

# SERA48: Southern Extension and Research Activities

## Annual Report of Activities: 2020

### Accomplishments

#### 1. Water Conservation and Drought Tolerance

*Dr. Richardson currently has several studies designed to test the effects of various cultivars on the drought tolerance and water use of Kentucky bluegrass and tall fescue. These studies are being sponsored by the National Turfgrass Evaluation Program and the Turfgrass Water Conservation Alliance.*

*Dr. Richardson is currently supervising a PhD student, Eric DeBoer, who is studying the effects of oxygenation of irrigation water with nanobubbles on putting green management and nutrient use. Eric also completed his MS with Dr. Richardson, studying the impact of wetting agents on desiccation and winter survival of ultradwarf bermudagrass putting greens. Two papers were recently published from Eric's MS work*

- *DeBoer, E.J., M.D. Richardson, J.H. McCalla, and D.E. Karcher. 2020. Effect of late-fall wetting agent application on winter survival of ultradwarf bermudagrass putting greens. Crop Forage and Turfgrass Management <https://doi.org/10.1002/cft2.20035>*
- *DeBoer, E.J., M.D. Richardson, J.H. McCalla, and D.E. Karcher. 2019. Reducing ultradwarf bermudagrass putting green winter injury with covers and wetting agents. Crop, Forage, and Turfgrass Management 5:190019. doi:10.2134/cftm2019.03.0019*

*Drs. Wu, Moss, Martin, and Fontanier serve as CoPI's within the USDA NIFA SCRI funded project "Improving drought tolerance and sustainability of turfgrasses used in southern landscapes through the integration of breeding, genetics, physiology, economics, and outreach (NC State as Lead Institution)." Within the project, OSU faculty have developed new bermudagrass germplasm for multi-location trials and worked closely with breeders and physiologists across five universities to develop drought resistance testing protocols.*

*Dr. Fontanier advised two undergraduate researchers who studied the effect of shade on water use rates of selected zoysiagrasses (Roy Stovall) and the effect of irrigation depth on cart-traffic injury (Heath McDonald).*

*Dr. Fontanier collaborated with Dr. Chrissie Segars (TAMU) to provide an outreach education session entitled "Tracking every drop: irrigation audits and troubleshooting for success" for the 2020 Sports Turf Manager Association National Conference.*

*Dr. Ervin advised a MS student (John Kaszan) who investigated utilizing cool-season grasses in a native mid-Atlantic flower-visitor-supporting meadow mix. (Kaszan, J., E. Ervin, S. Barton, D. Delaney, 2020)*

*Dr. Grady Miller advised a PhD student (Drew Pinnix) who investigated the water use of warm-season and cool-season turfgrasses. Several journal and extension publications resulted from this program.*

*One-hundred-eight Tennessee homeowners attending Field Days, Shows or Festivals received information regarding well-adapted turfgrass species and varieties, and best management practices including recommended irrigation and fertilization practices to sustain them with minimal inputs.*

*Drs. Jespersen, Schwartz, Raymer, and Waltz and involved in the Multi-institution USDA-SCRI grant “Improving drought tolerance and sustainability of turfgrasses used in southern landscapes through the integration of breeding, genetics, physiology, economics, and outreach” focusing on improved drought tolerance in warm-season turfgrasses.*

*Through an agreement with and the support of the Turfgrass Water Conservation Alliance, Virginia Tech installed a rain-out shelter and conducted its first drought tolerance field trials with Kentucky bluegrass cultivars in 2019. These data will eventually be used in adding a new category for variety recommendations in Virginia.*

*The turf team has initiated a project to examine the nature of water repellency in golf greens and other turf areas.*

*Dr. Wherley and McInnes advised MS student Will Bowling and PhD student Reagan Hejl who investigated the effect long-term management practices and irrigation scheduling practices on sand-capped fairways. Projects are funded by USGA Green Section.*

*Dr. Wherley and Aitkenhead-Peterson advised PhD student Baoxin Chang who investigated environmental impacts and ecosystem services of alternative landscape conversions versus turfgrass lawns. Project was funded by The Lawn Institute and Scotts Miracle-Gro Company.*

*Dr. Chandra and Meeks recent research (Meeks, M. and A. Chandra. 2020. Drought Response and Minimal water requirements of diploid and interploid St. Augustinegrass under progressive drought stress. Crop Science. 2020; 1–16. <https://doi.org/10.1002/csc2.20012>) demonstrates that interploid hybrids (polyploid x diploid) of St. Augustinegrass maintained above 50% green cover significantly longer than diploid St. Augustinegrass (including ‘Raleigh’ and ‘Palmetto’) under prolonged drought stress conditions imposed under a rainout shelter. These results show the potential use of these interploid hybrids could result in significant cost and water savings*

*Dr. Joseph Young (Texas Tech) advised a MS Student (Travis Culpepper) who investigated water requirements of turfgrasses common to Lubbock in greenhouse and field evaluations. (3 manuscripts published in 2019)*

*Dr. Joseph Young (Texas Tech) advised MS Student (Manish Sapkota) who studied carbon sequestration potential and microbial community dynamics in urban landscapes throughout Lubbock. (2 manuscripts under review in Urban Forestry and Greening; and Applied Soil Ecology)*

*Dr. Joseph Young (Texas Tech) oversaw an 8th and 10th grade student science fair project (Aaron and Mac Chaloupka) who investigated reduced water requirements of bermudagrass with variable fertilizer sources and rates along with soil surfactant.*

