bruce approached NTEP with ideas about how to partner on the technology his team has developed. The board has decided to delay making a decision on this as we investigate how we should build the NTEP database to make it more usable for reporting data to the public (most agree the current .txt files are not very user friendly). I recently met with a Computer Science professor at the University of Minnesota and he is willing to help NTEP think through the steps necessary to build a useful database. This will require some funding, but there may be federal grant opportunities that we can try and apply to for this. Once the database is created, then we explore interesting ways to improve data visualization, etc.; this will also allow NTEP to more easily get raw data to partners such as Winfield if the board should decide that is a good approach.
5. **Elections for 2016-2017:** Watkins, Chair; Kruse, Vice-Chair; Reid, Secretary.

2016 Chicago District Golf Association Station Report

Ed Nangles

1. Impact Nugget: A concise statement of advancements, accomplishments and impacts. (Limit to 1-2 sentences) ASA poster presented / Scouting Report production continued / Dollar spot study and nitrogen rates and sources initiated with UW

2. New Facilities and Equipment. Include production areas, sensors, instruments, and control systems purchased/installed. N/A

3. Unique Project Related Findings. List anything noteworthy and unique learned this year. Variations in firmness in relation to wetting agents apparent / Possible differences in depth of soil samples and pH values / Water quality has seasonality in Chicago area and issues can arise with salt in season.

4. Accomplishment Summaries. Draft one to three short paragraphs (2 to 5 sentences each) that summarize research or outreach accomplishments that relate to the project objectives. Please use language that the general public can readily comprehend.

Development of greater program footprint with over 120 course visits in 2015. International audience also reached with speaking engagement in London as well as continued work with Irish Sportsturf Institute which is now running funded trials – directly supporting turf managers in the country which they have never had before. Field day hosted 60 people with both Midwest Golf House and Cog Hill serving as sites for trial discussions.

Trial works focused on dollar spot control both preventatively and curatively last year with fairways gaining a lot of interest from the chemical companies. There was one insecticide trial completed with Purdue University (D Richmond).

5. Impact Statements. Please draft 2 or 3 impact statement summaries related to the project objectives. Statements should be quantitative when possible and be oriented towards the general public. This is perhaps the most difficult yet most important part of the report.

In fairway management of dollar spot, superintendents aiming to gain 30day windows of control with single active ingredients in the summer months in Chicago will struggle to do so – this was clearly shown at field day and has been discussed since in association presentations

Higher nitrogen rates do suppress dollar spot – the work is ongoing but there were noticeable differences in turf plots after year one of the trial

6. Published Written Works. Include scientific publications, trade magazine articles, books, posters, websites developed, and any other relevant printed works produced. Please use the formatting in the examples below.

E.J. Nangle, R.V. Townsend, B. Thomson. 2015. Investigating the impact of wetting agent use on turfgrass putting surfaces in the Chicago area. ASA Meetings Minneapolis MN, Nov 2015.

Nangle E.J. The Flood Drought Pendulum. 2015. Midwest Association of Golf Course Superintendents, On Course. 8-15-15.

A Unique situation for a Wexfordman. 2015. Golf Course Superintendents Association of Ireland. Greenside Magazine, Summer 2015

A Season of Research 2015. Midwest Association of Golf Course Superintendents, On Course. 8-15-15

E.J. Nangle, D.S. Gardner, J.D. Metzger, D.P. Petrella, and T.K. Danneberger, L. Rodriguez-Saona, J.L. Cisar. 2016. Cool-season Turfgrass Color and Growth Habit Response to Elevated Levels of Ultraviolet-B Radiation. HORTSCIENCE 51(4):439–443.

Nangle E.J. Pigments and their value today. 2016 Midwest Association of Golf Course Superintendents, On Course 5-15-16

7. Scientific and Outreach Oral Presentations. Include workshops, colloquia, conferences, symposia, and industry meetings in which you presented and/or organized. See below for formatting.

New Fungicides and what we can and can't do with them. Highland Meadows CC, Sylvania OH, March 10th 2016.

Water quality issues in the Chicago area and how we may need to deal with them going forward. Highland Meadows CC, Sylvania OH, March 10th 2016. NWOGCSA Spring kick-off

A review of 2015 and what went right and what went wrong. Michigan City, IN March 2nd 2016. Michiana GCSAA Spring kick-off

Shade management strategies for your golf course. Michigan City, IN March 2nd 2016

Tales from the crypt and stories from the field. Iowa Turfgrass Conference January 25th 2016, Coralville IA.

Winterkill: What did and didn't work. Iowa Turfgrass Conference January 25th 2016, Coralville IA Iowa Turfgrass Foundation Winter Conference

A season in Review in the Chicagoland. Swan Hills GC, Rockford IL, January 20th 2016 NWIGCSA January Half Day Education

A season in Chicago – how sustainability and cultural practices are changing on a daily basis to get superintendents through a season. Lingfield Park, Lingfield United Kingdom, Norwegian Superintendents Association, Jan 13th – 15th 2016.

Winterkill and what the Chicagoland dealt with recovery and protection successes. WI Turfgrass Symposium, Koehler WI December 2nd and 3rd 2015. Wisconsin Turfgrass Association

Surface firmness and water quality updates. Crestwicke CC, November 7th 2015 CIGCSA Fall Education Day

8. Fund leveraging, specifically, collaborative grants between stations and members.

Part of 10 site project evaluating zoysia grass (cold tolerant site)

9. Other relevant accomplishments and activities.

University of Illinois Project Station Report for NCER221-2016

Official NCERA rep: Thomas Voigt

Email: tvoigt@illinois.edu

Phone: 217-333-7847

1. Impact Nugget: A concise statement of advancements, accomplishments and impacts. (Limit to 1-2 sentences)

In 2015, University of Illinois provided turf and grassy weed identification training for Chicago-area golf, lawn-care, and sod-producing professionals that will potentially reduce misapplication of weed control products and better serve clientele.

2. New Facilities and Equipment. Include production areas, sensors, instruments, and control systems purchased/installed.

Nothing to report.

3. Unique Project Related Findings. List anything noteworthy and unique learned this year.

Nothing to report.

4. Accomplishment Summaries. Draft one to three short paragraphs (2 to 5 sentences each) that summarize research or outreach accomplishments that relate to the project objectives. Please use language that the general public can readily comprehend.

Maintained and evaluated Kentucky bluegrass cultivar, fine-leaf fescue cultivar, bentgrass fairway and putting green cultivar, tall fescue cultivar, and un-mowed golf course rough turf species trial to identify grasses that perform well with limited inputs.

Presented the findings of these trials to more than 200 professional turf managers.

5. Impact Statements. Please draft 2 or 3 impact statement summaries related to the project objectives. Statements should be quantitative when possible and be oriented towards the general public. This is perhaps the most difficult yet most important part of the report.

- Presented the findings of these trials to more than 200 professional turf managers.
- Provided turf and grassy weed identification training for Chicago-area golf, lawn-care, and sod-producing professionals that will potentially reduce misapplication of weed control products and better serve clientele.

6. Published Written Works. Include scientific publications, trade magazine articles, books, posters, websites developed, and any other relevant printed works produced. Please use the formatting in the examples below.

- Anderson, E.K., D.K. Lee, D.J. Allen, and T.B. Voigt. 2015. Agronomic factors in the establishment of tetraploid seeded *Miscanthus x giganteus*. *GCB-Bioenergy*. 7: 1075-1083.
- Quinn, L.D., E.C. Scott, A.B. Endres, J.N. Barney, T.B. Voigt, and J. McCubbins. 2015. Resolving regulatory uncertainty: legislative language for potentially invasive bioenergy feedstocks. *GCB-Bioenergy*. 7: 909-915.
- Quinn, L.D., K.C. Straker, J. Guo, S. Kim, S. Thapa, G. Kling, D.K. Lee, and T.B. Voigt. 2015. Stress tolerant feedstocks for sustainable bioenergy production on marginal land. *Bioenergy Research*. 8: 1081–1100.
- Anderson, E.K., T.B. Voigt, S. Kim, and D.K. Lee. 2015. Determining effects of sodicity and salinity on switchgrass and prairie cordgrass germination and plant growth. *Industrial Crops and Products*. 64: 79–87.
- Anderson, E.K., A.G. Hager, D.K. Lee, D.J. Allen, and T.B. Voigt. 2015. Response of seeded *Miscanthus x giganteus* to PRE and POST herbicides. *Weed Technology*. 29: 274-283.
- Straker, K.C., L.D. Quinn, T.B. Voigt, D.K. Lee, G.J. Kling. 2015. Black locust as a bioenergy feedstock:

a review. *Bioenergy Research*. 8: 1117-1135.

- Dougherty, R.F., L.D. Quinn, T.B. Voigt, and J.N. Barney. 2015. Response of naturalized and ornamental biotypes of *Miscanthus sinensis* to soil moisture and shade stress. *Northeastern Naturalist*. 22: 372-386.
- Kaiser, C.M., L.V. Clark, J.A. Juvik, T.B. Voigt, and E.J. Sacks. 2015. Characterizing a *Miscanthus* germplasm collection for yield, yield components, and genotype × environment interactions. *Crop Sciences*. 55: 1978-1994.
- Arundale, R.A., S. Bauer, F.B. Haffner, V.D. Mitchell, T.B. Voigt, and S.P. Long. (2015.) Environment has little effect on biomass biochemical composition of *Miscanthus x giganteus*, across soil types, nitrogen fertilization and times of harvest. *BioEnergy Research*. DOI 10.1007/s12155-015-9613-2.
- Li, D., T. Voigt, and A.D. Kent. (2015.) Plant and soil effects on bacterial communities associated with *Miscanthus x giganteus* rhizosphere and rhizomes. *GCB-Bioenergy*. DOI 10.1111/gcbb.12252
- Guo, J., S. Thapa, T. Voigt, A.L. Rayburn, A. Boe, and D.K. Lee. (2015.) Phenotypic and biomass yield variations in natural populations of prairie cordgrass (*Spartina pectinata* Link) in the USA. *Bioenergy Research*. DOI 10.1007/s12155-015-9604-3
- Hager, H., L.D. Quinn, J.D. Barney, T.B. Voigt, and J.A. Newman. (2015) Germination and establishment of bioenergy grasses outside cultivation: a multi-region seed addition experiment. *Plant Ecology*. DOI 10.1007/s11258-015-0516-2.

7. Scientific and Outreach Oral Presentations. Include workshops, colloquia, conferences, symposia, and industry meetings in which you presented and/or organized. See below for formatting.

- T. Voigt. 2015. Turf and Grassy Weed Identification. Turfgrass Foundation Turf Conference. Bolingbrook, IL. Illinois.
- T. Voigt. 2015. Cool-Season Turf and Grassy Weed Identification. Workshop Illinois Turfgrass Foundation Turf. Lemont, IL.
- T. Voigt. 2015. Warm-Season Turf and Grassy Weed Identification Workshop. Illinois Turfgrass Foundation Turf. Lemont, IL.
- T. Voigt. 2015. Energy Crops at the U. of I. Energy Farm. RAP Minority Students. Urbana, IL
- T. Voigt. 2015. Energy Crops at the U. of I. Energy Farm. BASF Employees. Urbana, IL.
- T. Voigt. 2015. Energy Crops at the U. of I. Energy Farm. CPSC 415 Students. Urbana, IL.
- T. Voigt. 2015. NTEP Cultivar Trials. Central IL Golf Course Superintendents Association Field Day. Urbana, IL.
- T. Voigt. 2015. NTEP Cultivar Trials. Illinois Professional Lawn Care Association Field Day. Urbana, IL.
- T. Voigt. 2015. Creeping Bentgrass Cultivar Trials. Workers at Champion's Tour Golf Event. Glenview, IL.
- T. Voigt. 2015. Turf Cultivar Studies. Illinois Professional Lawn Care Association. Urbana, IL.
- T. Voigt. 2015. Turf Cultivar Studies. Central Illinois Golf Course Superintendents Association. Urbana, IL.
- T. Voigt. 2015. Grasses for Un-Mowed Golf Course Roughs. Chicago District Golf Association Field Day. Lemont, IL.
- T. Voigt. 2015. Tall Fescues for Illinois Lawns. Illinois Professional Lawn Care Association. Glenview, IL.

8. Fund leveraging, specifically, collaborative grants between stations and members.

Nothing to report.

9. Other relevant accomplishments and activities.

Nothing to report.

NC Project Station Report Content: Purdue University

1. Impact Nugget.

Our focus on the chemical ecology and biogeochemical interactions of important turfgrass insect pests provides a foundation for the development of more sustainable, next-generation pest management tools.

Purdue University researchers quantified the C and N storage and flux in a turfgrass system as affected by species, inputs, and ecosystem age. This will provide data for use in future modeling to define the role of grasses in C storage in urban ecosystems. Species, cultivars, and management practices able to reduce mowing inputs were identified.

Purdue University researchers discovered how to enhance weed control with 2,4-D through new strategies such as improving spray tank water quality. Forty-five percent of workshop participants changed their tank-mixing practices based on this new research.

A Purdue University Extension publication (AY-336) popular among clientele, was distributed to over 5,723 clientele since 2012. A survey of found this reference helped 76% of them improve their weed control helped each save \$500 to \$833 annually.

Current projects include efforts to describe the spatial and temporal distribution of fungicide residues in golf course turf. Results provide a scientific foundation for turf managers to adjust fungicide scheduling based on an understanding of where fungicides persist and how long effective residues remain.

2. New Facilities and Equipment.

NONE

3. Unique Project Related Findings.

Our chemical ecology work with billbugs indicates that males primarily respond to host plant volatiles whereas females most likely respond to male-produced volatile cues. Qualitative and quantitative differences in the composition of cuticular hydrocarbons indicate that tactile chemical cues may be important for mate recognition among sympatric billbug species.

Our biogeochemical work with Japanese beetle larvae suggest that JB infestations may reduce soil organic matter, increase soil CO₂ emissions and cause significant and lasting changes to soil microbial diversity. Analysis of 16S microbial rDNA revealed the presence of ammonia oxidizing, nitrogen fixing and organic residue-degrading larval gut bacteria, many of which are commonly associated with soil.

4. Accomplishment Summaries.

Our combined research and extension efforts have resulted in the development of extension materials and other outputs that provide turfgrass managers and the general public with science-based recommendations for sound insect pest management and are laying the groundwork for the development of environmentally sustainable, next-generation pest management tools.

We have identified physiological traits and genes that are associated with growth and abiotic stress tolerance. The results revealed mechanisms of plant growth and adaptation to stress conditions. The research provides a better understanding of how plants respond to environmental stress. The gene-traits associations identified through the project may be used for assessment of germplasm to uncover genetic diversity for improving stress tolerance of turfgrass varieties.

5. Impact Statements.

Billbugs are increasingly being recognized as a serious threat to turfgrass across the United States. Recent expansion in the range of several billbug species has resulted in a national collage of billbug species assemblages. Resulting variation in seasonal life histories, behavior, and ecology that accompany such novel species interactions have challenged management schemes in many regions. Our work to date indicates that volatile and tactile chemical cues are important in the host- and mate-finding behaviors of billbugs. These chemical cues could potentially be exploited for the development of more environmentally sustainable management tools.

Invasive species are a serious economic and ecological threat throughout the world. Although the ecological consequences of invasion by above-ground insects have been well documented, the impacts of invasive insects that spend the majority of their life underground have received much less attention. Our work to date indicates that that Invasive soil insects such as Japanese beetle could potentially alter soil microbial communities in ways that influence C-cycling and soil health, and that interactions between these insects and the soil is, in part, microbially-mediated. These microbial interactions could provide a foundation for the development of next generation pest management tools.

