FOUNDATION NEWS

A PUBLICATION OF THE TRI-STATE TURF RESEARCH FOUNDATION WINTER 2023/24 VOL. 26 NO. 1

PRESIDENT'S MESSAGE

Rich Duggan, President of Tri-State Turf Research Foundation

INSIDE THIS ISSUE

Tri-State Turf Research Foundation Keeps Industry Professionals In-the-Know

I have been serving on the Tri-State board for eight years, which pales in comparison to the number of years some of my fellow board members have served, and it's only a fraction of the 32 years that the Tri-State Turf Research Foundation has been in existence, supporting our area's research efforts.

The pandemic has proved a surprising boon to the golf industry. With golf on the very short list of approved activities during COVID, the sport soared in popularity with waitlists for many clubs and a shift to younger families engaging in the sport. Everyone tangent to the golf industry has benefited, including golf course superintendents, whose clubs have been able to approve long-overdue projects, new equipment, and added staff. But there is one aspect of the superintendent's job that has not changed as a result of the pandemic and that's the need to address environmental concerns and the increasing scrutiny of how we manage our turf and surrounding properties. These needs will never end. This is where the Tri-State Turf Research Foundation and funding its research efforts are vital to you and your club.

Since 1992, the Tri-State has contributed over $1 million to some of the best and brightest research teams from institutions such as Rutgers, Penn State, Cornell, URI, UMass, and UConn. If you were among those who contributed in 2023 to the foundation's fundraising efforts, I would like to thank you. Your support allowed us to continue research efforts that address our turf issues.

Now, in 2024, we are looking, once again, to all of you for your support with a contribution of $300. If our industry is to keep pace with the turfgrass pests and problems that are forever evolving and the technology and practices that support our advancement in the industry, we must continue to support research—this year and every year. As we all know, research takes money!

Donating to the Tri-State enables us to fortify our mission of "providing turfgrass research for better golf and a safer environment." I urge you to visit www.tristateturf.org to print a hard copy of a donation form, or simply use the Donation Tab found on the bottom of the Home page to send in your contribution.

If you have any questions or comments relating to the Tri-State, please feel free to contact any one of our chapter representatives from our six allied associations: the CAGCS, GCSANJ, HVGCSA, LIGCSA, MetGCSA, and MGA. You will find them listed on page 12 of this issue.

RESEARCH NEEDS NEVER END

In this issue of *Foundation News*, you will see that the Tri-State is continuing its commitment to ongoing research by supporting three projects for nearly $42,000 this coming year:

(continued on page 7)

TRI STATE TURF RESEARCH FOUNDATION

Enhancing Rooting and Resilience of *Poa annua* Putting Greens

Rutgers researchers close in on solution to summer decline of Poa annua *putting greens*

With many superintendents accepting, and even giving in to cultivating, the large populations of annual bluegrass *(Poa annua)* on their putting greens, Rutgers researchers Dr. Bingru Huang and Sean McBride set out to find a viable solution to *Poa's* vulnerability to summer decline. With the support of the Tri-State Turf Research Foundation, they conducted a two-year field trial to investigate effective management strategies to improve *Poa* root growth and maintain high-quality annual bluegrass throughout the summer months in areas with limited irrigation.

More specifically, Dr. Huang and McBride's research targeted:

» the biostimulant effects of *phytohormones* and *plant-growth-promoting rhizobacteria (PGPR)* on rooting characteristics in *Poa* managed under putting green conditions in field plots

» the effective biostimulant component to improve *Poa* root growth and turf performance during summer stress

Because in the final year of their trial the weather was unusually dry, the researchers repeated the field tests in 2023 to confirm the results.

METHODOLOGY: RESEARCH FARM TRIAL

The 2022 trial was conducted in field plots at Rutgers Horticultural Research Farm (Field #17 B).

» The field site was established with mixed biotypes of *Poa* originally collected from the Rutgers University Golf Course and Plainfield Country Club.

» *Poa* turf plots were maintained as putting greens at a cutting height of 0.125 inches.

» A maintenance program was in place for full fungicide control, including brown ring patch, dollar spot, anthracnose, and summer patch.