## 2. Nutrient Management

*Fifty-eight University of Tennessee county Extension professionals attending a statewide Agents In-service Training Program received information regarding the proper fertilization of residential turfs based on soil test results, species and anticipated level of maintenance intensity.*

*Dr. Henry advised a MS student, Connor Bolton, who investigated the impact of microbial inoculation on nitrogen management and turfgrass establishment from seed and sprigs. (Bolton, C., G.M. Henry, M. Habteselassie, M. Cabrera. 2020)*

*Dr. Habteselassie advised a MS student (Bright Ofori) who studied the impact of turf care products on turf quality and soil biological health. (December 2019)*

#### Virginia's Fertilizer Applicator Certification Training (FACT) Program

*Virginia's state legislature began enforcing an unfunded mandate in 2013 that requires commercial applicators of fertilizer to turf and ornamental properties to be certified in the proper selection, handling, and application of fertilizer materials. In lieu of attending on-site training and testing programs, it was desirable to develop a web-based training and testing system that was readily available to Virginia's turfgrass industry professionals at reduced or no cost.*

*Personnel from Virginia Cooperative Extension, CALS-AHNRIT, VT Pesticide Programs, Virginia Department of Agriculture and Consumer Services, and the Virginia Department of Conservation and Recreation collaborated on the development of a no-cost, self-paced, web-based training and testing program to provide not only certification, but also testing that meets VDACS (certifying agency) requirements. The program is called FACT and is hosted on the Virginia Cooperative Extension website at [www.ext.vt.edu/fact](http://www.ext.vt.edu/fact). The program consists of 10 training modules developed in Adobe Presenter, and is also supported by numerous training videos and pdf files. The format features user self-enrollment and will automatically generate a certificate of completion for a user after successfully completing the 10 self-paced modules.*

*In 2019 an additional 617 participants became Certified Fertilizer Applicators in Virginia per their completion of this online training and testing program. Since its inception in 2013, approximately 2100 green industry professionals have become Certified Fertilizer Applicators through the FACT online training and testing program.*

*Dr. Wherley and McInnes advised MS student Garrett Flores who investigated feasibility of spent coffee grounds for use as turfgrass fertilizer and sand based root zone amendment. Project was funded by USGA Green Section and GeoJava.*

### 3. Pest Management

*Dr. Richardson continues to conduct studies on control of specific plant diseases of warm-season grasses, including large patch of zoysiagrass and spring dead spot of bermudagrass. These studies are focused on genetic, chemical, and cultural practices that impact management of these pathogens.*

*Dr. Richardson recently advised a MS student, Paige Boyle, on a project looking at cultural practices that impact management of earthworm casting in a golf course environment. Paige's literature review from her thesis was so comprehensive that she published that review article in Pest Management Science*

- Boyle, P.E., M.D. Richardson, M.C. Savin, D.E. Karcher, and D.A. Potter. 2019. Review - Ecology and management of earthworm casting on sports turf. *Pest Management Science* 75: 2071–2078, DOI 10.1002/ps.5479

*Dr. Nathan Walker advised a PhD student (Nathalia Grachet) who investigated the host-pathogen relationship of the causal agent of Spring Dead Spot of bermudagrass.*

*A Specialty Crop Research Grant was obtained from USDA to develop investigate annual bluegrass herbicide resistance in turfgrass systems. NC State University (Gannon) is leading the non-target site resistance component.*

*NC State turf faculty have recruited and advised MS and PhD graduate students pest management studies and projects.*

*In Tennessee, a total of 748 green industry professionals attended either a statewide field day (2), or multi-county events including a field day, a seminar, short courses (4) or workshops (2) during which pesticide performance and/or integrated pest management principles were discussed.*

*Tennessee researchers executed #PoaDay, an online event that features research on control of annual bluegrass in warm-season turfgrass.*

*Tennessee continues to run the Weed Diagnostics Center, accepting weed samples from four different states in the southeast and evaluating for specific herbicide resistance.*

*Fifty-four rose growers (members of the TN Rose Society, the Holston Rose Society, or the Chattanooga Rose Society) received information regarding recommended turf management practices to apply herbicides to maintain turf quality in heavily trafficked, pesticide-sensitive areas including rose gardens.*

*Area and statewide Extension specialists and county Extension professionals from eight counties in Tennessee conducted educational programs in 2019. These Extension personnel spent a total of 2,821 hours utilizing direct, indirect and non-contact educational methods that reached 18,995 individuals by direct contact and 48,939 by indirect contact. Direct methods included 17 client visits to Extension offices to reach 23 clients, 371 direct mail/telephone calls to contact 357 clients, 102 group meetings to reach 18,386 clients, and 143 on-site visits to reach 229 clients. Extension personnel also used indirect methods to reach clients. Two other methods reached two contacts, 56 social media platforms reached 48,936 contacts to alert them of pest and disease outbreaks and how to monitor for them.*

*UGA Department of Plant Pathology attained a fulltime position on turfgrass and grass forages pathology; Dr. Bochra Bahri joined the department in August 2019.*