6. Published Written Works.

Refereed Journal Articles

1. Beck, L.L., A.J. Patton, Q.D. Law, D.V. Weisenberger, J.T. Brosnan, J.J. Vargas Almodóvar, and G.K. Breeden, and D. Kopsell. 2015. Mesotrione activity on crabgrass (*Digitaria* spp.) as influenced by nitrogen fertilization rate, source, and timing. *Weed Technol.* 29:263-273.
2. Behle, R.W., D.S. Richmond, M.A. Jackson and C.A. Dunlap. 2015. Evaluation of *Metarhizium brunneum* F52 (Hypocreales: clavicipitaceae) for control of Japanese beetle Larvae in Turfgrass. *Journal of Economic Entomology* 108: 1587-1595.
3. Cui, Y., J. Wang, X. Wang, and Y. Jiang. 2015. Phenotypic and genotypic diversity for drought tolerance among and within perennial ryegrass accessions. *HortScience* 50: 1148–1154.
4. Hockemeyer, K., and Latin, R. 2014. Spatial and temporal distribution of fungicides applied to creeping bentgrass. *J. Environ. Qual.* 44:3:841-848.
5. Jiang, Y., Y. Cui, Z. Pei, H. Liu, S. Sun. 2016. Growth response and gene expression to deficit irrigation and recovery of two perennial ryegrass accessions contrasting in drought tolerance. *HortScience* (in press)
6. Latin, R. 2016. Influence of irrigation and wetting agent on fungicide residues in creeping bentgrass. *Plant Disease*. In press.
7. Law, Q.D., C.A. Bigelow, and A.J. Patton. 2016. Selecting turfgrasses and mowing practices that reduce mowing requirements. *Crop Sci.* In press.
8. Liu, M. and Y. Jiang. 2015. Genotypic variation in growth and metabolic responses of perennial ryegrass exposed to short-term waterlogging and submergence stress. *Plant Physiol. Biochem.* 95: 57-64.
9. Luo, N., X. Yu, N. Gang, J. Liu, and Y. Jiang. 2016. The specific peroxidase differentiates *Brachypodium distachyon* accessions and associates with drought tolerance traits. *Ann. Bot.* (In press).
10. Patton, A.J., D.V. Weisenberger, and W.J. Johnson. 2016. Divalent Cations in Spray Water Influence 2,4-D Efficacy on Dandelion (*Taraxacum officinale*) and Broadleaf Plantain (*Plantago major*). *Weed Technol.* 30:431-440.
11. Patton, A.J., J.M. Trappe, D.E. Karcher, and M.D. Richardson. 2016. Impact of golfer divots on golf course maintenance. *Crop, Forage & Turfgrass Management*. doi: 10.2134/cftm2015.0154.
12. Nie, G. L. Huang, X. Zhang, M. Taylor, Y. Jiang, X. Yu, X. Liu, X. Wang and Y. Zhang. Marker-trait association for biomass yield of potential bio-fuel feedstock *Miscanthus sinensis* from Southwest China. *Front. Plant Sci.* <http://dx.doi.org/10.3389/fpls.2016.00802>
13. Powell, G., J. Shukle, D. Richmond and J. Holland. 2016. Saproxylic beetle biodiversity in golf course habitats. *Crop Forage & Turfgrass Management* doi:10.2134/cftm2015.0194.
14. Reicher, Z.J., M. Sousek, A.J. Patton, D.V. Weisenberger, A. Hathaway, and R. Calhoun. 2015. Annual bluegrass control on putting greens from three or more years of season-long applications of herbicide or plant growth regulators. *Crop, Forage & Turfgrass Management*. DOI: 10.2134/cftm2014.0050
15. Strunk, W.D. M.D. Richardson, J. Young, D. Karcher, and A.J. Patton. 2015. Golf Shot Performance Characteristics Influenced by Ball Lie. *Crop, Forage & Turfgrass Management*. doi:10.2134/cftm2015.0136.

16. Yu, X., P.M. Pijut, S. Byrne, T. Asp, G. Bai, and Y. Jiang. 2015. Candidate gene based association mapping of winter survival and spring regrowth in perennial ryegrass. *Plant Sci.* 235: 37-45.
17. Zong, J., Y. Gao, J. Chen, H. Guo, Y. Wang, F. Meng, Y. Jiang, and J. Liu. 2015. Growth and enzymatic activity of four warm-season turfgrass species exposed to waterlogging. *J. Amer. Soc. Hortic. Sci.* 140: 151-162.

Extension Publications

1. Latin, R. Turfgrass Disease Profiles: BP-105-W Dollar Spot (revised 2015).
2. Latin, R. Turfgrass Disease Profiles: BP-115-W Summer Patch (revised 2016).
3. Latin, R. Turfgrass Disease Profiles: BP-121-W Root Knot Nematode (2015) .
4. Latin, R. Turfgrass Disease Profiles: BP-123-W Spring Dead Spot (2016).
5. Patton, A.J. and D.V. Weisenberger. 2016 Turfgrass Weed Control for Professionals. Purdue University Extension Publication. AY-336. 5th revision. 96 pages.
6. Patton, A.J., R. Latin, A. Martin, T. Gibb, D. Richmond, and G. Hardebeck. 2015. Turf Pest Management. Purdue University Extension Publication. PPP-3b.
7. Richmond, D.S. 2015. Integrated Management of Turfgrass Insects. Purdue Extension Publication E-61-W. <https://extension.entm.purdue.edu/publications/E-61.pdf>
8. Richmond, D.S. 2015. Managing Billbugs in Turfgrass. Purdue Extension Publication E-266-W. <https://extension.entm.purdue.edu/publications/E-266.pdf>
9. Richmond, D.S. 2015. Protecting Pollinators From Insecticide Applications in Turfgrass. Purdue Extension Publication E-267-W. <https://extension.entm.purdue.edu/publications/E-267/E-267.pdf>

7. Scientific and Outreach Oral Presentations.

1. Beck, L.L., and A.J. Patton. 2015. Development of herbicide resistant smooth crabgrass following quinclorac use in fine turf. Paper presented at: Synergy in science: partnering for solutions. ASA, CSSA, and SSSA Annual Meetings, Minneapolis, MN. 15-18 Nov. Paper 418-2.
2. Duffy, A.G. and D.S. Richmond. 2015. Hunting billbug adult feeding preference and host volatile recognition. Annual Meeting of the North Central Branch of the Entomological Society of America, Manhattan, KS, May 31-June 3, 2015.
3. Duffy, A.G. G. Hughes, M. Ginzel and D.S. Richmond. 2016. Volatile and tactile chemical cues associated with billbug behavior in managed turfgrass. Annual Meeting of the North Central Branch of the Entomological Society of America, Cleveland, OH, June 5-8, 2016.
4. Duffy, A.G., M.D. Ginzel and D.S. Richmond. 2015. Chemical mediation of hunting billbug *Sphenophorus venatus* host-finding and mating behavior. C5 Symposium, Annual Meeting of the ESA, CSSA, SSSA, ASA Minneapolis, MN, November 15-18, 2015.
5. Latin, R. September 9, 2015. Understanding Fungicides for Turf Disease Control. Department of Plant Pathology, NCSU
6. Latin, R. September 22, 2015. Factors that Influence Fungicide Performance. Department of Plant Pathology, Univ. Wisconsin --Madison
7. Latin, R. 2015. Understanding turfgrass fungicides. GCSAA. San Antonio, TX.
8. Latin, R. 2015. Scheduling fungicides for turf disease control. Midwest Association of Golf Course Superintendents. Flossmoor, IL
9. Latin, R. 2015. Turf disease identification and control. NHGCSA. Concord, NH
10. Latin, R. 2015. Turf Diseases. Purdue T/O Seminar. West Lafayette, IN
11. Latin, R. 2016. Scheduling fungicides for turf disease control. Indiana Green Expo. Indianapolis, IN
12. Latin, R. 2016. Understanding turfgrass fungicides. GCSAA. San Diego, CA

13. Law, Q.D. and A.J. Patton. 2015. Use of digital image analysis for counting dandelion blooms in field plots. Paper presented at: Synergy in science: partnering for solutions. ASA, CSSA, and SSSA Annual Meetings, Minneapolis, MN. 15-18 Nov. Paper 146-3.
14. Patton A.J. February 25, 2015. The Impact of Your Spray Tank Water on Pesticide Performance. Golf Course Superintendents Association of America Education Conference, San Antonio, TX. 102 attendees. Invited speaker. 2 hours.
15. Patton A.J., and J.T. Brosnan. February 23, 2015. Enhanced Weed Management for Cool-Season Turfgrass. Golf Course Superintendents Association of America Education Conference, San Antonio, TX. 38 attendees. Invited speaker. 4 hours.
16. Patton, A.J. and Geoff Schortgen November 12, 2015. Hands-on Identification and Control of Warm-Season Perennial Grassy Weeds. MRTF Turf and Ornamental Seminar. 78 attendees. West Lafayette, IN.
17. Patton, A.J. and L. Beck. July 30, 2015. Field Tour of Lawn Care Programs and Weed Ecology. Midwest Regional turf Foundation – Diagnostic Series – Lawn Care Diagnostic Training. 56 attendees. West Lafayette, IN. 2 hours.
18. Patton, A.J. and Q. Law. July 14, 2015. Diagnosis Common and Not So Common turf Problems. Purdue Turfgrass and Landscape Field Day. 496 attendees. West Lafayette, IN. 2 hours.
19. Patton, A.J. and R. Lerner. May 5, 2015. Spring Update to ANR Educators. WebEx. 12 attendees. 1 hour.
20. Patton, A.J. and Z.J. Reicher. February 24, 2015. Creating your agronomic program. Golf Course Superintendents Association of America Education Conference, San Antonio, TX. 36 attendees. Invited speaker. 6 hours.
21. Patton, A.J. August 27, 2015. The Turf Year to Date. 2015 Indiana Professional Lawn and Landscape Association Field Day. 150 attendees. Danville, IN.
22. Patton, A.J. December 10, 2015. Turf Herbicide Workshop: Identification, biology, and control of common turf weeds. 70 attendees. St. Charles, IL. 7 hours.
23. Patton, A.J. December 14, 2015. Influence of spray tank water quality on pesticide performance. 100 attendees. Olathe, KS. 1.0 hour.
24. Patton, A.J. December 14, 2015. Managing problem areas with site specific maintenance. 100 attendees. Olathe, KS. 1.0 hour.
25. Patton, A.J. December 14, 2015. Site specific agronomic programming. 100 attendees. Olathe, KS. 1.0 hour.
26. Patton, A.J. December 3, 2015. Turf Herbicide Workshop: Identification, biology, and control of common turf weeds. 113 attendees. Indianapolis, IN. 7 hours.
27. Patton, A.J. December 8, 2015. Turf Herbicide Workshop: Identification, biology, and control of common turf weeds. 119 attendees. Fort Wayne, IN. 7 hours.
28. Patton, A.J. February 18, 2015. Cultural practices of turf. Initial certification training for commercial pesticide applicators – category 3b – turfgrass pest control. West Lafayette, IN. 56 attendees.
29. Patton, A.J. February 18, 2015. Identification and management of turf weeds. Initial certification training for commercial pesticide applicators – category 3b – turfgrass pest control. West Lafayette, IN. 56 attendees.
30. Patton, A.J. February 19, 2015. Cultural practices of turf. Initial certification training for commercial pesticide applicators – category 3b – turfgrass pest control. West Lafayette, IN. 50 attendees.
31. Patton, A.J. February 19, 2015. Identification and management of turf weeds. Initial certification training for commercial pesticide applicators – category 3b – turfgrass pest control. West Lafayette, IN. 50 attendees.

32. Patton, A.J. February 25, 2015. Making Sense of Soil Tests. Golf Course Superintendents Association of America Education Conference, San Antonio, TX. 60 attendees. Invited speaker. 0.5 hour.
33. Patton, A.J. February 5, 2015. Diagnosing turf problems. Canadian Golf Course Superintendents Association Conference & Show. 100 attendees. Calgary, Alberta, Canada.
34. Patton, A.J. February 5, 2015. Spray Tank Water Quality Influences Pesticide Efficacy. Canadian Golf Course Superintendents Association Conference & Show. 10 attendees. Calgary, Alberta, Canada.
35. Patton, A.J. January 13, 2015. Enhancing your broadleaf weed control program. Illinois Turf Foundation Conference. Bolingbrook, IL. 45 attendees.
36. Patton, A.J. January 13, 2015. Selecting and establishing bermudagrass athletic fields. Illinois Turf Foundation Conference. Bolingbrook, IL. 25 attendees.
37. Patton, A.J. January 13, 2015. Yellow nutsedge biology and control. Illinois Turf Foundation Conference. Bolingbrook, IL. 45 attendees.
38. Patton, A.J. January 21, 2015. Spray Tank Water Quality Influences Pesticide Efficacy. Indiana Green Expo. 12 attendees. Indianapolis, IN. 3 hours.
39. Patton, A.J. January 22, 2015. Hot Issues: Invasive Weeds. Indiana Green Expo. 200 attendees. Indianapolis, IN.
40. Patton, A.J. January 22, 2015. Welcome to the Indiana Green Expo. Indiana Green Expo. 150 attendees. Indianapolis, IN.
41. Patton, A.J. January 23, 2015. Herbicide Resistant Weeds are Here - Golf. Indiana Green Expo. 30 attendees. Indianapolis, IN.
42. Patton, A.J. January 23, 2015. Herbicide Resistant Weeds are Here - Lawn. Indiana Green Expo. 75 attendees. Indianapolis, IN.
43. Patton, A.J. January 8, 2015. Equipment calibration and nozzle selection for increased spray efficacy. Golf Course Superintendents Association of America. 151 attendees. Online webcast. 90 minutes.
44. Patton, A.J. July 14, 2015. Weed identification and weed research update. Purdue Turfgrass and Landscape Field Day. 150 attendees. West Lafayette, IN. 2 hours.
45. Patton, A.J. July 30, 2015. Fundamentals of Building Lawn Care Programs. Midwest Regional turf Foundation – Diagnostic Series – Lawn Care Diagnostic Training. 56 attendees. West Lafayette, IN. 1 hour.
46. Patton, A.J. July 30, 2015. Herbicide Resistant Weeds. Midwest Regional turf Foundation – Diagnostic Series – Lawn Care Diagnostic Training. 56 attendees. West Lafayette, IN. 1 hours.
47. Patton, A.J. March 11, 2015. Weed management in turfgrass. Great Lakes School of Turfgrass Science. 2 hours. Online webcast. 77 attendees.
48. Patton, A.J. March 13, 2015. Cultural practices of turf. Initial certification training for commercial pesticide applicators – category 3b – turfgrass pest control. West Lafayette, IN. 70 attendees.
49. Patton, A.J. March 13, 2015. Identification and management of turf weeds. Initial certification training for commercial pesticide applicators – category 3b – turfgrass pest control. West Lafayette, IN. 70 attendees.
50. Patton, A.J. March 3, 2015. Turf and chemicals. Northwest Indiana Nursery and Landscape Association. Crown Point, IN. 30 attendees.
51. Patton, A.J. March 3, 2015. Turf research updated. Hoosier Golf Course Superintendent Association. Fort Wayne, IN. 60 attendees.
52. Patton, A.J. November 11, 2015. Weed Garden Tour. MRTF Turf and Ornamental Seminar. 78 attendees. West Lafayette, IN.
53. Patton, A.J. November 12, 2015. CSI Turf: Learning to Investigate Turf Problems. MRTF Turf and

- Ornamental Seminar. 78 attendees. West Lafayette, IN.
54. Patton, A.J. November 12, 2015. Jeopardy. MRTF Turf and Ornamental Seminar. 60 attendees. West Lafayette, IN.
 55. Patton, A.J. November 6, 2015. Controlling tough weeds. 50 attendees. Fort Wayne, IN. 1.0 hour.
 56. Patton, A.J. November 6, 2015. Herbicide update. 50 attendees. Fort Wayne, IN. 1.0 hour.
 57. Patton, A.J. October 19, 2015. Maintaining golf course tees. 75 attendees. Coeur D' Alene, ID. 1.0 hour.
 58. Patton, A.J. October 19, 2015. Managing troublesome areas with site specific practices. 75 attendees. Coeur D' Alene, ID. 1.25 hours.
 59. Patton, A.J. October 19, 2015. The ultimate guide to calibrating your sprayers and choosing nozzles. 75 attendees. Coeur D' Alene, ID. 1.0 hour.
 60. Patton, A.J. October 21, 2015. The past, present, and future of zoysiagrass. 68 attendees. Owensboro, KY. 0.75 hour. 60 attendees.
 61. Patton, A.J. October 29, 2015. Work Smart, Not Hard, to Improve Your Lawn. Wabash Area Lifetime Learning Association. 15 attendees. 1.25 hours.
 62. Patton, A.J. October 6, 2015. How turfgrass grows: the basics of turf maintenance. 3B Training. 30 attendees. West Lafayette, IN. 2 hours.
 63. Price, G.Y., B.F. Peterson, M.E. Scharf, M.D. Ginzel and D.S. Richmond. 2016. Biogeochemical interactions between an invasive scarab (Japanese Beetle *Popillia japonica* Newman) and its subterranean environment. Annual Meeting of the North Central Branch of the Entomological Society of America, Cleveland, OH, June 5-8, 2016.
 64. Price, G.Y., B.F. Peterson, M.E. Scharf, M.D. Ginzel and D.S. Richmond. 2015. Biogeochemical interactions between an invasive scarab (Japanese Beetle *Popillia japonica* Newman) and its subterranean environment. Annual Meeting of the Entomological Society of America, Minneapolis, MN, November 15-18, 2015.
 65. Pruitt, H.M., B.M. Schwartz, A.J. Patton, C. Arellano, and S.R. Milla-Lewis. 2015. Quantitative trait loci (QTL) analysis of freezing tolerance in zoysiagrass. Paper presented at: Synergy in science: partnering for solutions. ASA, CSSA, and SSSA Annual Meetings, Minneapolis, MN. 15-18 Nov. Paper 144-6.
 66. Richmond, D.S. 2015. Billbug biology and management. Chicago District Golf Field Day, West Lemont, IL, September 10, 2015.
 67. Richmond, D.S. 2015. How to scout for and identify soil insect pests: A hands-on activity. West Lafayette, IN, July 30, 2015.
 68. Richmond, D.S. 2015. Insect Update 2015: European chafers & Billbugs. Northeast Indiana Landscape & Turf Seminar. Fort Wayne, IN, November 6, 2015.
 69. Richmond, D.S. 2015. Invasive soil insects: patterns and processes in urban ecosystems. Symposium (Urban Soil Ecology: A New Frontier). Annual Meeting of the ESA, CSSA, SSSA, ASA, Minneapolis, MN, November 15-18, 2015.
 70. Richmond, D.S. 2015. Monitoring and Managing caterpillars in turfgrass. Purdue Turf & Landscape Field Day, West Lafayette, IN, July 14, 2015.
 71. Richmond, D.S. 2015. White grub identification, biology and management. Purdue Turf & Landscape Seminar, West Lafayette, IN, November 11, 2015.
 72. Richmond, D.S. 2016. Billbugs and other pest of warm-season turf. Indiana Green Expo, Indianapolis, IN, January 8, 2016.
 73. Richmond, D.S. 2016. Japanese beetle: Spatial and microbial dimensions of an invasive soil insect. Seminar presented to the Department of Entomology, University of Wisconsin, Madison, WI, April 15, 2016.