» Insecticide programs were in place to control annual bluegrass weevil.

» Field plots were irrigated adequately throughout the duration of the study.

» Due to frequent rain and irrigation, additional sprays of Daconil Ultrex and Mancozeb were applied to control algae growth.

TREATMENTS

The following treatments were applied every 14 days throughout the summer from June 6 through September 6 by foliar spray. Each treatment was replicated in four 3' x 3' plots.

1: Control: plants were sprayed with 2 gal./1000 sq. ft. water

2: Seaweed Extract 1 (SWE-1): XP (6 oz./1000 sq. ft.), and Stress Rx (6 oz./1000 sq. ft.)

3: Seaweed Extract 2 (SWE-2): XP-N (6 oz./1000 sq. ft.), and Stress Rx (6 oz/1000 sq. ft.)

4: Aminoethoxyvinylglycine (AVG): 25uM solution

5: Strigolactone (SL): 10uM solution

6: Plant-Growth-Promoting Rhizobacteria strain WSF-23 (PGPR-1)

7: Plant-Growth-Promoting Rhizobacteria strain WSF-24 + WSF-14 (PGPR-2)

MEASUREMENTS

The following measurements were taken every week:

» Turf quality was visually rated. Normalized Difference Vegetation Index (NDVI), Stress Index (SI), and Leaf Area Index (LAI) were evaluated using a multispectral radiometer (CropScan).

» Percent green canopy cover and Dark Green Color Index were measured and calculated using SigmaScan digital imaging analysis.

» Root cores were harvested throughout the study during the beginning of heat stress (June 29), at the height of heat stress (August 3), and at the end of summer (September 5).

» Cores were 30.48 cm deep and 2 cm in diameter, and four subsamples were collected from each plot on each sampling date.

» Cores were than stored in 4° C, before being hand washed and analyzed using WinRhizo root scanning software.

SIDEBAR

Acronym Guide

AVG: Aminoethoxyvinylglycine

LAI: Leaf Area Index

NDVI: Normalized Difference Vegetation Index

PGPR: Plant-Growth-Promoting Rhizobacteria

SI: Stress Index

SL: Strigolactone

SWE: Seaweed Extract

Enhancing Rooting and Resilience of *Poa annua* Putting Greens

RESULTS FOR TURF PERFORMANCE

The summer of 2023 had higher than average rainfall. Additionally, multispectral radiometer data collected in the first few weeks in June for NDVI, LAI, and SI were likely skewed to indicate higher stress due to air contamination from the Canadian wildfires.

Of the treatments, seaweed extracts had the greatest effect on maintaining *Poa* during the summer:

» Seaweed Extract 1 (SWE-1) had significantly higher turf quality on 6/15, 7/26, 8/9, and 9/6, while Seaweed Extract 2 (SWE-2) had higher turf quality on 7/31 and 9/6 *(Figure 1).*

» There were no significant differences in NDVI, LAI, or SI throughout the summer, but both SWE maintained relatively higher NDVI and LAI and lower stress levels (SI) beginning on 7/17, indicating healthier turf canopies.

» Both SWE-1 and SWE-2 had greater green canopy cover at different points throughout the summer; SWE-1 on 7/26 and 8/9, and SWE-2 towards the end of the summer on 8/9–8/14 and 9/1.

» Additionally, SWE-1 had significantly darker green turf indicated by DGCI on 7/26–7/31.

Ethylene Inhibitors showed mixed results, similar to 2022:

» Plant-growth-promoting Rhizobacteria treatments (PGPR-1 and PGPR-2) and AVG had little effect on turf quality, showing relative increases on 7/26. PGPR-1 also had relative increases towards the end of the summer 8/30–9/6, indicating faster recovery.

(continued on page 4)

FIGURE 1

Turf Quality as affected by seaweed extract treatments of *Poa* under summer heat stress. Least square means bars are displayed for dates to denote significant differences.