*Dr. Bahri and her post-doctoral associate (Suraj Sapkota) investigated the taxonomical identification of *Clariireedia* species causing dollar spot of turfgrass in Georgia. The results showed the identification of *C. jacksonii* on creeping bentgrass (C3 turfgrass) and *C. monteithiana* on bermudagrass, zoysiagrass, and seashore paspalum (C4 turfgrasses), and the cross-infect potential of *Clariireedia* species in the greenhouse under artificial inoculation.*

*Dr. Alfredo Martinez-Espinoza was selected for the 2019 D.W. Brooks award for Excellence in Extension. The D.W. Brooks award is the highest honor within the UGA College of Agricultural and Environmental Sciences.*

*Dr. Martinez obtained a Georgia Department of Agriculture Specialty Crop Block Grant to develop Rapid molecular detection (LAMP PCR) and fungicide resistance tests for Clarireedia sp (2019-2021).*

*Dr. Raymer's breeding program is evaluating advanced seashore paspalum lines with a non-genetically engineered herbicide resistance trait for resistance to ACCase inhibiting herbicides, sethoxydim, fenoxyprop, and pinoxaden, which promise to be useful in the management of many weedy grasses in seashore paspalum.*

*Dr. Raymer co-advised with Dr. Parrot a MS student, Gary Orr, researching a transformation pipeline for tall fescue using a non-pest construct to introduce herbicide resistance and growth regulatory traits*

*Dr. Raymer co-advised with Dr. Parrot a MS student, Katherine Catching, researching transformation of seashore paspalum using a non-pest construct to enhance dollar spot resistance via expression of oxalate oxidase.*

*Dr. Henry advised an MS student (AJ Brown) who investigated the effect of carrier volume and mechanical damage on the movement of herbicides within the soil profile and control of dallisgrass. (Brown, A.J., G.M. Henry, N.T. Basinger, J. Brosnan, W. Porter. 2019)*

*Historically a pest in the northeastern U.S., the annual bluegrass weevil (ABW) has become a damaging insect pest for golf courses in Virginia and North Carolina. Research conducted by Tom Kuhar, David McCall and their graduate student, Emeline Daly, confirmed a broad distribution of the pest on golf courses across Virginia, determined an earlier phenology of the pest in Virginia compared with the northeast, which greatly impacts the timing of control measures, and determined a high variability in pyrethroid susceptibility across ABW populations, suggesting the presence of resistance genes in populations. These research findings were disseminated via several talks at turfgrass meetings and a publication in the Virginia Turfgrass Journal in 2019-2020.*

*Spring dead spot (SDS) is the most problematic disease of bermudagrass amenity turfgrass in regions that typically experience winter dormancy. Several members of the Virginia Tech Turfgrass Pathology lab have addressed SDS management strategies for turfgrass professionals. Specifically, we have learned that the two primary causal agents found in Virginia, Ophiosphaerella korrae and O. herpotrica, respond differently to both chemical and cultural management strategies. We have also developed methods for effective targeted fungicide applications using aerial image analysis and GPS sprayer technology. We continue to develop new machine learning and unsupervised image classification to automate this process. Results from various projects related to SDS have been disseminated at various local, state, regional, and national audiences in 2019-20.*

*Annual bluegrass control efforts in Dr. Askew's lab include active participation in the ResistPoa project funded by SCRI and several field projects associated with chemical and mechanical control methods and seedhead suppression. The ResistPoa work at Virginia Tech is managed by postdoctoral associate Clebson Gonçaves. Related projects include work evaluating topramezone and metribuzin for goosegrass control in bermudagrass led by Ph.D. candidate, John Brewer. Another Ph.D. candidate, Jordan Craft, is heading a project to assess zoysiagrass response to herbicides applied to dormant or semi-dormant turf. Graduate research assistant, John Peppers, is pursuing a Ph.D. project to explore weed control options on creeping bentgrass putting greens. Drs. Askew and Goatley continue to collaborate on a project to promote native plants in managed landscapes. Funding from the Virginia*

*Department of Transportation and the Virginia Agricultural Council has led to several field studies evaluating weed management techniques during pollinator-plant establishment and incorporating pollinator-serving bulb plants in lawns. Dr. Askew is currently seeking a qualified postdoctoral associate or Ph.D. student to lead a recently-funded project to assess plant communities on Virginia roadsides.*

*MSU collaborated with the Mid South Sod Council on a research project to investigate the effects of different herbicide programs applied at St. Augustine grass establishment on subsequent sod strength. The results of this study will provide the producer with information on the performance of these programs and allow them to make more informed decisions on weed control options. A workflow for acquiring various remotely acquired growth/health parameters is also being developed.*

*Dr. Tomaso-Peterson's turfgrass pathology research program has focused on the distribution and quantification of ectotrophic root-infecting fungal complexes associated with bermudagrass decline in ultradwarf putting greens.*

#### **4. Development of Improved Turfgrass Varieties for the Southern Region**

*The OSU turf bermudagrass breeding program developed more than 10,000 new plants in 2020. Of this large progeny population, 20 plants were included in a drought tolerance trial at eight regional locations and a shade tolerance trial at two locations, and 100 plants were tested for turf performance in seven regional locations. The trials were funded in a USDA SCRI grant led by Dr. Susana Milla-Lewis at North Carolina State University.*

*The OSU turf bermudagrass breeding program selected and sent 27 fine textured plants to Dr. Moss. Dr. Moss group tested the germplasm in two greens-type mowing trials.*