74. Richmond, D.S. 2016. White grub control update. Indiana Green Expo, Indianapolis, IN, January 7, 2016.
75. Richmond, D.S. 2016. White grub update. Hoosier Golf Course Superintendents Association, Ft. Wayne, IN, March 1, 2016.
76. Schortgen, G., A.J. Patton, and D.V. Weisenberger. 2015. Influence of water hardness of 2,4-D efficacy in field and greenhouse weed control experiments. Paper presented at: Synergy in science: partnering for solutions. ASA, CSSA, and SSSA Annual Meetings, Minneapolis, MN. 15-18 Nov. Paper 146-5.
77. Schortgen, G., A.J. Patton, and D.V. Weisenberger. 2015. The identification of a 2,4-D resistant population of buckhorn plantain (*Plantago lanceolata*) in managed turf. Paper presented at: Synergy in science: partnering for solutions. ASA, CSSA, and SSSA Annual Meetings, Minneapolis, MN. 15-18 Nov. Paper 36-1.
78. Taylor, M.S., C-E. Tornqvist, P.P. Grabowski, M. D. Casler, and Y. Jiang. 2016. Genetic variation of flowering time and biomass in switchgrass. The Plant and Animal Genome Conference, San Diego, CA, USA. Abstract no. P0016.
79. Yu, X., P. M. Pijut, S. Byrne, T. Asp, G. Bai, and Y. Jiang*. 2015. Genetic mechanisms of winter survival in perennial ryegrass. The Annual Meeting of the Crop Science Society of America, Minneapolis, MN.

8. Fund leveraging, specifically, collaborative grants between stations and members.

1. Agency/Title of Grant: Purdue AgSeed: Exploring the gut microbiota of Japanese beetle: leveraging information for development of next generation pest management tools

2. Duration of Funding: One (1) year (2016-2017)

3. Total amount of award: \$43,682

4. Your role: PD

5. Total Funding if Co-PI:

1. Agency/Title of Grant: United States Golf Association: Understanding billbug chemical communication to improve management.

2. Duration of Funding: Two (2) years (2015-2016)

3. Total amount of award: \$59,208

4. Your role: PD

5. Total Funding if Co-PI: NA

Agency/Title of Grant: United States Golf Association: Baculovirus research to control black cutworms. 1.

2. Duration of Funding: Three (3) years (2015-2016)

3. Total amount of award: \$60,000

4. Your role: Co-PI (R. Behle USDA-ARS lead)

5. Total Funding if Co-PI: \$14,000

Agency/Title of Grant: United States Golf Association/Evaluation of experimental approaches for annual bluegrass control in golf course putting greens. 1.

- 2. Duration of Funding: 2014-2017 (initially funded for two years and then extended)
- 3. Total amount of award: \$84,437
- 4. Your role: PI (Dr. Patton)
- 5. Responsibility: 40% (\$33,849); Collaborators at University of Illinois and Univ. of Nebraska

- 1. Agency/Title of Grant: United States Golf Association/Evaluation of experimental zoysiagrasses for the transition zone.
- 2. Duration of Funding: 2013-2017
- 3. Total amount of award: \$120,059
- 4. Your role: Co-PI
- 5. Responsibility: 38% (\$45,234); Collaborators at Kansas State Univ. and Texas A&M Univ.

9. Other relevant accomplishments and activities.

Great Lakes School of Turfgrass Sciences - ONLINE - new

Issue: There is a large need for information and education among the turf professionals. Historically, many states conducted their own week-long turfgrass short courses as a way to educate clientele. However, these short courses are expensive due to additional travel costs (hotel, mileage, meals) and in recent years, events in the Midwest were cancelled due to low registration. **Objective:** Provide high-quality, science-based, topic-focused, online turf education in a short course like fashion to reduce obstacles to attendance. **Product:** The Great Lakes School of Turfgrass Science Online launched in 2014 and has since been held annually. Twelve turf Extension specialists cover various topics over ten, 2-hour online sessions (offered live with access to recordings) scheduled each Wednesday night (7-9 pm EST) from January through March. The audience is turfgrass professionals including lawn, golf, sports, and sod. This program is co-lead out of the University of Minnesota and the University of Wisconsin with instructor participation from seven other institutions. **Delivery:** Online using Google Hangouts, PPT, chat rooms, and Moodle. **Attendance:** (2014-2016): 67 (avg.) annually including some international participant.

State Report for NCER221-2016

University: Iowa State University
Official NCERA rep: Nick Christians

Email: nchris@iastate.edu

Phone: 515-450-1263

1. Staffing:

Current team members: Nick Christians, Shuizhang Fei, Adam Thoms

Additions:

Adam begins on July 1, 2016

2. General turf program comments: We have seen considerable reductions in funding the last 5 years, but we still have positions in teaching, research, and extension, with a good balance between the three.

3. Teaching Program

Current undergraduate enrollment: 32

Trend in undergraduate enrollment over last 3 years: Decreased from about 60 three years ago.

Placement: 100%

Brief comments on teaching: We have seen a downturn in the golf area, but an increase in sports turf. Increases in tuition are beginning to affect recruitment. There are also 5 two-year programs in the state and many undergrads go to community colleges first to save money.

4. Research

Faculty member (complete for each faculty member):

Nick Christians

Current or recently graduated graduate student: Dan Strey and Kevin Hansen finished MS degrees in 2015, Josh Lenz, 2016. Isaac Mertz will finish his MS in summer 2015 and began a Ph.D. in fall.

MS or PhD: Nick currently have 2 MS students. Both of them are in full time jobs and completing their degrees through the Horticulture non-thesis program.

Project(s): We are working with the effects of paint on grass and soil on sports turf areas. There is also a project on rhizomatous tall fescue and some work on biostimulants.

We completed a major construction project in 2015 that includes over 3 acres of sports field areas.

I. Mertz, N.E. Christians, E. H. Ervin, and X. Zhang. 2016. Physiological Responses of Creeping

Bentgrass (*Agrostis stolonifera* L.) to a Tryptophan-containing Organic Byproduct under Deficit Irrigation. Crop Science, in revision.

Shuizhang Fei

Current or recently graduated graduate student: Yang Liu, PhD student; Paul Merrick, graduated spring 2016.

We developed high-throughput gene silencing tools for the model grass species, *Brachypodium distachyon* and creeping bentgrass.

List Publications (published or in press) with other NCERA collaborators over the last two years (list):

Merrick P and Fei S 2015. Regeneration and genetic transformation in switchgrass Journal of Integrative Agriculture. 14:483-493

Feng Y, Yin Y, Fei S. 2015. Down-regulation of BdBRI1, a putative brassinosteroid receptor gene produces a dwarf phenotype with enhanced drought tolerance in *Brachypodium distachyon*. Plant Science: 234:163-173

Li Y, Han L, Hao J, Fei S. 2015. *Agrobacterium tumefaciens* -mediated transformation of big bluestem (*Andropogon gerardii* Vitman). Journal of Plant Biotechnology 122:117-125.

5. Extension Program

State conference dates: January 25-28th 2016

Collaborating with other organizations on conference (yes/no): Yes

If so who: Iowa Turfgrass Institute, Iowa GCSA, ISTMA and IPLCA

Iowa Turf Conference Attendance figure: 816

6. Other

Research field day held (yes/no): Yes

If so, when: July 28th, 2016

Attendance figure in 2015: 125

Ryan Adams left the extension job in June 2016 and Adam Thoms will take over extension responsibilities on July 1, 2016.

Station Report

University: Kansas State University
Official NCERA or WERA rep: Jared A. Hoyle

Email: jahoyle@ksu.edu

Phone: 785-532-1419

1. Impact Nugget:

Kansas State University turfgrass researchers released a new zoysiagrass cultivar, and evaluated cultural practices for establishing and maintaining turf with lower requirements for fertilizer, pesticides, and water.

2. New Facilities and Equipment

The Rocky Ford Turfgrass Research Center in Manhattan, KS received irrigation pump upgrades in the spring of 2016. Two submersible VFD pumps, operating at 110 PSI, were installed into two new intake tubes, buried beneath the riverbed to maximize water availability during drought, in the Big Blue River to supply water to the turfgrass and pathology research plots.

New turfgrass research plots (approx. 3 acres) are currently being installed at the Rocky Ford Turfgrass Research Center. Research plots were exchanged between the Department of Horticulture, Forestry, and Recreation Resources and the Department of Pathology. With the exchange the turfgrass research group gained another operating facility.

3. Unique Project Related Findings

- When transitioning from tall fescue to 'Sharp's Improved II' buffalograss, glyphosate applications up to 4 days after seeding does not reduce buffalograss establishment.
- Slit-seeding increases buffalograss establishment by 25%, 30% and 50% cover compared to aerification, verticutting, and non-treated, respectively.
- Addition of turfgrass paint to November glyphosate applications on dormant zoysiagrass increases tall fescue control (100% control). November applications of glyphosate alone resulted in 60% control.
- Buffalograss can withstand repeated winter and summer traffic. (Various studies conducted from Evan Alderman, MS Graduate Student)
- A newly developed zoysiagrass which has been released jointly by K-State and Texas A&M, has hardiness equivalent to 'Meyer', but superior quality.

4. Accomplishment Summaries:

Best management practices to covert cool-season turfgrass to buffalograss are being explored. Cultivation practices of verticutting, aerification, and slit-seeding were tested across 1, 2 and 3" mowing heights. Regardless of mowing height, slit-seeding and aerification resulted in the most efficient and successful conversion of tall fescue to buffalograss. Timing of glyphosate applications prior to conversion was also explored. Results showed that buffalograss is not inhibited by any glyphosate application up to 4 days after seeding.

Three individual research studies were conducted to explore the influence of nitrogen fertilization on buffalograss quality when subjected to golf cart traffic, recovery of buffalograss when subjected to winter traffic, and longevity of turfgrass colorants and to determine optimal nitrogen rate to increase divot recovery. Buffalograss quality regardless of traffic level was highest when at least 1 lb N/1,000ft² was applied. When traffic was applied to dormant buffalograss during the winter no differences were observed in quality after spring transition. Turfgrass colorants applied to dormant buffalograss resulted in unacceptable winter color when traffic was applied. Divot recovery increased by 6.3 days to reach 50% recovery in a buffalograss fairway when 1 lb N/1,000ft² of urea fertilizer.

A new zoysiagrass cultivar, KSUZ 0802 (formal name coming soon), was released jointly by the Kansas Agricultural Experiment Station and Texas A&M AgriLife Research. The cultivar is a hybrid between *Z. japonica* and *Z. matrella*, and has better quality than Meyer, but equivalent cold tolerance.

Research continues to evaluate way to make zoysiagrass more amenable to homeowners and golf courses when its dormant. Graduate students have evaluated colorants and application volumes and times and observed these can be effectively used to enhance winter-long color. Current research is focusing on the benefits of using seed mixtures of zoysiagrass and tall fescue.

A joint project between K-State, Purdue, and Texas A&M focuses on screening zoysiagrass genotypes for quality and resistance to large patch. Other cooperators evaluating grasses within the NCERA region include the Chicago District Golf Association and the University of Missouri.

5. Impact Statements:

With increasing drought conditions and decreasing water supplies, drought tolerant turfgrass species are being explored for use in golf courses, home lawns, recreational and utility turfgrass systems. Research at Kansas State University has demonstrated that cool-season grasses can be converted to buffalograss and that its quality can be maintained when good cultural practices are used – even under traffic stress.

A new cold-hardy zoysiagrass cultivar was released, and has better quality but equivalent cold tolerance to Meyer, which has been the cultivar of choice for over 60 years. Homeowners may be more accepting of zoysiagrass lawns when colorants are used to improve winter color, and we identified several that were effective. Seeded zoysia can also be mixed with tall fescue to enhance winter color and reduce the incidence of brown patch.

We surveyed users of the K-State Turf E-newsletter/blog (See Kennelly and Hoyle, 2015, under publications). In that survey, 73% of respondents indicated they use the resource to diagnose disease problems, 67% to identify weeds, and 63 % to identify insects. On an overall scale of 1-6, with 6= best, the participants gave a ranking of 4.95 in overall usefulness and 5.02 in overall quality. Finally, 87% of users responded “yes” to the question, ““Has the K-State turf and landscape newsletter/blog helped you better communicate about turf or landscape topics with others (e.g., your supervisor, your employees, your clients, your neighbors, or others)?”

Small unmanned aircraft systems: Kansas State University is evaluating the ability of small unmanned aircraft systems (UAS) to detect drought stress in turfgrass across a gradient of well-watered to severe deficit irrigation. They compared the remote measurements with traditional (handheld) techniques. Preliminary results indicates high-resolution remote sensing with small UAS can detect drought stress before it is visible to the human eye.

Nitrous oxide (N₂O) is important greenhouse gases that has been implicated in global climate change and is the most important ozone-depleting substance in the atmosphere. Turfgrass systems are typically fertilized with nitrogen (N) and irrigated, which may result in significant N₂O emissions. The development of management practices such as slow-release N fertilizer and/or deficit irrigation may mitigate N₂O emissions, but also affect carbon sequestration in turf soils. Our objective was to quantify the magnitude and patterns of N₂O emissions in turfgrass and determine how irrigation and N fertilization may be managed to reduce N₂O emissions. In the first year of measurements, urea fertilizer had higher peak N₂O-N fluxes (ug N m⁻²/h⁻¹) after fertilization and overall annual emissions than polymer-coated N-fertilizer and differences were negligible due to irrigation treatment.

Future water availability is a serious issue in the United States, and state and local drought restrictions may be imposed on turf managers with no regard for damage to turfgrass. Past research has been conducted separately into the issues of drought resistance and traffic tolerance in turfgrass. Our objective was to evaluate the combined effects of golf cart traffic on both warm- and cool-season turfgrass species at golf course related heights during a simulated drought period and evaluate the subsequent recovery period. Preliminary results in the first year indicated remarkable recovery in turf quality after a 40-day dry down with cart traffic.

6. Published Works:

Refereed Journal Articles

An, N., A.L. Goldsby, K.P. Price, and D.J. Bremer. 2015. Using hyperspectral radiometry to predict green leaf area index of turfgrass. *Int. J. Remote Sens.* 36:1470-1483.

Braun, R., J. Fry, M. Kennelly, D. Bremer, and J. Griffin. 2016. Colorant application volume and color persistence on a ‘Chisholm’ zoysiagrass lawn. *HortTechnology*: (in press).