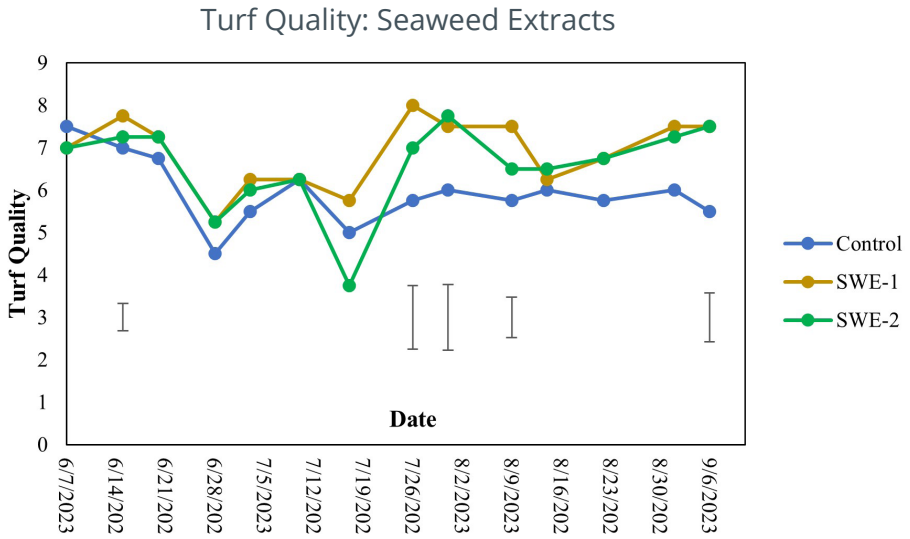
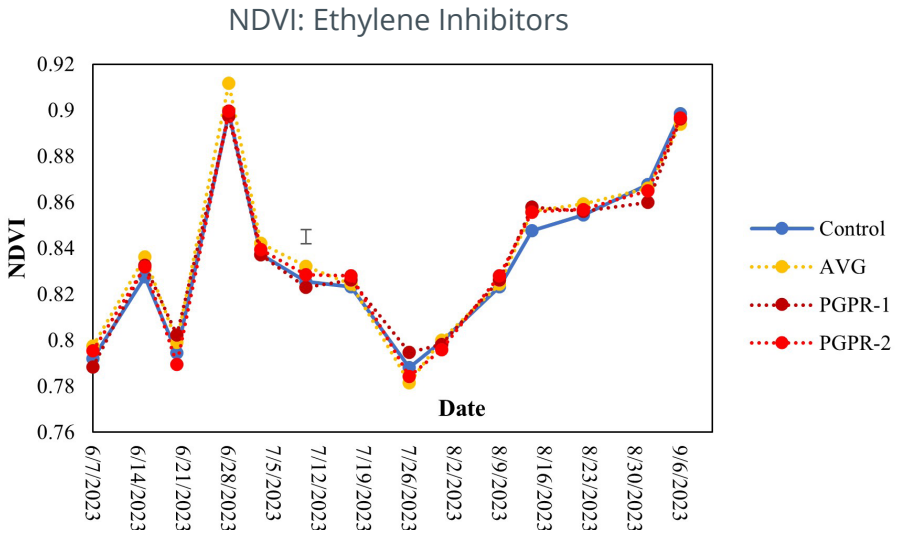


FIGURE 2

NDVI affected by ethylene inhibitor treatments of *Poa* under summer heat stress. Least square means bars are displayed for dates to denote significant differences.



Enhancing Rooting and Resilience of *Poa annua* Putting Greens

» AVG seemed to have an effect during early heat stress with significant increases in NDVI *(Figure 2)* and LAI seen on 7/12, but no effect on Stress Index.

Ethylene inhibitors had little effect on green canopy cover and DGCI.

Strigolactone (SL) had little effect on turf quality, NDVI, LAI, SI, and green canopy cover.

» However, plots treated with SL had relatively higher DGCI during early summer and a significant increase on 7/26.