*The OSU turf bermudagrass breeding program in collaboration with Dr. Moss, Dr. Martin, Dr. Fontanier, and Dr. Nathan Walker selected and sent 7 entries to the 2019-2024 NTEP National Bermudagrass Test, and 3 entries to the 2019-2024 NTEP Warm-season Putting Green Test.*

*'OKC 1131' (trade mark 'Tahoma 31') was granted a plant patent, US PP31,695P3 (Wu, Y.Q., D.L. Martin, J.Q. Moss, N. Walker, and C. Fontanier, 2020).*

*Dr. Ervin is conducting the 2018 tall fescue NTEP trial in Newark, DE and will be installing the 2020 fine fescue NTEP trial under natural shade in September 2020.*

*A third Specialty Crop Research Grant was obtained by NC State University from the USDA to develop more drought tolerant southern turfgrasses.*

*One-hundred-fifty-eight Tennessee Extension Master Gardener interns from 10 counties each received 2½ hours of training regarding the management of residential turfs including the selection of new and better varieties for sustained performance.*

*Launched and maintained the Department of Plant Sciences Turf Website for Tennessee (<https://ag.tennessee.edu/turf/Pages/default.aspx>) received 9,478 page views from January 1 thru December 2 in 2019, with an average of 1.8 min. spent viewing each page. The Webpage topic turfgrass selection received 156 page views (average of 4.7 min. per page).*

*Dr. Martinez developed and implemented twenty-two educational seminars (2019-2020), conferences and workshops on turfgrass disease management sharing relevant information to stakeholders and members of the Georgia Golf course Superintendent Association, The Georgia Green Industry, The Urban Agriculture Council, landscape companies, sod growers Association and through UGA Extension.*

*Although it is not development by way of an active turfgrass breeding program, Virginia Tech continues its long-term partnership with the University of Maryland and the state crop improvement associations of Virginia and Maryland in developing an annual turfgrass variety recommendation list on the basis of field research trials at Blacksburg, Virginia Beach, Richmond, and College Park, MD.*

*In the year the MSU Turf team has participated in 7 National Turfgrass Evaluation Program (NTEP) tests. Some have been completed but most are ongoing. They include trials for bermudagrass, tall fescue, St. Augustinegrass, sea shore paspalum, warm season greens, warm season low input turf and warm season water use. These tests are highlighted at our field days and make MSU a destination for the observation of these trials. The data from these trials are processed by NTEP and disseminated.*

*MSU has partnered with Sod Solutions™ in a breeding program to use MSU derived germplasm and proprietary germplasm from Sod Solutions to produce new bermudagrass cultivars.*

*MSU has established 5000 square ft of a St. Augustine grass as the first phase of a cultivar nursery that will allow sod producers larger quantities of foundation material. MSU identified a bottleneck in transferring new cultivars to the market place. This material was sold to an MS sod producer who is not going to ramp up into production.*

*Dr. Chandra's turfgrass breeding program has developed an ultra-dwarf putting greens zoysiagrass which is an interspecific hybrid between Zoysia minima and Z. matrella (Chandra, A., A.D. Genovesi, M. Meeks, Y. Wu, M.C. Engelke, K. Kenworthy, and B. Schwartz. 2020. Registration of 'DALZ 1308' Zoysiagrass. J Plant Regist. 2020;1-16. <https://doi.org/10.1002/plr2.20016>. This article was featured as journal's cover image)*

## 5. Developing and Conduction Educational, Extension, and Outreach Programs Summarizing and Promoting Transfer of the previous 4 areas.

*Dr. Ervin lead a team of golf course superintendents and Extension Specialists in the writing and web-publishing of Best Management Practices for Delaware Golf Courses in 2019.*

*[https://cdn.extension.udel.edu/wp-content/uploads/2019/04/18160522/DE-BMP\\_FinalVersion-with-cover\\_4\\_17\\_19.pdf](https://cdn.extension.udel.edu/wp-content/uploads/2019/04/18160522/DE-BMP_FinalVersion-with-cover_4_17_19.pdf)*

*Each year the NC Turfgrass Work Group hosts four regional turfgrass programs in the state (averaging 75 attendees per event), along with an annual field day (average 800 attendees), week-long turfgrass short course (average 40 attendees), and speak at over 100 county extension meetings.*

*Extension Associate Michael Richard has organized a number of "Coaches Clinics" to provide athletic field management education to coaches and field managers mainly at the high school level. These clinics have been vendor funded. County agents have helped promote these events and they are well attended.*

*The MSU turf team has partnered with Auburn University and the University of Florida to put on the Deep South Turf Expo in Biloxi MS. This successful conference and tradeshow draws over 500 participants to hear about relevant topics in turf management.*

*In 2019 MSU's Turfgrass Research Field Day drew over 275 participants to Rodney Foil Plant Science Research Center to learn about the latest advances in turfgrass management and culture. Participant's left with an enhanced understanding of turfgrass research as well as some programs that they may be able to use in their management of turf. Supplemental education on sod production, native species weed control and fertilizer spreader calibration was also provided.*

*Chandra, A. 2019. New Zoysiagrasses for Golf Course Use. Texas Turfgrass Association Conference, Corpus Christi, TX (invited).*

*Chandra, A., B. Wherley and R. Hejl. 2019. Response to Day-Of-The-Week Watering Restriction in Warm-season Turfgrass Cultivars and Elite Lines. Turfgrass and Landscape Field Day, College Station, TX. October 9 (150 in attendance).*