- Bremer, D.J., S.J. Keeley, A. Jager. 2015. Effects of home value, home age, and lot size on lawn-watering perceptions and behaviors of residential homeowners. *HortTech*. 25:90-97.
- Miller, G., D. Earlywine, R. Braun, J. Fry, and M. Kennelly. 2016. Influence of nitrogen source and application timing on large patch of zoysiagrass. *Crop, Forage, and Turfgrass Management*: doi:10.2134/cftm2015.0189
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Abstracts and Proceedings

- Alderman, E.J., J.A. Hoyle, J.D. Fry and S.J. Keeley. 2015. Influence of Nitrogen Source and Rate on Buffalograss Divot Recovery. *K-State Research Forum*. P.66.
- Alderman, E.J., J.A. Hoyle, S.J. Keeley, J.D. Fry. 2015. Effect of Nitrogen Rate and Simulated Golf Cart Traffic on Buffalograss Rough Density. *Proc. Agron. Soc. Amer.* 93005.
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- Braun, R., and D.J. Bremer. 2015. Nitrous oxide emissions and carbon sequestration in turfgrass: Effects of irrigation and N fertilization. Abstract 83-8 of the Crop Science Society of America Meeting, Minneapolis, MN.
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- Reeves, J.A., J.A. Hoyle and C.S. Thompson, 2015 Bermudagrass Control with Glyphosate, Fluazifop and Mesotrione For Spring Renovation. *Proc. K-State Research Forum*. P.26.
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Popular Articles

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- Fry, J. 2015. Root of happiness. May/June. Australian Turfgrass Management Journal. p. 44-46.
- Fry, J. 2015. Through the green: At their service. Golf Course Management. Feb. p. 126.
- Fry, J. 2015. Through the green: Nearest point of relief. Golf Course Management. April. p. 84.
- Fry, J. 2015. Through the green: The perils of an outside agency. Golf Course Management. June. p. 86
- Fry, J. 2015. Through the green: Baa baa black sheep. Golf Course Management. August. p. 82.
- Fry, J. and A. Chandra. 2015. New fine-textured, cold-hardy zoysiagrass on the horizon. Golf Course Management. Dec. p. 34.
- Hoyle, J.A. 2015. Power Raking or Core Aeration?. TURFnews, The Kansas Turfgrass Foundation Newsletter. August, 2015.
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- Hoyle, J.A. and J. Reeves. 2015. Timming effects of turf paint + glyphosate application on grassy weed control. Golf Course Management Magazine. July 2015. P.95.
- Keeley, Steve. 2015. The Glory of Real Grass, and “Fundamentals First”—Midsummer Turf Musings from K-State. Turf News – The Kansas Turfgrass Foundation Newsletter. July.
- Raudenbush, Zane and Steve Keeley. 2015. Nitrogen fertilization and silvery-thread moss: Figuring out N’s contributions to STM success. Golfdom 71(10):52-57.
- Raudenbush, Z., S. Keeley, and L. Stark. 2015. Managing silvery-thread moss in golf course greens: Best management practices for silvery-thread moss often conflict with cultural practices used on greens. Golf Course Management 83(10):72-77.
- Other Creative Works*
- Alderman, E., J.A. Hoyle, J. Fry and S. Keeley. 2015. Influence of Simulated Golf Cart Traffic and Nitrogen Rate on Buffalograss Quality. Kansas Agriculture Experiment Station Research Reports: Vol.1: Iss.6.
- Alderman, E., J.A. Hoyle, J. Fry and S. Keeley. 2015. Influence of Fertilizer Source and Rate on Buffalograss Divot Recovery. Kansas Agriculture Experiment Station Research Reports: Vol.1: Iss.6.
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- Bremer, D., Keeley, S., and Jager, A. 2015 "Effects of Home Value, Home Age, and Lot Size on Lawn Watering Practices of Residential Homeowners," Kansas Agricultural Experiment Station Research Reports: Vol. 1: Iss. 6.

- Hoyle, J.A. Tall Fescue Varieties for Kansas. 2015. Kansas State University Agriculture Experiment Station and Cooperative Extension Service, MF-3268.
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- Hoyle, J.A. and J.A. Reeves. 2015. Dormant Turfgrass Amino Acid and Glyphosate Application Timing Effects on Annual Bluegrass and Tall Fescue Control. Kansas Agriculture Experiment Station Research Reports: Vol.1: Iss 6.
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- Reeves, J.A., J.A. Hoyle, D. Bremer, S. Keeley and J. Griffin. 2015. Influence of Cultivation practice and Mowing Height on Conversion of Golf Course Rough from Tall Fescue to 'Sharps Improved II' Buffalograss. Kansas Agriculture Experiment Station Research Reports: Vol.1: Iss.6.

7. Scientific and Outreach Presentations:

- Fry, J. 2015. Quebec Golf Course Superintendents Association, Quebec City (invited), Jan. 21: "Managing Moss on Putting Greens"; "When Golf Course Maintenance and the Rules of Golf Collide."
- Fry, J. 2015. New England Turfgrass Conference, Providence, Rhode Island (invited), Jan. 26 and 27. "Managing Moss on Putting Greens"; "When Golf Course Maintenance and the Rules of Golf Collide."
- Fry, J. 2015. Golf Course Superintendents Association of America International Conference, San Antonio, February: "Minimizing Moss Madness: Research-Based Strategies to Suppress Moss on Putting Greens" (with Dr. Kennelly); "When Golf Course Maintenance and the Rules of Golf Collide."
- Fry, J. 2015. New Zealand Fine Turf Seminar, Wellington, New Zealand, June 14-17: "Overseeding Oversights"; "Turfgrass's Niche in a Green Society"; "Managing Irrigation for Plant Health"; "Roots First"; "Improving Communication Skills for Career Advancement."
- Fry, J. 2015. Australian Turfgrass Conference, Hunter Valley, June 21-25: "Stress Management Strategies for Maintaining Quality Turf (5 hour seminar)"; "Turfgrass's Niche in a Green Society"; "Sportsfield Maintenance Mythbusters"; "When Golf Course Maintenance and the Rules of Golf Collide"; "Managing Irrigation for Plant Health."
- Fry, J. 2015. Singapore - Special Conference on Turfgrass Management, June 29: "Turfgrass's Niche

in a Green Society”; “Roots First.”

Fry, J. 2015. Hong Kong – Golf Course Superintendents Meeting, June 30: “Turfgrass’s Niche in a Green Society”; “Roots First.”

Hoyle, J.A. 2015. Use of Buffalograss in Kansas to Reduce Turfgrass Irrigation. KSRE Annual Conference. Manhattan, KS.

Hoyle, J.A. 2015. Water Use Efficiency in the Landscape. KSRE Annual Conference. Manhattan, KS.

Hoyle, J.A. 2015. How are you using social media at your golf course?. Kansas Golf Course Superintendents Association Meeting. Hutchinson, KS.

Hoyle, J.A. 2015. Turfgrass Research Update. Kansas Nursery and Landscape Association Field Day. Wichita, KS.

Hoyle, J.A. 2015. Turfgrass Weed Identification for Effective Control. Kansas Applicators Recertification Workshop. Shawnee, KS.

Hoyle, J.A. 2015. Turfgrass Weed Control. Kansas Applicators Recertification Workshop. Wichita, KS.

Hoyle, J.A. 2015. Kansas Turfgrass Weeds: Identification and Control. KSRE IPM Commercial Pesticide Applicator Training Program Workshop. Salina, KS.

Hoyle, J.A. 2015. How to Achieve Long Term Weed Control. KSRE IPM Commercial Pesticide Applicator Training Program Workshop. Salina, KS.

Hoyle, J.A. 2015. Turfgrass Pests and Their Control. Heartland Green Industry Expo/Common Ground Educational Conference. Olathe, KS.

Hoyle, J.A. 2016. Difficult to Control Weeds. Kansas Pest Control Association Annual Conference. Wichita, KS.

Hoyle, J.A. 2016. “What’s New What Works? What Doesn’t – Herbicide Update. Kansas Pest Control Association Annual Conference. Wichita, KS.

Hoyle, J.A. 2015. Turfgrass Research Update and How It Can Help You. Horticulture Project Focus Team Training Workshop. Wichita, KS.

Hoyle, J.A. 2015. Best Management practices for Social Media and your Golf Course. Oklahoma Golf Course Superintendents Association Meeting. Blanchard, OK.

Hoyle, J.A. 2015. Get Connected: Use Social Media at Your Golf Course. Nebraska Turf Conference and Trade Show. LaVista, NE.

Hoyle, J.A. 2015. Troublesome Weed Control Strategies. Nebraska Turf Conference and Trade Show. LaVista, NE.

Hoyle, J.A. 2015. Controlling Weeds on Golf Turf. Nebraska Turf Conference and Trade Show. LaVista, NE.

Hoyle, J.A. 2015. Turfgrass Weed Control Update. Kansas Turfgrass Field Day. Olathe, KS.

Hoyle, J.A. 2015. Don’t be mad that your golf course is aerifying... It is for the golfer’s benefit. “Fore” the Golfer Workshop. El Dorado, KS.

Hoyle, J.A. 2015. Preventing Another Imprelis Disaster. 65th Annual Kansas Turfgrass Conference. Topeka, KS.

Hoyle, J.A. 2015. Preparing Your Lawn for 2016. KSRE Spring Turfgrass Management Workshop. Colby, KS.

Hoyle, J.A. 2016. Weed Control and Turfgrass Colorants for Athletic Fields. MOKAN Sports Turf Managers Association Meeting. Kansas City, KS.

Hoyle, J.A. 2016. Yellow Nutsedge and Knotweed Control. Kansas Golf Course Superintendents Association Meeting. Junction City, KS.

Hoyle, J.A. 2016. KSU Teaching, Research and Extension; Past, Present and Future. Joint KGCSA and HAGCSA Meeting. Lenexa, KS.

Hoyle, J.A., D.J. Bremer, J.D. Fry, S. J. Keeley, and M.M. Kennelly. 2015. KSU Research Update. 65th Annual Kansas Turfgrass Conference. Topeka, KS.

Hoyle, J.A. and G. Henry. 2016. Advanced Weed Control of Athletic Field Turf. Sports Turf Managers Association of America National Conference. San Diego, CA.

Hoyle, J.A. and J.D. McCurdy. 2015. What's New in Weed Management. 65th Annual Kansas Turfgrass Conference. Topeka, KS.

Hoyle, J.A. and M.M. Kennelly. 2015. Life in the Steam Cooker: 2015 Turf Woes and Tips to Avoid them Next Year. Heartland Green Industry Expo/Common Ground Educational Conference. Olathe, KS.

Keeley, S. 2015. Turfgrass and Weed Identification. K-State Turfgrass Field Day, Olathe, KS.

Keeley, S. 2015. Turfgrasses for Kansas. 65th Annual Kansas Turfgrass Conference, Topeka, KS.

Keeley, S. and D. Bremer. 2015. Maximizing Microclimatic Turfgrass Management. 65th Annual Kansas Turfgrass Conference, Topeka, KS.

Kennelly, M.M. 2016. Managing Moss Madness. National Educational Conference, Golf Course Superintendents' Association of America. San Diego, CA.

Kennelly, M.M., 2015. Meet the pests, hands-on mini-workshop. 65th Annual Kansas Turfgrass Conference. Topeka, KS

Kennelly, M.M., 2015. Basic Turf Diseases. 65th Annual Kansas Turfgrass Conference. Topeka, KS

Kennelly, M.M., 2015. Top ten disease problems. 65th Annual Kansas Turfgrass Conference. Topeka, KS

Kennelly, M.M., 2015. Common diseases of turf and ornamentals. Salina KS. Pesticide applicator certification training.

Kennelly, M.M., 2015. Turf diseases. Pesticide applicator certification training. Shawnee, KS.

Kennelly, M.M. 2015. Hot topics in 2015 turf and landscape diseases. Kansas Turfgrass Field Day, Olathe KS.

Kennelly, M.M. 2015. Disease update. Kansas Golf Course Superintendents Association meeting

8. Funding leveraging

Current collaboration with UNL (Dr. Kreuser) is exploring growth potential models for cool-season turfgrass in the transition zone. Preliminary research across multiple universities is currently being conducted. More information can be found in the University of Nebraska Station Report.

Kansas State University is working with PI, Dr. Watkins in obtaining funding for the Regional Roadside Turfgrass Testing Program.

Multiple-state cooperation on project to evaluate zoysiagrass genotypes for quality, cold hardiness, and resistance to large patch (USGA sponsored).

9. Other Relevant Accomplishments and Activities:

Extension Programing

State conference dates: Dec 1-3, 2015 in Topeka, KS

In 2015, the Kansas Turfgrass Foundation collaborated with the Kansas Nursery and Landscape Association (KNLA) and NurseryWorks Conference to join the Annual Conference and Trade Show. The addition of KNLA to the conference will also allow a previously separate landscape-training program, NuseryWorks, to be added to the program as a separate educational track.

Attendance figure: about 600-800

Research field day held (yes/no): Yes

If so, when: Always first Thursday in August. Aug. 6, 2015 in Olathe and Aug. 4, 2016, in Manhattan, KS.

Attendance figure: varies by location, average 200-300

Digital Outreach

Kansas State University has expanded the digital outreach through a targeted social media campaign. The digital outreach consists of;

1. Facebook – www.facebook.com/ksuturf - As of June 2016, the KSU Turfgrass Facebook Page has **859 “likes”** (Average increase of 17.8 per month in 2015). This has increased the audience engagement reaching up to **2,400 users** by an individual post.
2. YouTube - https://www.youtube.com/channel/UCCR_yPZef0uVkcDLi4dvdXA Launched in May the KSU Turfgrass YouTube Channel has uploaded 4 videos with over **500 views**. YouTube serves as a repository for research, extension and teaching videos available to the public.
3. Twitter – www.twitter.com/ksuturf - @KSUTurf - Contributed **1,207 tweets** specifically about KSU turfgrass research, extension and teaching to **1,358 followers**. Just between August 26, 2015 and September 3, 2015, **71,730 impressions** (the total number of times tweets are delivered to timelines) were made and reached **66,682 accounts** with only 5 individual tweets.
4. KSU Turfgrass Blog - blogs.ksu.edu/turf - Working closely with the KSU Technical Services and Dr. Megan Kennelly the new Kansa State University Turfgrass Blog has been launched. This blog is supported by the university and contains all extension and research information to then be disseminated to end users through various pathways. The KSU Turfgrass Blog had **18,495** page views from January through December 2015.
5. Digital Newsletter - Information from social media, KSU Turf Blog, publications and other media is distributed via a weekly email to **1,171 subscribers** on the K-State Turf List-Serve Newsletter. Information contained in the newsletter is identified through communication with extension agents, reports from commercial turfgrass managers, and the Plant Diagnosis Clinic. Information distributed is on current needs of homeowners, extension agents, and professional turfgrass managers.
6. Video Broadcasts – Periodic video interviews and educational programming are distributed through local broadcast channels of NBC, ABC and FOX.
7. Radio Broadcasts – Monthly radio interviews are conducted to address homeowner needs in the lawn and landscape through Kansa State University’s Radio Program, Agriculture Today.
8. KSU Turfgrass Website – www.ksu.edu/turf – The KSU Turfgrass Website serves a hub for all digital information supported in the social media campaign.

Teaching Program

Current undergraduate enrollment: 45 in turf-related areas

Trend in undergraduate enrollment over last 3 years: Flat for last 3 years, after a downward trend for several years prior to 2011. The department is initiating new efforts to recruit freshmen and transfer students using web site development and social media. View a new recruitment video on YouTube here:

<https://www.youtube.com/watch?v=9jeKiQnCBFQ>

Placement: excellent

Brief comments on teaching: A distance course, Water Issues in the Lawn and Landscape (3 cr.) has been quite popular over the last several years, and is available to students outside of KSU through the AgIdea program. Bremer, Fry, Keeley, Lavis are contributing instructors.

NCERA 221

Project Station Report: Maryland

Report Date June 2016

Period Summarized 2015

Impact Nugget. Strategies employing the use of compost as means to reduce stormwater runoff and lawn fertilizer use were investigated at The University of Maryland with the results of these investigations being disseminated (in the form of industry trade publications) to over 3700 members of the Maryland building and landcare industries in 2015.

New Facilities and Equipment. None, all equipment pertaining to activities associated with this regional project were purchased and installed in 2012 and 2013.

Accomplishment Summaries. The University of Maryland completed the analysis of runoff data collected over a 27 month period from research plots located at universities' turf farm and from a newly completed residential development located in Clarksville, Maryland. Elevated concentrations of N and P in runoff were detected from never fertilized tall fescue+microclover lawns amended with 2 inches of compost prior to the establishment, when compared to a regularly fertilized tall fescue lawn areas established in a non-compost amended soil. Regression analysis of the runoff data predicted that a runoff reduction of 35 to 37% is needed from the compost amended tall fescue + microclover lawn area to have a N load loss equivalent to that of a regularly tall fescue lawn area. In the case of the total-P load losses, the required reduction in runoff is 52 to 54%.

The University of Maryland also completed a field study that examined the potential consequences of the State of Maryland's 2013 lawn fertilizer law on select aspects of organic lawn care. In a 3 year study, the use of two compost types on turf quality was compared with the use of an enhanced efficiency fertilizer. Annual compost topdressing nitrogen loads in excess of 5 times the amount applied using the enhanced efficiency fertilizer were required to obtain similar levels of turfgrass quality. Monthly applications of compost tea had little effect on quality of the turf receiving the three fertilizer treatments.

Impact Statements. In most instances, the passage of state lawn fertilizer laws has been in response to total daily maximum nutrient and sediment load limits placed on watersheds within the state. Results obtained from lawn care trails conducted by the University of Maryland indicate that if bagged fertilizer N application restrictions are extended to include composted materials, a likely consequence of this action would be a decline in turf quality.

Amending soil with 2 inches compost prior to turfgrass establishment is a recommended practice to improve the chemical and physical properties of compact infertile soils frequently found on the lots of newly constructed homes. Based on runoff investigations conducted at the University of Maryland, a 54% or greater reduction in runoff needs to occur with the use of this practice to reduce stormwater N and P losses from lawn areas.

Published Written Works.

Refereed Journal Articles

Lilly P., J. Jenkins and M.J. Carroll. 2015. Management alters C allocation in turfgrass lawns. *Landscape and Urban Planning*. 134: 119-126.

Bulletins

Carroll, M. and G. Felton. 2015. Amending soil with compost to reduce stormwater runoff and lawn fertilizer use. University of Maryland, Turfgrass Technical Update TT120, 4 pp.

Turner, T. and M. Carroll. 2015. Microclover – Tall fescue lawns in the mid-atlantic region. University of Maryland, Turfgrass Technical Update TT121. 4 pp.

Popular Articles

Carroll, M.J. 2015. Compost to reduce runoff and lawn fertilizer use. *MTC TurfNews*. (2) 22-25.

Carroll, M.J. 2015. Soil restoration of new residential lawn areas: A house divided. *BUILD Maryland* (5) 10-11.

Scientific and Outreach Oral Presentations.

Organization of Outreach Symposia and workshops

Carroll, M. 2015. Microclover to minimize fertilizer use symposium. Maryland Turfgrass Conference, College Park, MD

Carroll, M., T. Turner, and G. Reinhart. 2015. Great looking lawns using bay friendly lawn care practices. National Arboretum, Washington, DC.

Fund leveraging: None with regards to other members of this project.

Other relevant accomplishments and activities

The inclusion of microclover into lawn turf is cultural practice that can reduce the use of lawn fertilizer, however there is need to identify consumer and stakeholder groups that can serve as first adaptors for promoting the use of this practice within the Chesapeake Bay watershed. A survey to gauge the acceptance of introducing microclover into lawns was administered to various stakeholder groups attending field day and/or workshop events held at the University of Maryland and Pennsylvania State University turfgrass research facilities and at the Grass Roots exhibit located at the National Arboretum in Washington DC. Based on the results of 156 survey respondents, turf and landscape professionals attending the Penn State field day, and homeowners who viewed tall fescue + microclover plots at the Grass Roots exhibit, were identified as groups having a negative impression of the presence microclover in a tall fescue lawn. In contrast, horticulturist employed at Longwood Gardens who visited the Penn State plots had a clear preference for lawns containing microclover. Stormwater specialists (mainly civil engineers, landscape architects and natural resource planners), master gardeners and turf and landscape professional visiting plots at the University of Maryland had no clear preference for the presence or absence of microclover in tall fescue lawns viewed at this site.

BRIEF State Report for NCERA211 (formerly 192)

University: Michigan State University

Official NCERA rep: Kevin W. Frank

Email: frankk@msu.edu

Phone: 517-353-0147

Teaching

Current undergraduate enrollment: 60 total [25 (4 yr.), 35 (2 yr.)]

Trend in student enrollment over last 3 years: flat

Placement: Excellent

Joint teaching activities with other regional collaborators:

Research

Faculty member (complete for each faculty member): **Kevin W. Frank**

Project: Long term nutrient leaching

Description: Nitrogen fate 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. As of 2016, the turfgrass area has now been under continual fertilization practices for 26 years with percolate collection for the last 18 years consecutively. 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 13 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. A paper summarizing the research results from 1998-2013 is currently under review for publication.

Project: Refining Phosphorus Recommendations for Turfgrass Grown on Sand Based Rootzones

Description: A prior fertilizer program research trial on an A4 creeping bentgrass putting green at the Hancock Turfgrass Research Center has 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 using the Olsen extractant from the site are classified as very low (< 6 ppm) and recommend a phosphorus application. The objective of our research is to fine tune MSU phosphorus soil testing recommendations to ensure that the recommendations meet turfgrass needs without overestimating the amount of phosphorus the plant requires.

Project: Effect of Nitrogen Rate on Runoff Water Quality

Description: A runoff research area was constructed at the Hancock Turfgrass Research Center in the summer of 2013. The turfgrass is Kentucky bluegrass maintained similar to a home lawn with a mowing height of 3 inches and clippings retained on the plots. The research objective is to determine the effect of different rates of polymer coated urea applied either once or twice per year in comparison to standard four application home lawn programs on runoff water quality, in particular nitrogen. Research was initiated in 2014 and continues in 2016.

Project: NTEP Trials

Description: Current trials under evaluation

Creeping bentgrass green

Creeping bentgrass fairway

Fine leaf fescue lawn height
Fine leaf fescue fairway height with traffic
Low input sustainable turf

Faculty member (complete for each faculty member): **Emily Merewitz**

Current or recently graduated graduate student: Kevin Laskowski

MS or PhD: PhD student

Project: Winterkill research in a low temperature growth chamber

Golf courses were subject to extremely cold temperatures and snow/ice cover for long durations during the winters of 2013/2014 and 2014/2015 which killed part or entire putting greens. Our research aims to determine whether commonly use fungicides and plant growth regulators can alleviate these extreme winter conditions effects on putting greens. Field plots were treated in late summer through the fall with Civitas One, Embark T&O, Banner Maxx, or Primo Maxx at label recommended rates. A golf course cup cutter was then utilized to take samples from these treated research plots and transferred to a low temperature growth chamber for controlled conditions at -4°C. One half of the samples were subject to an ice cover while the other half was not. After 20, 40, and 60 days, samples were removed from the chamber and put in optimal growth conditions for regrowth evaluations. Results indicate that ice covered plugs treated with Embark T&O, Banner Maxx, and Civitas One all had more regrowth than Primo Maxx and untreated control plugs after 20 and 60 days in the low temperature growth chamber. In the spring of 2015, field plots treated with Banner Maxx had lower quality in early spring when compared with other treatments and the control on creeping bentgrass. Primo Maxx and Embark T&O treated plots had the highest quality in early spring on creeping bentgrass whereas Embark T&O treated plots resulted in the lowest quality on annual bluegrass.

Project: Polyamines and Abiotic Stress of Turfgrasses

Current or recently graduated graduate student: Yingmei Ma

MS or PhD: PhD

Polyamines (spermidine, spermine, and putrescine) are compounds that are known to accumulate in some plants during stress conditions to promote stress tolerance. If and how these compounds play a role in abiotic stresses of common turfgrass species is not yet known. We have conducted a series of growth chamber studies including one hydroponic and two soil based GC studies with creeping bentgrass 'Penncross' (*Agrostis stolonifera*) and 'Penn-G2' to determine whether exogenous application of PAs may affect plant growth and drought stress tolerance. Application of relatively low concentrations of spermidine (500 or 750 µM) or spermine (500 µM) promoted tillering rates under optimal growth conditions in hydroponics. The same levels of polyamine treatments moderated the damages associated with drought stress in the soil based growth chamber studies. The most notable differences in drought response associated with polyamine treatment were increased membrane health. This was observed as greater photochemical health and less membrane damage in polyamine treated plants compared to control plants. The relatively low level of exogenous polyamines used in this study did not have a major effect on plant water relations under drought stress. Canopy temperatures and soil moisture content were not affected by any polyamine treatment; however, on some days during early drought stress relative water content was significantly higher in polyamine treated plants compared to controls. Polyamines could play a major role in protecting photosynthetic and cellular membranes during drought stress of creeping bentgrass. Further research is ongoing related to gene changes due to polyamine treatment under drought and responses of creeping bentgrass to polyamines under salt stress conditions.

Project: Physiological Responses of Creeping Bentgrass to Infection by a Bacterial Pathogen (*Acidovorax avenae* subsp. *avenae*)

Current or recently graduated graduate student: Sha Liu

MS or PhD: MS

Description: Bacterial etiolation caused by *Acidovorax avenae* subsp. *Avenae* (*Aaa*) results in significant decline in creeping bentgrass putting greens. Plant-bacterial interactions in this disease system are not well understood. Here we performed phytohormone analysis of multiple *Aaa* isolates (MSU-1, MSU-4 and MSU-13). Creeping bentgrass (*Agrostis stolonifera*) 'Tyee' and 'Penn A-4' were grown in hydroponics under optimal and heat stress conditions in growth chambers and infected with MSU-13. In pure culture of *Aaa*, gibberellic acid isoforms (GA1, GA3, GA4) and indole-3-acetic acid (IAA) were found. At high temperature, 'Penn-A4' exhibited lower turf quality, lower chlorophyll content, and higher electrolyte leakage compared to 'Tyee'. 'Tyee' infected with *Aaa* at high temperatures showed higher SA which is related to plant defense system in stems and roots, and less GA3 and GA20 in leaf and stem tissues compared to 'Penn-A4' under same conditions. The study showed that gibberellic acid produced by *Aaa* could be the contributor to etiolation symptom. High temperature can exacerbate disease and 'Tyee' is more resistant to *Aaa* infection than 'Penn A-4'. This pathogen is also being evaluated under field conditions.

Project: Cultivar screening and transcriptome evaluation of creeping bentgrass exposed to drought stress

Description: Golf course putting greens of creeping bentgrass are particularly susceptible to drought stress due to the genetic sensitivity of creeping bentgrass to drought, due to the low mowing height and the tendency of turf managers to maintain putting greens on the dry side for optimal golf play conditions. The genetic sensitivity combined with cultural management practices of creeping bentgrass turf areas make the species particularly susceptible to drought stress. 19 cultivars of creeping bentgrass are currently being screened for variation in drought tolerance in both field and growth chamber settings. The screening will include turf quality ratings, relative water content and other physiological health indicators of both leaves and roots. These cultivars include: Alpha, V-8, T-1, Flagstick, Crenshaw, Mackensie, PennA1, PennG2, Tyee, Seaside II, Penncross, Mariner, PSG1SLTZ, 007, PSG1RH733, L-93, Declaration, Pure distinction, Pure selection. The top and bottom performing cultivar based on all physiological data will be used for RNA seq analysis to identify differentially expressed genes in both leaves and roots at early, moderate and severe drought levels. This project will produce valuable, widely usable data that is both basic and applied in nature that will have impact locally to Michigan and worldwide. The field and chamber screening results will produce highly informative data to use for recommendations to turfgrass managers on proper cultivar selection for drier field sites or climates. The transcriptome data related to drought stress will have numerous future applications for turfgrass physiologists, breeders, and pathologists. This project will greatly enhance the gene information available for creeping bentgrass and will also be useful for other turfgrass species and other abiotic stresses.

Project: Effect of Shade on creeping bentgrass physiology and hormone regulation

Description: The maintenance of quality turf in shaded areas present problems for even the most competent turfgrass managers. It is estimated that 20% of the turf grown in United States is subjected to some degree of shade. Common physiological and morphological symptoms of shade stress include thinner leaves, reduced shoot density, root growth, tillering, increased leaf length, longer internodes and upright growth habits and reduced photosynthesis and increased Gibberellic acid production. The objective of this study is to better understand the shade stress physiology in bentgrass under normal and shaded conditions in growth chamber settings. Plants will be covered with silver cloth with 50% light reduction to simulate shade stress conditions. The study will focus on the physiology and hormonal regulation of bentgrass plants treated with Primo (GA inhibitor), Phenidone (JA inhibitor) and n-Propyl gallate (JA inhibitor) under shaded and non-shade conditions. This study will provide better understanding of shade stress physiology and will help in providing better management strategy involving plant growth regulators for shade stress adaptation.

Faculty member (complete for each faculty member): **Thomas A. Nikolai**

Notable research projects led by faculty member:

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

Description: Michigan State University 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 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. 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. 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.

Title: Management of Naturalized Secondary Roughs

Description: Naturalized secondary roughs have become more common on Michigan golf courses over the last 20 years. Whether designed by the architect, or implemented by existing golf courses, these 'out-of-play' areas now appear on all styles of golf courses. Theoretically, these areas require fewer inputs than finely maintained primary rough. However, we have learned that they do require some inputs in order to look and perform as desired. Research at MSU is exploring ways to most effectively and efficiently maintain these areas with minimal chemical and cultural inputs. The goal is to maintain the ornamental quality (i.e. inflorescence, adequate turf cover) and playability (i.e. thin enough so golf balls can be found and played). The main focus will be weed control, investigating a variety of weed control programs with differing herbicides and timings.

Title: Annual Bluegrass (ABG) Control

Description: Control of Annual Bluegrass is an annual endeavor. Products with potential for selective control come and go from year to year. Four trials were initiated in 2015 to evaluate new and old herbicide including PGRs for ABG control in creeping bentgrass (CBG) and Kentucky bluegrass (KBG). PoaCure (methiozolin) and Trimit (paclobutrazol) were applied to a CBG putting green and fairway at the Hancock Turfgrass Research Center (HTRC) and were also applied to a nursery CBG green at Forest Akers West Golf Course. Some treatments were applied throughout the growing season while others were applied in the late fall. The differences in ABG biotypes are apparent even from sites just a mile apart as ABG control was much better at Forest Akers than at HTRC. We will begin to see if fall treatments differed this spring. PoaCure and Tenacity were applied to a KBG fairway – Tenacity applied 5 times, at 7 day intervals, was an excellent program, providing 90% of the ABG in an area that started with 50-70% ABG cover.

Faculty member (complete for each faculty member): **John N. Rogers, III**

Current or recently graduated graduate student: Thomas Green

MS or PhD: PhD

Project(s): EFFECTS OF GRAVEL LAYER PARTICLE SIZE AND SUB-GRADE SLOPE ON THE MAGNITUDE AND SPATIAL PATTERN OF SOIL WATER IN A VARIABLE-DEPTH USGA-SPECIFICATION PUTTING GREEN

Graduation date: 2019

Description: Uniform distribution of soil water in high-sand content putting greens is a major concern for golf course superintendents. Although gravel is commonly used as a component of a sand-based root zone in order to increase moisture retention in the root zone, the contour and slope in putting greens significantly affect moisture retention due to gravity. As a result, coarse-textured soils become prematurely dry in higher elevations, and excessively wet in lower elevations. This non-uniform wetting of soil not only could hamper putting green performance, but also, could increase water and labor inputs. The objective of this study is to assess the impact of gravel layer particle size and slope on soil water content in a variable-depth (shallower at the slope apex yet deeper at the slope base) high-sand content root zone. Due to lack of published research and the United States Golf Association's (USGA) wide-ranged specification for selection of a gravel based on the root zone material, determining the optimal bridging, filtering, permeability, and uniformity factors capable of increasing root zone soil moisture uniformity across the undulations of a variable-depth, high-sand content

putting green is critical. Our objective is to evaluate the effects of gravel layer particle size and sub-grade slope on the magnitude and spatial pattern of soil water in a variable-depth, USGA-specification putting green. Our hypothesis is the following: increasing the particle size difference between the gravel and root zone layers, in combination with a variable-depth rootzone, will improve soil moisture uniformity in an undulating putting green.

Current or recently graduated graduate student: Eric Chestnut

MS or PhD: MS

Project(s): Establishment Strategies for Creeping Bentgrass Putting Greens

Graduation date: August 2016

Description: Ongoing research at Michigan State University is examining the effects of various chemical treatments and cultural practices on the rate of establishment of a creeping bentgrass putting green. Recent breeding efforts have focused on creating bentgrass cultivars (like 'Pure Distinction', the bentgrass used in these studies) that are more tolerant to the stresses of a putting green situation (i.e. low height of cut, frequent traffic, summer heat). These grasses are in many ways more desirable than older creeping bentgrass cultivars and annual bluegrass (the other common putting green grass in the northern United States). Investigating factors that will expedite the establishment process can provide golfers with a quality playing surface as soon as possible while saving golf courses money. While these projects are not yet completed, there are some conclusions that can be drawn from them. Traditionally, the initial mowing height was suggested to be at least 0.200", if not higher. Our research has shown that it can be initiated at 0.150" with no detrimental effects to plant health. Nitrogen fertilizer rates of up to 0.25 lb N/1000 sq. ft. have been shown to be beneficial to plants on a high sand content root zone. Bi-weekly vertical mowing treatments were too aggressive on the new seedings and had a detrimental effect on plant health. Plant growth regulator (Primo Maxx) treatments increased plant color and quality late in the growing season. Results from brushing before mowing and wetting agent applications are still under investigation.