*Chandra, A., B. Wherley and S. Ahmed. 2019. ProVista St. Augustinegrass: A New Option for Low-Input Landscapes. Turfgrass and Landscape Field Day, College Station, TX. October 9 (150 in attendance).*

*Chandra, A. and C. Segars. 2019. Sod Harvest of Elite St. Augustinegrass Hybrids at Kubicek Turf Farm. Field Day with the Turfgrass Producers of Texas, St. Augustinegrass Research Group, Needville, TX. August 12 (20 in attendance).*

*Fry, J. and A. Chandra. 2019. Advancements in Zoysiagrass. Kansas Turf and Ornamentals Field Day, Kansas State University, Olathe, KS. August 1 (300 in attendance).*

*Segars, C. 2019. ET-based Irrigation Management. Texas Sports Turf Managers, June and August 2019.*

*Segars, C. 2019. Interpreting Irrigation Water Reports. Kentucky Turfgrass Conference, Louisville, KY,*

*Dr. Chrissie Segars leads a Spring and Fall Integrated Pest Management Conference in the Dallas-Fort Worth area that updates attendees on the latest pest management strategies including weeds, insects, and diseases of turfgrass.*

*In 2019, Dr. Chrissie Segars presented approximately 50 educational presentations covering pest control and new turfgrass varieties.*

*Dr. Bowling delivered a total of 96 Extension programs in 2019: 10 Specialist Programs, 6 Extension Personnel Trainings, 7 Multi-State and National Presentations, 30 Regional and Statewide Programs, 23 presentations in support of County Extension programming, 13 Master Gardener Trainings and 7 presentations at Field Days/Tours.*

*Dr. Bowling and Dr. Diane Boellstorff continued their work on the The Healthy Lawns and Healthy Waters (HLHW) program: an educational training program that aims to improve and protect surface water quality by enhancing Texas residents' awareness and knowledge of best management practices for residential landscapes. The program is offered by the Texas A&M AgriLife Extension Service in cooperation with the Texas Commission on Environmental Quality and other partner agencies and organizations. A second round (HLHW 2) was successfully funded through 2023.*

*Dr. Bowling planned and executed the Texas A&M AgriLife Extension Turfgrass Ecology and Management Short Course. a four-day course designed for turf professionals and enthusiasts looking to expand their knowledge of turfgrass systems and best management practices. This course moves linearly from site preparation and appropriate species selection to establishment, cultural practices, and pest management. Attendees have the opportunity to learn from a wide range of experts with unique problem-solving perspectives. The objective of this course is to empower turfgrass managers to make confident, well-informed decisions through a combination of applied and theoretical knowledge. Participants spend time both in the classroom and engaged in group and hands-on activities. There were 38 attendees in the 2019 course, with a program earnings of \$23,035.*

*Compilation of turfgrass faculty from throughout Texas who are working with the Lonestar GCSA Chapter in developing Texas Golf Course BMPs document for release in 2020. (Bowling, Segars, Young, Wherley)*

*Dr. Young handles much of the general education throughout the Texas Panhandle having given 60 educational seminars to novice or professional turfgrass management audiences, although he does not carry a formal extension appointment at Texas Tech.*

## **Impacts**

### ***Preventing Winter Injury of Ultradwarf Bermudagrass with Wetting Agents – Richardson, De Boer, Karcher***

*Issue: Winter injury is a common problem of ultradwarf bermudagrass (Cynodon dactylon x C. transvaalensis) putting greens. One possible cause of winter injury is plant tissue desiccation. Desiccation injury can be caused by the formation of hydrophobic soils resulting in irregular shaped patches of injured turf. Wetting agents are commonly applied to actively growing ultradwarf greens to relieve or prevent plant stress from hydrophobic soils. Less is known about the effects of a late-fall/early-winter (late-season) wetting agent application to dormant putting greens. A late-season wetting agent application may have the potential to reduce winter desiccation injury and consequently hasten spring green-up and improve overall turf quality during the following spring.*

*Action: Research being conducted aims to quantify any reduction in winter injury from making a late-season wetting agent application on a dormant ultradwarf bermudagrass putting green. In early December, three wetting agents commonly used by golf course superintendents were applied to a 'Tifeagle' ultradwarf bermudagrass putting green and were compared to control plots receiving no wetting agent. Wetting agents were applied at label rate and twice the label rate to quantify any residual benefit of making a more concentrated application. Spring green-up is measured visually and digitally, and soil moisture content readings are recorded bi-weekly.*

*Impact: The potential for late-season wetting agent applications to reduce winter injury of ultradwarf bermudagrass can be a significant monetary benefit for a golf course superintendent. Reducing the chance of sustaining extreme winter injury mitigates risk putting green death, which can be very costly and may compromise a superintendent's job security. Reduced winter injury also correlates with a hastening of spring green-up. This allows for more days of the year with actively growing turf, resulting in more days open for play with acceptable putting surfaces, resulting in increased revenue.*