Current or recently graduated graduate student: Jacob Bravo

MS or PhD: MS

Project(s): Dazomet (Basamid) as a soil sterilant for re-grassing putting greens and fairways

Graduation date: Spring 2018

Description: With the popular soil sterilant methyl-bromide becoming outlawed, a need for a suitable replacement has become necessary. Basamid (dazomet) is the primary product in line to take the position of methyl-bromide. As a possible replacement, dazomet is distributed in a granular formulation as opposed to a gas. Research will take place in 2016-2107 on a bentgrass/annual bluegrass mixed stand at putting green height to evaluate best rates for annual bluegrass control and times for reseeding creeping bentgrass. These plots will be covered with plastic. For fairway studies, coverage with a tarp is not feasible, and the incorporation of the basamid will be controlled through irrigation applications, with the same objectives as above.

Faculty member: **Joe Vargas, Jr.**

Current or recently graduated graduate student:

MS or PhD: Liu Yan

Project(s): Bacterial Disease of Perennial Ryegrass

Graduation date: Spring 2017

Description: Perennial ryegrass is widely used on golf course fairways and roughs as well as athletic fields. In spite of good management programs, during warm summers, significant turf can be lost that is difficult to explain. We have been able to isolate a bacterium from the infected areas, identified as *Xanthomonas translucens*. It is a known pathogen of *Poa annua* and *Poa trivialis*. However, this is the first known occurrence of the *X. translucens* on perennial ryegrass. *Xanthomonas translucens* pv *poae* has been identified as the pathogen occurring on the *Poa* species. We are attempting to identify the pathovar attacking perennial

ryegrass and to compare it to the *Poa* pathogens to see how similar they are to the one on perennial ryegrass. We also plan on developing probes that can be used by diagnostic laboratories for rapid identification of perennial ryegrass samples with suspected bacterial infection.

Since this is a new disease, we are in the process of identifying the temperature range over which infection takes place as well as the optimum temperatures for symptom development. The initial studies will be conducted in controlled environment growth chambers. It is highly unlikely that we will be able to identify a chemical control for the disease since it is a bacterial disease for which there are no registered products for use on turfgrass. The best approach for controlling the disease could be the use of resistant cultivars. Some of the most commonly available perennial ryegrass cultivars will be tested to determine whether there is any resistance among them that could possibly be used in future breeding programs. Based on the information from the growth chamber studies, field studies will be initiated at the Hancock Turfgrass Research Center. The plots will be inoculated with *X. translucens* to ensure symptom development and various management strategies will be investigated.

Title: Flagstick, a new dollar spot resistant creeping bentgrass cultivar

Description: 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. A limited supply of seed was commercially available in 2015, with a more significant quantity available in 2016. 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.

Extension

State conference dates: Jan. 3-5, 2017

Collaborating with other organizations on conference (yes/no): Yes

If so who: Michigan Turfgrass Foundation

Attendance figure: 500 (from 2016 conference)

Research field day held (yes/no): yes

If so, when: Aug. 10, 2016

Attendance figure: 300 (from 2015 field day)

Other Extension activities:

Web (yes/no): www.turf.msu.edu www.gddtracker.net www.msuturfweeds.net www.msuturfinsects.net
www.msuturfdiseases.net

FaceBook/Twitter/social networking (yes/no): yes (Twitter)

Kevin Frank @msuturf

Trey Rogers @msuturfdoc

Aaron Hathaway @turficidal

Joint Extension publications with other regional collaborators:

General turf program comments

MSU China Turfgrass education program has concluded with the final class going through commencement in June, 2016 at Beijing Forestry University. A total of 471 students earned a B.S. from MSU and their respective Chinese university over the 10 years of the program.

Dr. Gilstrap's online 'Wor

BRIEF State Report for NCER221-2016

University: University of Missouri

Official NCERA rep: Xi Xiong

Email: xiongx@missouri.edu

Phone: 573-882-1824

Teaching Program

Current undergraduate enrollment: 8-10.

Trend in undergraduate enrollment over last 3 years: 10-12

Placement: golf courses, sports fields, lawn-care companies, graduate colleges, and others.

Brief comments on teaching: Introductory Turfgrass Management and Advanced Turfgrass Management have been offered every year in fall and spring semester, respectively. An 8-week course on Horticultural Drainage & Irrigation Systems (2 credits) is being offered during spring semester as well.

Research

Faculty member: Xi Xiong

Current or recently graduated graduate student: John Haguewood

MS or PhD: MS

Project(s): *Poa annua* control on creeping bentgrass putting green

Graduation date: May, 2014

Current or recently graduated graduate student: Xiaowei (Natalie) Pan

MS or PhD: PhD

Project(s): Effect of organic amendment for control of large patch on zoysiagrass fairway

Graduation date: May, 2016

Current or recently graduated graduate student: Enzhan (Steve) Song

MS or PhD: PhD

Project(s): Soil hydrophobicity and wetting agent application on turf

Graduation date: May, 2017

Current or recently graduated graduate student: Naba Amgain

MS or PhD: PhD

Project(s): Tolerance of bermudagrass to AOPP herbicides

Graduation date: December, 2019

Current or recently graduated graduate student: Michael Patterson

MS or PhD: MS

Project(s): IPM strategies for control of billbug on zoysiagrass fairway

Graduation date: May, 2019

Current or recently graduated graduate student: Matt Fleetwood

MS or PhD: MS

Project(s): Effect of soil surfactant on infiltration

Graduation date: May, 2019

Other notable research projects led by faculty member:

Title: Herbicide options to postemergence control of windmillgrass on warm- and cool-season turf

Description: We carried out greenhouse-base experiments to evaluate herbicide options to control of windmillgrass, which has become an emerging problem in various turf areas in Missouri and surround states.

Collaborators (name, institution): Jim English (University of Missouri), Reid Smeda (University of Missouri), Steve Anderson (University of Missouri), Keith Goyne (University of Missouri), Carl Sams (University of Tennessee), Justin Moss (Oklahoma State University), and Mike Richardson (University of Arkansas).

Faculty Member: Lee Miller

Current or recently graduated graduate student: Derek Cottrill

MS or PhD: MS

Project(s): Geographic distribution and management of spring dead spot in Missouri

Graduation date: May 2014

Current or recently graduated graduate student: John Koehler

MS or PhD: MS

Project(s): Evaluation of fertilizer strategies for preventing or recovering from large patch of zoysiagrass

Graduation date: December 2016

Current or recently graduated graduate student: Kyle Robertson

MS or PhD: MS

Project(s): Assessment of hormetic responses in *Sclerotinia homoeocarpa* isolates to sublethal doses of DMI fungicides.

Graduation date: December 2017

Other notable research projects led by faculty member:

1. 2013-17 National Turfgrass Evaluation Ancillary Trials: Spring Dead Spot on Bermudagrass & Large Patch on Zoysiagrass

NCERA Collaborators (name, institution): Brad Fresenburg, University of Missouri; Mike Richardson, University of Arkansas

2. Integration of fraze mowing into an IPM approach for spring dead spot control on bermudagrass

3. Impact of post-application and pigment on the efficacy of spring fungicide applications targeted for large patch control

4. Evaluation of fertilizer strategies for preventing or recovering from large patch of zoysiagrass

NCERA collaborators on grad projects

Megan Kennelly, Kansas State University, Brad Fresenburg, University of Missouri

Faculty member: Brad Fresenburg

Other notable research projects led by faculty member:

NTEP: We are presently conducting the 2012 Tall Fescue trials, two ancillary trials in cooperation with Dr. Lee Miller – the 2013 Bermudagrass trial for Spring Dead Spot Resistance and the 2013 Zoysiagrass trial for Large Patch Resistance. We also have the 2014 Creeping Bentgrass Putting Green trial, the 2014 Creeping Bentgrass Fairway trial, the 2014 Fine Fescue trial, the 2015 Low Input trial and a 2015 Ancillary Low Input trial. These trials are conducted at the University of Missouri Turfgrass Research Facility.

Extension Program

State conference dates: December 9, 2015

Collaborating with other organizations on conference (yes/no): Yes

If so who: Gateway Irrigation Association (GIA), the Gateway Chapter of STMA, the Missouri Turf & Ornamental Council (MoTOC), the Mississippi Valley Golf Course Superintendents Association (MVGCSA) and a new partner – the Missouri Landscape & Nursery Association (MLNA)

Attendance figure: over 500 with participants, vendors and speakers.

Research field day held (yes/no): Yes

If so, when: July 19, 2016

Attendance figure: 200 at July 21, 2014 event

Faculty Member: Lee Miller

Other Extension activities:

Lawn care Workshop Series

In cooperation with regional extension horticulture specialists, a planned series of lawn care workshops was held in 2013 - 2015 for 50 attendees each in St. Charles, Jackson, and Greene counties. The workshops are targeted towards homeowners and lawn care operations in metropolitan areas and are planned again in 2016. A small handbook entitled "Pest Management for Home Lawns" is nearing completion and designed as a basis for this curriculum. Outreach specifically to homeowners has also been accomplished in association with regional extension specialists through the Master Gardener training program, or in association with the Extension and Agricultural Office in the form of press releases to news media outlets.

Plant Diagnostic Laboratory

The MU Turfgrass Diagnostic Lab merged with the newly reopened MU Plant Diagnostic Clinic in 2014, which had been out of operation for 2 years due to a lack of funding. Patricia Wallace was hired as Director of the Plant Diagnostic Clinic, and Lee Miller serves as faculty supervisor. Over 450 samples were submitted to the Clinic in 2015, with 61 submissions from turfgrass areas.

Missouri Pesticide Applicator Program

The Commercial Pesticide Applicator Program in Missouri is mandated by the USA-EPA with the main educational role provided by University of Missouri Extension and enforcement provided by the Missouri Department of Agriculture. Brad Fresenburg and Lee Miller teach classes for the certification and recertification of pesticide applicators in Category 3: Turfgrasses and Ornamental Pest Control. Recently, an updated version of the training manual for these classes was co-authored by Fresenburg and Miller, and used in 2014 and 2015. In 2013 and 2014, we educated over 2000 commercial turfgrass managers through this program in Springfield, Cape Girardeau, Columbia, St. Louis, and Kansas City.

Website (yes/no): Yes

If yes, please list website address(es): www.turfpath.missouri.edu - Ninety-eight online disease reports have been written from March 2011 – June 2016 on a biweekly basis during the season. From March 2011-May 2015, the website has had over 55k page views from over 18k unique visitors.

FaceBook/Twitter/social networking (yes/no): Yes

If yes, please list info: @muturfpath – 1,132 followers, 622 messages

Faculty member: Brad Fresenburg

Other Extension activities:

Heartland Green Industry/Common Ground Expo:

The Heartland Green Industry/Common Ground Expo was held on December 14th and 15th, 2015. Tracks (Golf, Lawn Care, Business, and Pesticide Re-certification) were offered over 2 days. This is a joint conference with the Heart Golf Course Superintendents Association and Mid-America Green Industry Council. Brad participates in the Pesticide Re-Certification Program of the conference.

Commercial & Non-commercial Pesticide Applicator Training:

Pesticide Applicator Training was held in Springfield, Kansas City, Columbia, Cape Girardeau, and St. Louis, MO for four weeks in January. Attendance was 2053 in 2016. Category 3 (Ornamental & Turf) attendance was 707 (34% of total). With the retirement of Wayne Bailey this past year, Brad presently serves as the Commercial Pesticide Applicator Coordinator and PSEP Grant Principal Investigator.

Master Gardener Training:

Conducted 12 Master Gardener training session for Home Lawn Care in various locations across Missouri.

Sports Turf AdvanTage (STAT) program:

STAT is a program designed to train sports turf managers about sports field maintenance, construction, and design. These are 1 day programs that offer 4 hours of classroom time on various topics from turfgrass maintenance to irrigation to pest management to infield mixes. The second half of the day is spent on a local facility for demonstrations, field evaluations, and recommendations. These programs are coordinated by regional extension specialist with state specialist providing some of the topics and discussion. This program fills a need to provide education opportunities to sports turf managers who cannot attend national and regional conferences. Minimal fees are charged to recover cost and provide a lunch. These workshops are provided at the request of Regional Extension Specialists.

STMA Innovation Grant:

The national STMA received an ASAE Innovation Grant to determine the feasibility of data collection from sports turf field managers for the purpose of determining at what point does a field become unsafe. This grant will also determine the feasibility of developing a phone app for this. Brad was asked to be the project leader for this grant with much of the work completed by the end of 2016.

Brief comments on Extension: We have had discussions on establishing and implementing a fee based structure for extension. Several of the regional offices have implemented this program where an additional fee is charged per participant to cover any expenses of campus faculty who participate in training in addition to providing an assigned amount to Campus Extension.

BRIEF State Report for NCERA221 and WERA011

University: University of Nebraska Lincoln

Official NCERA rep: Bill Kreuser

Email: wkreuser2@unl.edu

Phone: 402-472-1869

Official WERA rep: Keenan Amundsen

Email: kamundsen2@unl.edu

Phone: 402-472-8390

Teaching Program

Current undergraduate enrollment: 40

Trend in undergraduate enrollment over last 3 years: steady

Placement: 100%

Research

Faculty member (complete for each faculty member): Keenan Amundsen

Current or recently graduated graduate student: Elizabeth Niebaum

MS or PhD: MS

Project(s): Resolving mechanisms of buffalograss seed dormancy

Graduation date: May 2018

Other notable research projects led by faculty member:

Title: Cultivar development of buffalograss and other alternative grass species.

Description: Through traditional field-based breeding and molecular breeding techniques, develop new cultivars and improved buffalograss germplasm with better turf quality, stand persistence, establishment rate.

Funded by the Native Turf Group, Todd Valley Farms, and the United States Golf Association.

NCERA Collaborators (name, institution):

Paul Johnson, Utah State University; Shaun Bushman, USDA, Logan, UT;

List Publications (published or in press) with other NCERA or WERA collaborators over the last two years (list):

1. Ramm, C., M. Wachholtz, **K. Amundsen**, T. Donze, T. Heng-Moss, P. Twigg, G. Sarath, and F. Baxendale. 2015. Transcriptional Profiling of Resistant and Susceptible Buffalograsses in Response to *Blissus occiduus* (Hemiptera: Blissidae) Feeding. *Journal of Economic Entomology*. doi: 10.1093/jee/tov067
2. Donze, T., B.S. Amaradasa, C. Caha, T. Heng-Moss, **K. Amundsen**. 2015. Molecular differentiation of gender in buffalograss. *Crop Science* 55(4): 1827-33. doi:10.2135/cropsci2014.07.0478
3. Ramm C., A. Wayadande, L. Baird, R. Nandakumar, N. Madayiputhiya, **K. Amundsen**, T. Donze, F. Baxendale, T. Heng-Moss. 2015. Morphology and Proteome Characterization of the Salivary Glands of the Western Chinch Bug, *Blissus occiduus* (Hemiptera: Blissidae). *Journal of Economic Entomology* doi: 10.1093/jee/tov149
4. Amaradasa, B.S., D. Lakshman, **K. Amundsen**. 2015. AFLP fingerprinting for identification of infra-species groups of *Rhizoctonia solani* and *Waitea circinata*. *J. Plant Pathol. Microb.* 6(3):262. Doi: 10.4172/2157-7471.1000262
5. Bushman, S., **K. Amundsen**, S. Warnke, J. Robins, P. Johnson. 2016. Transcriptome Profiling of Kentucky bluegrass (*Poa pratensis* L.) Accessions in Response to Salt Stress. *BMC Genomics* 17:48. DOI: 10.1186/s12864-016-2379-x

6. Amaradasa, B.S., and **K. Amundsen**. 2016. Characterization of defense-related genes of buffalograss challenged with the leaf spot pathogen *Curvularia inaequalis*. *Frontiers in Plant Science* DOI: 10.3389/fpls.2016.00715
7. Li, L., M.D. Sousek, **K.L. Amundsen**, Z.J. Reicher. 2016. Seeding date and bur treatment affect success of dormant-seeded buffalograss. *HortScience* (accepted).

Faculty member: Roch Gaussoin

Current or recently graduated graduate student: Matt Pederson

MS or PhD: PhD

Project(s): Strobilurin fungicide secondary plant stress alleviation effects August 2016

Current or recently graduated graduate student: Luqi Li

MS or PhD: PhD

Project(s): Ecology and Genetics of Yellow Nutsedge (*Cyperus esculentus* L.) May 2018

List Publications (published or in press) with other NCERA or WERA collaborators over the last two years (list):

1. Schmid, C.A., **R.E. Gaussoin**, R.C. Shearman, M. Mamo and C.S. Wortmann. 2015. Cultivation Effects on Organic Matter Concentration and Infiltration Rates of Two Creeping Bentgrass (*Agrostis stolonifera* L.) Putting Greens. *Applied Turfgrass Science* doi:10.2134/ATS-2014-0032-RS
2. Ferguson, J. C., **R.E. Gaussoin**, JA Eastin and G. Kruger. 2016. Comparison of an ultra-low volume (ULV) sprayer against a conventional sprayer, for foliar fertiliser and fungicide applications in turfgrass." *Journal of Plant Protection Research* 56.1 (2016): 54-59.