### ***Reducing Winter Injury of Ultradwarf Bermudagrass - Richardson, De Boer, Karcher***

*Issue: Ultradwarf bermudagrass (Cynodon dactylon x C. transvaalensis) putting greens are best adapted for use in hot, humid climates with mild winters. Due to the record breaking heat of recent summers, many golf courses throughout the central United States, including Arkansas, are converting their existing cool-season putting greens to ultradwarf bermudagrass. Ultradwarfs are characterized by their exceptional ability to tolerate wear (foot traffic) and heat stress, essential for survival during summer months. Ultradwarfs are also characterized by their lack of winter stress tolerance, potentially leading to winter kill due to extreme low temperature exposure. Golf courses place protective covers on their putting greens when temperatures are predicted to drop below 25 °F. In places like northern Arkansas, this may happen many times throughout the winter resulting in many costly covering and uncovering events to allow for golfing on warmer winter days. Covering and uncovering events require significant labor costs and decrease income by reducing the amount of days a golf course is open for play.*

*Action: Research was conducted on three of the most widely used ultradwarf cultivars to quantify the effects of lowering the current predicted low temperature threshold for placing covers on ultradwarf bermudagrass greens. Covers were deployed based on forecasted low temperatures of 25, 22, 18, and 15 °F and results were compared to an uncovered control plot. Covers are not removed until high*

temperatures reach 45 °F, which is designed to mimic a golf course open for play on a warm winter day. Data collected included soil temperature and volumetric water content through the winter and spring green-up and winter injury was quantified both visually and using digital image analysis.

*Impact:* Utilizing the data collected from this research, superintendents can now make informed decisions based on predicted temperatures, and cost-effectively utilize their protective covers. The potential to reduce the number of covering events each winter can have a positive impact on a golf courses budget in two ways. Golf courses are able to reduce labor costs by limiting unnecessary covering and uncovering events. Reducing this number of events also keeps a golf course open for play more days throughout the winter, resulting in increased revenue and more efficient use of resources.

### **Discovering experimental herbicides with international impact**

Annual bluegrass was recently reported by a nation-wide survey of the Weed Science Society of America to be the most troublesome weed in managed turf systems. It invades turf so rapidly that it is impossible to exclude. This issue manifests most prominently on golf putting greens where even small anomalies in the turfgrass canopy and its surface uniformity can negatively impact the game of golf and concomitantly reduce golf course revenue. Dr. Askew's integrated research and extension efforts on annual bluegrass address a large percentage of his client's problems and exemplify his broader research endeavors. Having evaluated nonchemical control methods (e.g., solarization, shading, allelopathy, fertility manipulation) and conventional herbicides to no avail, he continued to look to experimental chemistry for a solution to the annual bluegrass problem. In 2009, he conducted the first U.S. field research to evaluate methiozolin, an herbicide of unknown mode of action under evaluation by Moghu Research Center, a small company in Daejeon, South Korea ([www.moghu.com](http://www.moghu.com)). Dr. Askew's research demonstrated the products effectiveness for selective annual bluegrass control on golf putting greens (*Weed Technology* 28:535-542). Subsequent work led to a novel, sequential-treatment, approach that vastly improved efficacy (paper in draft). Upon visiting the Korean Peninsula and East China, he recognized similarities with Virginia in climate, turf management, and weed pests. Collaborations with Korean colleagues (Suk Jin Koo and Kyung Han) have supported three Ph.D. students. Through his research and extension efforts to evaluate methiozolin and other experimental herbicides for annual bluegrass control, he has provided expertise to stakeholders in several U.S. states, Korea, China, Japan, and Canada. Dr. Askew has thrice been invited to present research results regarding methiozolin to the Environmental Protection Agency's Office of Pesticide Programs. Treatment programs and methodologies developed at Virginia Tech were incorporated into the label recommendations of Poa-Baksa, a methiozolin-based herbicide registered in Korea and PoaCure, a similar product recently registered in the U.S. and Japan. Dr. Askew's research on annual bluegrass control has led to international collaborations and keynote presentations at golf superintendent conferences, academic departments, and corporate meetings at several locations in the United States and East Asia.

### **State Agencies Partner to Deliver Registered Technician Pesticide Certification**

*Relevance:* The Virginia Department of Transportation (VDOT) and the Virginia State Police (VSP) are two state entities that manage areas that pesticide use is necessary. However, the number of certified pesticide applicators employed by these two agencies are very small. As a result, many applications are not being done or are being done quickly and revisited annually which can cost the state more money in the future due to lack of efficiency. The Virginia Pesticide Control Act, and related Regulations, set forth the requirements for applicator certification, business licensing and product registration. Individuals

*whose job duties involve the application of pesticides may need to be certified under the Virginia Pesticide Control Act. This requirement will depend on either the type of business they work for or the pesticides, which are used during the course of their work.*

*Response: The manager of the roadside management of VDOT reached out to Virginia Cooperative Extension (VCE) Agent Kevin Camm and Extension Specialist Shawn Askew to continue the success of their Registered Technician Certification Program. Camm collaborated with VCE Agent Melanie Barrow in planning and conducting a four-day, required twenty-hour, classroom training and Askew developed and instructed the required twenty-hour hands on training. In 2019, the Department of Veterans Affairs in Salem, VA were included in the training.*

*Impact: Since the pilot class in mid-2017, 250 VDOT and VSP employees have participated from several localities across the Commonwealth. VCE Agents from around the Central Southeast District participated in the instruction. Testing was proctored following the forty hours of instruction and the passing rate continues to be 100 percent. Comments from the participants include, "Pesticides are not always the answer", "I will be more prepared to be safety minded and be following the laws and be covered", "I now have the knowledge to spray the correct way", and "I will not just mix and go, but strategize and try to do it properly despite boss preference". VDOT and VSP have requested that this partnership of state agencies continue around Virginia in order to train and certify state employees as pesticide applicators and treat pests correctly the first time to save money in their annual budget.*

### **Healthy Virginia Lawns Program**

*The Healthy Virginia Lawns program is an ongoing water quality improvement initiative that provides a comprehensive framework for developing urban nutrient management plans to homeowners. Ten extension offices in the most urbanized areas of Va continue to offer Healthy Virginia Lawn services to clients locally. Eight of the 10 units provided summary data from their programs. In 2019, 221 Extension Master Gardener volunteers reported nearly 5,500 hours of volunteer service against the HVL program locally. These volunteers and agents engaged with 889 clients and wrote 1,093 nutrient management plans. These plans covered more than 261 acres of residential turf. Healthy Virginia Lawns was the signature program highlighted at the Extension Master Gardener booth at the State Fair of Virginia for the third year in a row; EMG volunteers engaged with more than 3,500 State Fair of Virginia goers.*

*The OSU turf bermudagrass breeding program has created a full pipeline of new bermudagrass genotypes. We released 'Latitude 36' and 'NorthBridge' in 2010 and 'Tahoma 31' in 2017 for commercial production. 'Latitude 36' and 'NorthBridge' have been produced on 39 sod farms in 16 southern States. They have been used on sports fields such as Washington Redskins-FedEx Field, Philadelphia Eagles Field, St. Louis Rams-practice fields, Arrowhead Stadium, Kauffman Stadium, FC Dallas-Toyota Stadium, Texas Rangers baseball field, Tulsa Drillers-ONEOK Field, University of Oklahoma-football and soccer fields, Texas A&M University-Olsen and Kyle Fields, etc. 'Tahoma 31' has been licensed to 20 sod farms in the US and one group of farms in Australia, and one sod producer in Spain, and one sod farm in Japan. Collectively, the three cultivars have been used in 13 professional football facilities, 13 professional baseball fields, more than 10 professional soccer fields, more than 30 college/university athletic facilities, and more than 60 golf courses.*

*Presently, the UT Turfgrass twitter account (@utturfgrass) is reaching 4,096 followers, and the UT Turfgrass Facebook page (<https://www.facebook.com/UTturfgrass/>) has 2,077 followers.*

*tnturfgrassweeds.org -- Since its debut online on 1 October 2008 the website has been visited by over 267,234 individuals from 199 countries, 50 U.S. states and 276 municipalities across Tennessee.*

*Since launching on May 1st, 2013, the mobileweedmanual.com site has been used by more than 200,910 individuals in 191 different countries, all 50 US states, and 268 municipalities in Tennessee.*

*In 2019, Dr. Jim Brosnan's Twitter account (@UTturfweeds) had more than 507,600 impressions.*

*More than 180 of the 246 Green Industry Professionals participating in statewide meetings in which specialists presented information indicated that they intend to 1) change at least one turf establishment, maintenance or renovation procedure, 2) plant seed, sprigs or sod of a new, improved turfgrass species or variety, 3) purchase at least one new turf care product; and/or 4) Lease or purchase an additional turf care implement as a direct result of attending the event.*

*More than 470 of the 576 professionals attending multi-county meetings indicated that having attended the event they are better prepared to identify a specific weed species and intend to 1) modify at least one turf management practice, 2) plant a new turfgrass variety or species, 3) lease or purchase a new maintenance implement, and/or 4) apply a product they have not previously used.*

*One-hundred-thirty of 158, or ~80 percent of the Tennessee Master Gardener candidates receiving lawn care training conducted by the statewide specialist report that, on a 1-10 scale with 10= 100 percent confidence, they increased their personal confidence level with respect to recommending proper lawn care principles to others by at least three points as a result of their participation.*

*More than 70 percent of Tennessee Master Gardener Candidates surveyed indicated that they intend to change or implement at least one lawn care practice, or purchase a new product in an effort to improve the quality of their home lawn.*

*Mississippi State University's Turfgrass Field Day has become a go to event for turfgrass practitioners in Mississippi. They attend this event to keep current on the latest developments in turfgrass culture. It could be interest in a new cultivar or cultural program but things viewed at field day are used by those that attend.*

*A research project with Redixim Charterhouse has demonstrated that fraze mowing can be used in both ryegrass overseeding and overseeding removal in bermudagrass turf. Frazee mowing is a new tool for turfgrass managers and this research demonstrated the efficacy of a chemical free method for removing ryegrass overseeding in a timely manner.*

*The sod production study will provide sod producers with information on the performance of weed control programs with respect to sod strength and this will allow sod producers make more informed decisions on weed control options.*

*The coaches clinics have increased the skill and knowledge of those managing athletic fields at the high school level and will allow them to provide safer and more playable athletic fields.*