Faculty member: Tiffany Heng-Moss and Fred Baxendale

Current or recently graduated graduate student: Kyle Koch (co-advised with Jeff Bradshaw)

MS or PhD: Ph.D.

Project(s): Evaluation of tetraploid switchgrasses for resistance to phloem-feeding insects

Graduation date: December 2016

List Publications (published or in press) with other NCERA or WERA collaborators over the last two years (list):

1. Koch, K., R. Fithian, **T. Heng-Moss**, J. Bradshaw, G. Sarath, and C. Spilker. 2014. Evaluation of tetraploid switchgrass populations (*Panicum virgatum* L.) for host suitability and differential resistance to four cereal aphids. *J. Econ. Entomol.*107: 424-31.
2. Koch, K., **T. Heng-Moss**, J. Bradshaw, and G. Sarath. 2014. Categories of resistance to greenbug and yellow sugarcane aphid (Homoptera: Aphididae) in three tetraploid switchgrass populations. *BioEnergy Research* 7:909–918.
3. Palmer, N., A. Saathoff, B. Waters, T. Donze, **T. Heng-Moss**, P. Twigg, C. Tobias, G. Sarath. 2014. Global changes in mineral transporters in tetraploid switchgrasses (*Panicum virgatum* L.). *Frontiers in Plant Nutrition*. Published online 2014. doi: [10.3389/fpls.2013.00549](https://doi.org/10.3389/fpls.2013.00549).
4. **Heng-Moss, T.**, Bradshaw, J., Koch, K., Prochaska, T., Donze-Reiner, T., Sarath, G. 2014. Grow them and we will come for the feast. *Biofuels, Bioproducts and Biorefining* 8: 145-146.
5. Amaradasa, B., T Donze, G Sarath, **T Heng-Moss**, and K Amundsen. 2014. Characterising differential gene expression in polyploid grasses lacking a reference transcriptome. *OA Biotechnology* 10(3).
6. Palmer, N., T. Donze-Reiner, D. Horvath, **T. Heng-Moss**, B. Waters, C. Tobias and G. Sarath. 2015. Switchgrass (*Panicum virgatum* L) flag leaf transcriptomes reveal molecular signatures of leaf development, senescence, and mineral dynamics. *Functional and Integrative Genomics* 15:1-16.

7. Koch, K., N. Palmer, M. Stamm, J. Bradshaw, E. Blankenship, L. Baird, G. Sarath, and **T. Heng-Moss**. 2015. Characterization of Greenbug Feeding Behavior and Aphid (Hemiptera: Aphididae) Host Preference in Relation to Resistant and Susceptible Tetraploid Switchgrass Populations. *Bioenergy Research* 8:165-174.
8. Donze-Reiner, T., B. Amaradasa, C. Caha, **T. Heng-Moss**, K. Amundsen. 2015. Molecular differentiation of gender in buffalograss. *Crop Science* 55:1827-1833.
9. Ramm, C., M. Wachholtz, K. Amundsen, T. Donze, **T. Heng-Moss**, P. Twigg, G. Sarath, and F. Baxendale. 2015. Transcriptional Profiling of Resistant and Susceptible Buffalograsses in Response to *Blissus occiduus* (Hemiptera: Blissidae) Feeding. *Journal of Economic Entomology* 108:1354-1362.
10. Ramm, C., A. Wayadande, L. Baird, R. Nandakumar, N. Madayiputhiya, K. Amundsen, T. Donze, f. Baxendale, G. Sarath, and **T. Heng-Moss**. 2015. Morphology and Proteome Characterization of the Salivary Glands of the Western Chinch Bug, *Blissus occiduus* (Hemiptera: Blissidae). *Journal of Economic Entomology* 108:2055-2064.

Faculty member: Bill Kreuser

Current or recently graduated graduate student: Darrell Michael

MS or PhD: MS

Project(s): Winter desiccation prevention and recovery

Graduation date: August 2016

Current or recently graduated graduate student: Glen Obear

MS or PhD: PhD

Project(s): Characterization, remediation, and prevention of iron layer formation in USGA putting greens

Graduation date: December 2018

List Publications (published or in press) with other NCERA or WERA collaborators over the last two years (list):

1. **Kreuser**, W.C., and F. S. Rossi. 2014. Civitas increases clipping yield on a cool-season putting green. *Applied Turfgrass Science*.
2. **Kreuser**, W. C., and F. S. Rossi. 2014. The horticultural spray oil, Civitas™, causes chronic phytotoxicity on cool-season golf turf. *HortScience*. 49:1217-1224. doi:10.2134/ATS-2014-0012-BR.

Extension

State conference dates: January 12-14, 2016

Collaborating with other organizations on conference (yes/no): No

If so who:

Attendance figure: 512

Research field day held (yes/no): Yes

If so, when: July 22

Attendance figure: 174

Other Extension activities: Backyard Farmer TV, Thursday nights ~20,000 viewers/episode

Web (yes/no): Yes

FaceBook/Twitter/social networking (yes/no): Yes

Joint Extension activities/publications with other regional collaborators over in the last two years: none

Staffing:

Additions:

Cole Thompson was hired as the new Integrated Turfgrass Management Specialist, expected start date of July 1, 2016

Retirements/vacancies:

None

NC Project Station Report (ND 2015)

Deying Li

1. Impact Nugget:

At North Dakota State University, the turfgrass research group focused on salinity and low maintenance issues on turfgrass used as lawn and sports turf. This addressed an area 0.76 million hectares of sodium and 0.28 million hectares of salinity affected areas in the state. The research also provides information to deal with salinity issues as a result of spills and discharge of cutting and drill fluids during the oil fracking.

2. New Facilities and Equipment.

No new facility or equipment.

3. Unique Project Related Findings.

Sixty five grass species were screened for their tolerance to crude oil and drill cuttings at the germination stage. Two species were grouped as tolerant, 18 species as moderately tolerant, 27 species as moderately sensitive, and 18 species as sensitive to drill cuttings. In the test with crude oil, 28 species were classified as tolerant, 29 species as moderately tolerant, 6 species as moderately sensitive, and 2 species as sensitive.

Nine species were further tested at different contamination levels. Seed germination and seedling biomass of all species was reduced. Buffalograss (*Buchloe dactyloides* (Nutt.) Engelm.), showed the least reduction of germination and biomass when grown in contaminated soil. Thus, it is a potential species to be used in remediation of oil contaminated with hydrocarbons.

4. Accomplishment Summaries.

Using Fourier transform infrared spectroscopy to test the soil samples, it was found that concentrations of hydrocarbons in soil were reduced differently by different species. Annual ryegrass (*Lolium multiflorum* Lam.) and barley (*Hordeum vulgare* L.) showed the highest reduction of hydrocarbons from drill cuttings, while yellow foxtail and annual ryegrass showed the highest reduction of hydrocarbons from crude oil contamination.

5. Impact Statements.

The oil and gas industry is vital to the economy of North Dakota. More than 8,000 oil wells have been completed in western North Dakota's rugged prairie, which brought in \$4 billion tax revenue since 2010 for the state. Eighty-nine percent of the shale formations in the west that hold either oil or a mixture of oil and gas are on private lands that are normally owned by farmers or ranchers for agricultural production. According to the statistics by U.S. Bureau of Land Management (BLM), 2,024 leases covering 1,028,533 acres of land in ND are signed for oil and gas production. Soil contamination at oil and gas drilling and production sites is caused primarily by the intentional, accidental and incidental discharge of drilling fluids, crude petroleum and refined petroleum products (i.e. fuels and lubricants used in machinery and equipment).

6. Published Written Works.

1. Liqi Yang and **Q. Zhang**. 2015. Kentucky bluegrass seedling growth as affected by four different salts. *In* Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, St. Paul, MN.
2. Kevin Rue and **Q. Zhang**. 2015. Tolerance to saline, waterlogging, and saline-waterlogging in Kentucky bluegrass cultivars. *In* Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, St. Paul, MN.
3. **Zhang, Q.** 2015. Genetic variations of drought tolerance in creeping bentgrass. 2015 Annual ASA, CSSA, SSSA meeting. Nov. 6-9, St. Paul, MN.
4. Gao, Y. and Deying **Li**. 2015. Assessing leaf senescence in tall fescue (*Festuca arundinacea* Schreb.) under salinity stress using leaf spectrum. *Europ. J. Hort. Sci.* 80:170-176.

7. Scientific and Outreach Oral Presentations.

Zuk, Allan. 2015. Ornamental grasses: Uses and Cold Hardiness - North Cent. Turfgrass Growers Assn. Annual Conf. Fargo, ND.

Zuk, Allan. 2015. Tessman Turf Academy - Interpreting the Soil Test, Core Aeration and Weed Control. Fargo, ND.

Zuk, Allan. 2015. Growing a Great Lawn - 2015 Dakota Garden Expo, Bismarck, ND.

Zuk, Allan. 2015. Gave two presentations on weed control and turf establishment. - 2015 Yard and Garden Field Day. Fargo, ND.

Zuk, Allan. 2015. Our Environment and Our Health- Touchmark Retirement Facility, Fargo, ND.

Zuk, Allan. 2015. The Development of Pink and Gray Snow Mold - 2016 NCTGA Annual Conference, Fargo, ND.

Li, D. 2015. Grasses for Low Maintenance Lawn in Bismarck Area. Invited presentation at the Dakota Garden Expo. Bismarck Event Center. April 18, 2015.

8. Fund leveraging, specifically, collaborative grants between stations and members.

N/A

9. Other relevant accomplishments and activities.

BRIEF State Report for NCER221

University: The Ohio State University

Official NCERA rep: David Gardner

Email: gardner.254@osu.edu

Phone: 614-292-9002

Staffing:

Current team members: Karl Danneberger, David Gardner, Pam Sherratt; Joe Rimelspach (Plant Pathology); Dave Shetlar (Entomology); Ed McCoy (Natural Resources)

Additions: None

Retirements/vacancies: John Street (Horticulture and Crop Science)

Teaching Program

Current undergraduate enrollment: 20-25

Trend in undergraduate enrollment over last 3 years: Down 30

Placement: 92%

Brief comments on teaching: Most classes continue to be offered but with lower enrollments, some upper level classes are being cancelled every other year. PGM students (65 majors currently) take some turf courses. Pam Sherratt and Dave Gardner have assumed more responsibilities in general education and landscape horticulture.

Research

Faculty member: Dave Gardner

Current or recently graduated graduate student: Arly Drake

MS or PhD: MS/PhD

Project(s): MS - Influence of Cultural Practices on Sand-Based Putting Green Firmness (Completed); PhD – Use of Giberrellin Synthesis-Inhibiting Plant Growth Regulators for the Prevention of *Acidovorax avenae* Infection of Creeping Bentgrass

Graduation date: 2017

Current or recently graduated graduate student: Dominic Petrella

MS or PhD: Ph.D.

Project(s): Methods of Inducing Anthocyanin Production in Plants

Graduation date: 2017

Other notable research projects led by faculty member:

Integrating Microclover with Turfgrass to Develop a More Environmentally Sustainable Ecosystem

Faculty member: Karl Danneberger

Current or recently graduated graduate student: Matt Williams

MS or PhD: M.S.

Project(s): Adaptability of Bermudagrasses in Northern Climates

Graduation date: 2017

Current or recently graduated graduate student: Chenchen Gu

MS or PhD: M.S.

Project(s): The Physiological Effects on Brushing on Bentgrass Putting Greens

Graduation date: Spring, 2016

Faculty member: John Street

Current or recently graduated graduate student: Eva Fang

MS or PhD: MS

Project(s): Methiozolin for control of *Poa annua*

Graduation date: Autumn, 2015

List Publications (*published or in press*) with other NCERA collaborators over the last two years (list):

1. Nangle, E.J., D.S. Gardner, J.D. Metzger, D.P. Petrella, T.K. Danneberger, L. Rodriguez-Saona, and J.L. Cisar. 2016. Pigment Changes in Cool-Season Turfgrasses in Response to Ultraviolet-B Light Irradiance. *HortScience*. 51(4):439-443.
2. Nangle, E.J., D.S. Gardner, J.D. Metzger, L. Rodriguez-Saona, M. M. Guisti, T. K. Danneberger, and D.P. Petrella. 2015. Pigment Changes in Cool-Season Turfgrasses in Response to Ultraviolet-B Light Irradiance. *Agron J.* 107:41-50.

Extension Program

State conference dates: December 7-10

Collaborating with other organizations on conference (yes/no): No

If so who:

Attendance figure: 1500

Research field day held (yes/no): Yes

If so, when: August 11, 13

Attendance figure: 325 + 175

Other Extension activities: Spring Tee Off/OSU Sports Turf Short Course in February. Total attendance ~200

Website (yes/no): yes

If yes, please list website address(es): buckeyeturf.osu.edu, hcs.osu.edu/plantscienceonline

FaceBook/Twitter/social networking (yes/no): yes

If yes, please list info:

Facebook: Buckeye Turf, Turfopps

Twitter: @osuturf @grassybrit @globalturf

BRIEF State Report for NCER221

University: Wisconsin

Official NCERA rep: Doug Soldat/Paul Koch

Email: djsoldat@wisc.edu/plkoch@wisc.edu

Phone: 608-263-3631

1. Impact Nugget:

The University of Wisconsin turfgrass team continues to be a leader in researching sustainable turfgrass management through the prudent use of fertilizer and reduced-impact pesticides.

2. New Facilities and Equipment. Include production areas, sensors, instruments, and control systems purchased/installed.

3. Unique Project Related Findings. List anything noteworthy and unique learned this year.

4. Accomplishment Summaries. Draft one to three short paragraphs (2 to 5 sentences each) that summarize research or outreach accomplishments that relate to the project objectives. Please use language that the general public can readily comprehend.

Soldat:

The focus of my extension program is on improving nutrient and water use efficiency in turfgrass systems and urban landscapes. I conduct applied research in these areas and communicate the results to a large clientele group that includes: professional turf managers, homeowners, state agencies, county extension staff, and others. I made over 2,000 face-to-face contacts during 2015, and had a very successful year with the harder to quantify indirect contacts from articles, television, and radio. Our turfgrass field day and winter conference had approximately 500 attendees, combined. Recently my extension program has expanded into the area of soil contamination and safety of urban gardening.

Koch:

The primary goal of my extension program is to conduct highly applied research and disseminate research-based recommendations for the sustainable management of turfgrass landscapes out to the turfgrass industry and the general public. Dissemination from my program (all my staff combined) occurred through multiple vehicles, including 55 extension presentations, 19 extension articles (including 3 national trade journals), and 17 technical research reports posted on our website (www.tdl.wisc.edu/research). Fourteen of the above presentations were out-of-state, four were international, eleven were for county extension agents, and 14 were for the Pesticide Applicator Training program. Dissemination of information also occurred through direct contacts like email, phone calls, and text messages. I had approximately 199 extension-related emails in 2015, while Turfgrass Diagnostic Lab Manager and Associate Researcher Bruce Schweiger reported 593 extension-related emails, 474 phone calls, 596 texts, and 77 in-person meeting in 2015. Additional means of dissemination were also used and included connecting with clientele via Twitter (615 'tweets' to 692 'followers'), contributing columns to a national 'Turf Diseases' blog, producing a video with the Golf Course Superintendents Association of America, and partaking in multiple interviews with various national trade publications. The Turfgrass Diagnostic Lab also diagnosed 266 samples in 2015, including 29 samples from Minnesota, 24 samples from Illinois, and samples from locations as far as away as California and Washington.

5. Impact Statements. Please draft 2 or 3 impact statement summaries related to the project objectives. Statements should be quantitative when possible and be oriented towards the general public. This is perhaps the most difficult yet most important part of the report.

Soldat:

My research on soil testing and potassium fertilization of bentgrass is changing the way that potassium fertilizer is applied on golf courses, lawns, and other turf areas in the North Central Region and beyond.

Koch:

My development of reduced-toxicity pest management programs for both golf courses and home lawns is aimed at reducing pesticide active ingredient input into the environment and has been effective during multiple contentious situations between the turfgrass industry and anti-pesticide activists.

6. Published Written Works. Include scientific publications, trade magazine articles, books, posters, websites developed, and any other relevant printed works produced. Please use the formatting in the examples below.