*Wherley, Chandra, Bowling, and Segars are all co-PI's on multi-year (4-yr) USDA-NIFA funded Specialty Crops Research Initiative project involving collaboration among faculty from Texas A&M AgriLife Research, Oklahoma State Univ., Univ. of Florida, Univ. of Georgia, and N.C. State University, UC Riverside. Goal of the current project is to advance drought and salinity tolerant turfgrass cultivars*

developed during the earlier projects (2011-2019) and determine reference ET-based water requirements, wilt-based minimal water requirements, and drought resistance mechanisms. This multidisciplinary project involves breeders, physiologists, extension, and economists. These projects have garnered over \$16 million in funding and resulted in co-authorship on seven peer-reviewed publications (4 published and 3 in prep). More importantly, six cultivars possessing superior drought and salinity tolerance have been released from the program. The first of these cultivar releases, 'TifTuf' bermudagrass, uses 38% less water than 'Tifway', the most widely utilized bermudagrass cultivar around the world. Since this release, 'TamStar' St. Augustinegrass and 'Tahoma 31' bermudagrass have also been released from the program. These two drought tolerant grasses are increasing in production acres and licensees across the U.S. The most recent drought-tolerant release, 'CitraBlue' St. Augustinegrass, is under initial expansion with producers, and two zoysiagrass releases are still being evaluated by producers to make decisions regarding commercialization.

Texas A&M faculty (Wherley & McInnes) have developed an industry partnership with GeoJava, a subsidiary of Aspen Beverage, San Antonio, Texas, and Mayer, LLC, Azle, TX. Aspen is one of the world's largest cold and hot brew coffee extractors, and generates substantial quantities of spent coffee grounds (SCG). Mayer is a manufacturer of potting soils, amendments, and fertilizers for the turf and landscape industry. Designing and carrying out research to address challenges and questions regarding potential use of SCG, they have brought together a team of SCSC and Horticulture faculty to explore feasibility of utilizing SCG as a topdressing/fertilizer, pre-emergence herbicide, and also as a root zone amendment for sand-based systems. The findings of the research demonstrate very promising results of SCG when used as a root zone amendment, and as a component of bridge fertilizer, and suggest it may be a viable substitute for sphagnum peat moss (a non-renewable resource that is currently in short supply) in sand based root zones. The findings have received national and international interest, and were even highlighted in Farm Week Ireland. Currently, based on our research findings, Mayer Materials and GeoJava have co-developed multiple SCG-based organic and bridge fertilizers for the lawn, garden, and professional turf industries including 'Java Turf' Hybrid Fertilizer, 'Java Peat' organic root zone amendment, 'Java Soil' coffee ground amended potting soil, all of which are being distributed nationally by Mayer Materials.

Dr. Chandra's breeding program in collaboration with Dr. Jack Fry at Kansas State University have developed and released a cold tolerant zoysiagrass named 'Innovation' which is currently produced on 19 sod farms in 11 U.S. states as well as three farms internationally (Brazil and Italy). Innovation zoysiagrass is finer in texture with high shoot density and turfgrass quality as compared to 'Meyer' zoysiagrass.

Impacts of the HLHW Program lead by Dr. Diane Boellstorff and Dr. Becky Grubbs-Bowling at Texas A&M University: Knowledge gained as measured by pre/post-tests administered at the trainings: pre-test scores averaged 45% correct answers, while post-test scores averaged 78% correct.

Intentions to adopt behavior change: 96% of participants will fertilize based on recommendations from a soil test. 95% of participants will install a RWH system. 95% of participants will improve management of their home irrigation system. 98% of participants will select plants/grass species based on water conservation.

*In addition, a 6-month follow-up survey was developed and delivered online to assess behavior changes adopted and other activities, such as the percentage sharing educational resources, by HLHW training participants. The online survey link is emailed to past participants 6 months after attending the training. SCSC analyzes the results using descriptive statistical procedures. Outcomes from the 6-month follow-up: 83% of participants indicated they have implemented or plan to implement Smart watering techniques presented at the HLHW training. 73% of participants not already soil testing made changes or plan to make changes to their lawn fertilizer program based on soil test recommendations or information provided at HLHW, 100% of participants have applied resources/materials provided at the training, 75% of participants have shared HLHW resources/materials with others.*

*Also, six-month follow up indicated that 42% of participants reduced the amount of total fertilization product applied to their lawns as a function of the knowledge gained from the program they attended. Assuming a 42% reduction from standard recommendation rates, we estimate that the total annual nitrogen applied across all 355 participants was effectively reduced by between 18,977 and 113,865 total lbs. yr-1, and total applied phosphorus was reduced by between 6,326 and 37,955 lbs. yr-1. This reduction saves participants between \$7,220.26 and \$45,545.88 in nitrogen costs.*

*Results from six-month follow-up surveys indicated that 73% of participants have adopted practices from their soil test or information provided at the HLHW training. Additionally, 83% of participants have adopted smart watering techniques presented at the training, and 83% have implemented or plan to implement some type of RWH with the average size tank being 651 gallons.*

*Participants were asked about their implementation of the various practices they learned about at the program. Follow-up surveys indicated that 83% of HLHW participants have implemented or plan to implement a rainwater harvesting system (RWH). The average tank size for participants was 651 gallons per household. An accepted approach in Texas has been for Watershed Protection Plans to estimate bacteria concentrations using a runoff curve number that shows areas with less impervious surface such as residential lawns are estimated to discharge about 10,000 CFUs/100 mL (PBS&J 2000, Ling et al. 2012). Using publicly available monthly rainfall amounts and assuming 40% utilization of captured water for winter months and 70% utilization during warmer months, an estimated 3,485,981 gallons of water was captured via RWH and retained on site, and thus an *E. coli* reduction of 4.27713E+12 CFUs occurred.*

## **Publications**

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### 3. Abstracts

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