Soldat:

- Obear, G.R., and D.J. **Soldat**. 2015. Sand greens and sodium: Understanding base cations and hydraulic conductivity of sand root zones. *Golfdom*. 71(11):32-36.
- Soldat**, D. 2015. Determining soil potassium requirements of sand-based putting greens: An interim report to the Canadian Allied Turfgrass Research Office. *GreenMaster*. 50(6):30-32.
- Soldat**, D. 2015. Golf course research updates from around the United States. *Grass Roots*. 44(6):46-47.
- Soldat**, D. 2015. Soil and Plant Analysis Laboratory in Madison to be consolidated with the Marshfield Soil and Forage Analysis Laboratory. *Grass Roots*. 44(5):24.
- Soldat**, D. 2015. Bugs, dirt, and grass at Grandparents University. *Grass Roots*. 44(4):20.
- Soldat**, D. 2015. Does the one-third rule really work? *Grass Roots*. 44(3):26-27.
- Soldat**, D., and B. Kreuser. 2015. Getting the most from your Primo Maxx program. *The Dogwood*. Spring p. 34-36.
- Soldat**, D. 2015. Evaluation of prohexadione-calcium, a new plant growth regulator for creeping bentgrass. *Grass Roots*. 44(1):12, 14, 16-17.
- Siemering, G., J.B. Peters, and D. **Soldat**. 2015. Sampling lawn and garden soils for analysis. UWEX Publication A2166.
- Folstad, J. S.C. Long, D. **Soldat**, and G. Siemering. 2015. Soil contaminants in community gardens. UWEX Publication A3905-03.
- Siemering G., and D. **Soldat**. 2015. Lead in home garden soil. UWEX Publication A4089.
- Siemering, G., and D. **Soldat**. 2015. Reducing exposure to lead in your garden soil. UWEX Publication A4088.
- Qadah, D., K. Smith, B. Hui, E. Yanke, L. Lien, S. Johnson, C. Hamilton, N. Gilliam, J. Davis, M. Martin, D. Cardona, B. Gramling, D. **Soldat**, G. Siemering, S. Ventura, S. Gradus, and S. Bhattacharyya. 2015. Growing healthy soil for healthy communities: A community, academic and public health partnership to build soil testing capacity. Association of Public Health Laboratories Annual Meeting. Indianapolis, IN. 18-21 May, 2015.

Koch:

- Koch, P. L., Stier, J. C., Kerns, J. P. 2015. Snow cover has variable effects on persistence of fungicides and their suppression of microdochium patch on amenity turfgrass. *Plant Pathology*. doi: 10.1111/ppa.12379
- Koch, P. L., Kerns, J. P. 2015. Temperature influences persistence of chlorothalonil and iprodione on creeping bentgrass foliage. *Plant Health Progress*. doi: 10.1094/PHP-RS-15-00012. **Selected as an Editor's Pick**.
- Koch, P. L. 2015. Preventative fungicide applications for the control of dollar spot at fairway height, 2014. *Plant Disease Management Reports* 9 (T033).
- Koch, P. L. 2015. Preventative fungicide applications for the control of dollar spot at putting green height, 2014. *Plant Disease Management Reports* 9 (T028).
- Koch, P. L. 2015. Preventative fungicide applications for the control of snow mold on creeping bentgrass, 2013-2014. *Plant Disease Management Reports* 9 (T029)

- Koch, P. L. 2015. One snow mold fungicide to rule them all? *Golfdom* 71(8): 38-40.
- Koch, P. L. 2015. Influence of temperature on fungicide persistence. *Golf Course Management* 83(10): 78-84.
- Koch, P. L. 2015. Snow mold fungicide persistence. *Golf Course Management* 83(8): 89-93.
- Koch, P. L. 2015. State of the lab update. *The Grass Roots* 44(6): XX.
- Koch, P. L. 2015. Snow mold fungicide persistence. *The Grass Roots* 44(5): 8-14.
- Koch, P. L. 2015. Wisconsin snow mold review. *The Grass Roots* 44(4): 6-17.
- Koch, P. L. 2015. The skeptical plant defense activation user. *The Grass Roots* 44(3): 8-9.
- Koch, P. L. 2015. Spring disease checklist. *The Grass Roots* 44(2): 14-16.
- Koch, P. L. 2015. Turfgrass Pathology Research Roundup. *The Grass Roots* 44(1): 24-26.

7. Scientific and Outreach Oral Presentations. Include workshops, colloquia, conferences, symposia, and industry meetings in which you presented and/or organized. See below for formatting.

Soldat

- “Turfgrass and potassium: Reviewing the relationship. *Lawn & Landscape Webinar*. 10 Dec. 2015. (75 participants).
- “Turfgrass and potassium: Reviewing the relationship. *Golf Course Superintendents Association of America Webinar*. 8 Dec. 2015. (100 participants).
- “Practical soil microbiology” *Golf Course Superintendents Association of Mexico Conference*, 24 Oct. 2015, Puebla, Mexico. (100 participants).
- “Golf course soil management” *Golf Course Superintendents Association of Mexico Conference*, 24 Oct. 2015, Puebla, Mexico. (100 participants).
- “Caring for high traffic lawns” *American Public Gardens Association Meeting*, 6 Oct. 2015, Madison, WI (30 participants).
- “Frankly Speaking” *Turfnet Radio*, 5 Oct. 2015. 5,000 downloads.
- “Garden Talk with Larry Meiller” *Wisconsin Public Radio*, 4 Sept. 2015. (listening audience of 100,000).
- “Turfgrass nutrition and disease” *Envirosol Summer Seminar Series*, 18-20 Aug. 2015, Fraserville, Thames Centre, Copetown, ON (225 participants).
- “Tour of selected soils research studies” *Wisconsin Turfgrass Field Day*, 28 July 2015, Madison, WI (250 participants).
- “Garden Talk with Larry Meiller” *Wisconsin Public Radio*, 24 Apr. 2015. (listening audience of 100,000).
- “Using the Web Soil Survey” *Wisconsin Nursery and Landscape Association Meeting*, 14 Apr. 2015. Madison, WI (30 participants).
- “Nearly 100 years of watching the grass grow: The surprisingly interesting history of turfgrass research at UW-Madison.” *Founder’s Day Event*, 1 April 2015, Waukesha, WI (50 participants).
- “Re-thinking fall fertility” *South Dakota Golf Course Superintendents Association Conference*, 11 Mar. 2015, Sioux Falls, SD (75 participants).
- “Managing irrigation for maximum turfgrass performance” *South Dakota Golf Course Superintendents Association Conference*, 10 Mar. 2015, Sioux Falls, SD (75 participants).
- “Using growing degree days for scheduling and enhancing PRG performance” *South Dakota Golf Course Superintendents Association Conference*, 10 Mar. 2015, Sioux Falls, SD (75 participants).
- “Nutrient management for sports fields and grounds” *ProGreen Open House*, 5 Mar. 2015, Milwaukee, WI (100 participants).

- “Progressive annual bluegrass and creeping bentgrass management” *Golf Industry Show*, 23 Feb. 2015, San Antonio, TX (200 participants).
- “Seeding for success: Seeds, coatings, and establishment techniques for getting results” *Wisconsin Grounds Maintenance Short Course*, 11 and 13 Feb. 2015, Kenosha, Waukesha, and Sheboygan, WI (400 participants).
- “The fate of pesticides applied to turf” Wisconsin Golf Course Superintendents Association Meeting, 9 Feb. 2015, Fond du Lac, WI (75 participants).
- “Building your turf nutrition program from the bottom up” *Northern Great Lakes Golf Course Superintendents Association Meeting*, 4 Feb. 2015. Green Bay, WI (50 participants).
- “Sodium, bicarbonate, and iron: Should you be concerned?” *Canadian International Turfgrass Conference*, 3 Feb. 2015, Calgary, AB. (100 participants).
- “Practical turfgrass microbiology” *Canadian International Turfgrass Conference*, 2 Feb. 2015, Calgary, AB. (50 participants).
- “Soil science research update” *Wisconsin Club Managers Association Meeting* 26 Jan. 2015, Madison, WI (30 participants).
- “Sodium, bicarbonate, and iron: Should you be concerned?” *Northern Green Expo*, 16 Jan. 2014, Minneapolis, MN (50 participants).
- “Nutrient management planning for athletic fields” *Northern Green Expo*, 15 Jan. 2014, Minneapolis, MN (100 participants).
- “Soil science research update” *Wisconsin Turfgrass Association Research Day*, 6 Jan. 2015, Madison, WI (150 participants).

Koch

Presentation Title	Conference/Meeting	Audience Size	Date	Location
Snow mold control: What works and why didn't it work at my place	Green Expo Turf and Landscape Show	150	Dec 10	Atlantic City, NJ
Reduced-Risk Pest Management: How to do it and why it's important	Green Expo Turf and Landscape Show	100	Dec 9	Atlantic City, NJ
Reduced-Risk Disease Control: How to do it and why it's important	Green Expo Turf and Landscape Show	75	Dec 9	Atlantic City, NJ
University of Wisconsin Snow Mold Review	Golfdom Snow Mold Webinar	50	Nov 5	Online
The White Menace: Winter injury on turfgrass	Peaks and Prairies Golf Course Superintendents Association Meeting	100	Oct 28	Billings, MT
Reduced-Risk Disease Control: How to do it and why	Peaks and Prairies Golf Course Superintendents	100	Oct 27	Billings, MT

it's important	Association Meeting			
Snow mold control: What works and why didn't it work at my place	Peaks and Prairies Golf Course Superintendents Association Meeting	100	Oct 27	Billings, MT
Nutrient impacts on disease development	Wisconsin Golf Course Superintendents Association Monthly Meeting	10	Jun 22	Valders, WI
All things turf	UW Extension Responding to Horticulture Inquiries	50	May 27	Wausau, WI
All things turf	UW Extension Responding to Horticulture Inquiries	75	May 14	Lake Geneva, WI
No bull: the university perspective	BASF Product Launch	10	May 12	La Crosse, WI
Pesticide Applicator Training Program, Cat 3.0	Pesticide Applicator Training Program	75	Apr 17	Wausau, WI
University of Wisconsin Snow Mold Field Days	University of Wisconsin	20	Apr 9	Wausau, WI
Pesticide Applicator Training Program, Cat 3.0	Pesticide Applicator Training Program	100	Apr 8	Oconomowoc, WI
Pesticide Applicator Training Program, Cat 3.0	Pesticide Applicator Training Program	100	Mar 25	Oconomowoc, WI
CSI Turfgrass: Deciphering what killed the lawn and what can be done to prevent it	UW Extension Grounds Maintenance Short Course	75	Feb 20	Sheboygan, WI
Pesticide Applicator Training Program, Cat 3.0	Pesticide Applicator Training Program	75	Feb 19	Madison, WI
Beating the heat: Summer disease management strategies	Central Indiana Golf Course Superintendents Association	50	Feb 19	Indianapolis, IN
CSI Turfgrass: Deciphering what killed the lawn and what can be done to prevent it	UW Extension Grounds Maintenance Short Course	75	Feb 18	Waukesha, WI

CSI Turfgrass: Deciphering what killed the lawn and what can be done to prevent it	UW Extension Grounds Maintenance Short Course	75	Feb 18	Racine, WI
Pesticide Applicator Training Program, Cat 3.0	Pesticide Applicator Training Program	75	Feb 16	Eau Claire, WI
Snow mold control: What works and why didn't it work at my place	Agrium Advanced Solutions Meeting	125	Feb 5	Toronto, Ontario, CA
Snow mold control: What works and why didn't it work at my place	Bayer Green Solutions Meeting	100	Jan 22	Toronto, Ontario, CA
Snow mold control: What works and why didn't it work at my place	Bayer Green Solutions Meeting	100	Jan 21	Toronto, Ontario, CA
Pesticide Applicator Training Program, Cat 3.0	Pesticide Applicator Training Program	75	Jan 21	Oconomowoc, WI
The White Menace: Winter injury on turfgrass	Quebec Golf Course Association Show	75	Jan 20	Quebec City, Quebec, CA
Pesticide Applicator Training Program, Cat 3.0	Pesticide Applicator Training Program	50	Jan 15	Green Bay, WI
Reduced-Risk Disease Control: How to do it and why it's important	Wisconsin Turfgrass Association Winter Conference	115	Jan 6	Madison WI

8. Fund leveraging, specifically, collaborative grants between stations and members.

9. Other relevant accomplishments and activities.

**NCERA221 Regional Research Committee
HISTORIAN'S REPORT**

Nick Christians
June 21-22, 2016 in Chicago, IL

Following is the Historian's Report for the NCERA221 (formerly NCR-10, NCR-192, and NCERA192) Regional Research Committee. Its purpose is to maintain a record of meeting sites and officers of the NCERA211 committee.

Year	Meeting Site	Chairperson	Secretary
<u>PROPOSED SITES</u>			
2022	North Dakota	Deying Li	To be announced
2021	Nebraska	William Kreuser	Deying Li
2020	Minnesota	Eric Watkins	William Kreuser
2019	Missouri	Xi Xiong	Eric Watkins
2018	Kansas	Hoyle/Fry	Xi Xiong
2017	ITSC (New Jersey)	Hoyle/Fry	Xi Xiong
<u>HISTORICAL SITES</u>			
2016	Illinois	Voigt/Nangle	Hoyle/Fry
2015	Iowa State	Shui-Zhang Fei	Tom Voigt/Nangle
2014	Purdue	Aaron Patton	Shui-Zhang Fei
2013	ASA-CSSA-SSSA	Patton/Bigelow	
2012	Joint meeting with WRC-11 in Corvallis, Oregon	Zac Reicher	Aaron Patton
2011	Joint meeting with WRC-11 at Ft. Collins, CO (Nebraska co-host)	Zac Reicher	Cale Bigelow
2010	Southern Illinois	Ken Diesburg	Cale Bigelow
2009	Michigan State University	Kevin Frank	Ken Diesburg
2008	Ohio State	David Gardner	Kevin Frank
2007	Wisconsin	John Stier	David Gardner
2006	North Dakota	Ron Smith	John Stier
2005	South Dakota	Leo Schleicher	Ron Smith
2004	Nebraska (Joint with WRC 11)	Gerald Horst	Leo Schleicher
2003	Minnesota State University	Brian Horgan	Gerald Horst
2002	Missouri	John Dunn	Brian Horgan
2001	Kansas State University	Jack Fry	Barb Corwin
2000	Glenview, Ill.	Bruce Branham	Jack Fry
1999	Michigan	Jim Baird	Bruce Branham
1998	Iowa State University	Dave Minner	Jim Baird
1997	Purdue University	Clark Throssell	Dave Minner
1996	Colorado State (joint WRC-11)	Clark Throssell	Tom Voigt
1995	University of Wisconsin	Frank Rossi	Clark Throssell
1994	Southern Illinois Univ.	Ken Diesburg	Frank Rossi
1993	Palm Beach Florida	Karl Danneberger	Ken Diesburg
1992	Ohio State University	Karl Danneberger	Ken Diesburg
1991	University of Minnesota	Don White	Karl Danneberger
1990	University of Nebraska/ Joint meeting with WRC 11	Roch Gaussoin	Don White
1989	Kansas State University	Jeff Nus	Roch Gaussoin
1988	University of Illinois	David Wehner	Jeff Nus
1987	University of Missouri	David Minner	David Wehner/Tom Fermanian
1986	Michigan State University	Bruce Branham	David Minner
1985	Iowa State University	Nick Christians	Bruce Branham/Paul Rieke
1984	Purdue University	Bill Daniel	Nick Christians
1983	Beltsville Maryland (Joint NCR-10, WRCC-11, NE-139 meeting)	Bob Carrow	Bill Daniel and Ray Freeborg
1982	Ohio State University	Keith Karnok	Bob Carrow
1981	University of Minnesota	Don White	Keith Karnok
1980	University of Nebraska	Bob Shearman	Don White
1979	University of Illinois	A. J. Turgeon	Bob Shearman
1978	Kansas State University	David Martin	A. J. Turgeon
1977	St. Louis, MO	Ed Kinbacher	David Martin
1976	St. Louis, MO	K. T. Payne	E. J. Kinbacher
1975	Indianapolis, IN	C. Hodges	K. T. Payne
1974	Indianapolis, IN	J. H. Dunn	C. Hodges
1973	St. Louis, MO	P. E. Rieke	J. H. Dunn
1972	Fort Mitchell, KY	R. W. Miller	P. E. Rieke

1971*

1970 Monticello IL

R. C. Newman

R. W. Miller

1969 Chicago, IL

R. C. Newman

A. E. Dudeck

1968 Chicago, IL

J. B. Beard

R. C. Newman

1967 East Lansing, MI

J. D. Butler

J. B. Beard

* No meeting in 1971; a joint meeting between NCR-10 and the NE group was planned for summer but never took place because of scheduling conflicts.