RESULTS FOR ROOT ANALYSIS

Poa's shallow root system and high-thatch density resulted in significant variation within treatments:

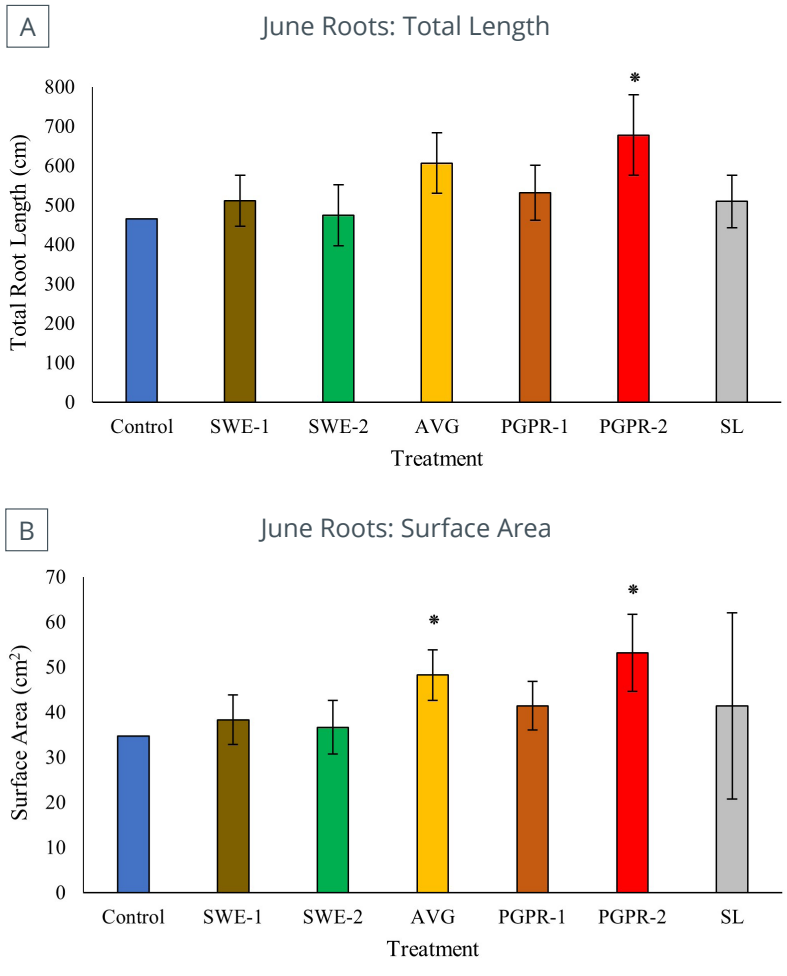
» Samples taken in late June showed early treatment effects.

» Of the treatments, the ethylene inhibitors had the greatest effect on root growth in June, where PGPR-2 had significantly greater root length *(Figure 3a)*, surface area *(Figure 3b)*, and relatively greater root depth.

» AVG also had relatively greater total root length and depth, as well as significantly greater surface area.

» By early August, treatments no longer had a significant impact on improving root characteristics. This is likely due to damage caused by prolonged heat stress.

» The only treatment showing any kind of relative improvements was SWE-2, which had relatively great length, surface area, and depth compared to the control *(Figures 4a and 4b)*.



FIGURES 3A & 3B

Root characteristics of *Poa* under heat stress taken on June 29 as affected by treatments. Significant differences are indicated by "*".

Enhancing Rooting and Resilience of *Poa annua* Putting Greens

» There was dense thatch in the root samples collected in September, where most of the shallow root systems were located, which may have masked treatment effects.

» Root length, surface area, and depth did not show significant treatment effects at this time.

FUTURE EXPECTATIONS

Both seaweed extract and PGPR treatments show the greatest potential in improving heat performance in *Poa*.

» Seaweed extracts have the greatest effect on performance throughout the summer, with the potential to promote root growth as seen for SWE-2 in August.

» The PGPRs had an initial impact on root growth that could have the added effect of improving *Poa* performance and recovery from summer stress.

» Further work will look toward investigating whether combining PGPRs and seaweed extracts would have a greater effect in promoting *Poa* summer performance.

For further information, you can reach Dr. Bingru Huang at huang@sebs.rutgers.edu or Sean McBride at spm196@sebs.rutgers.edu.

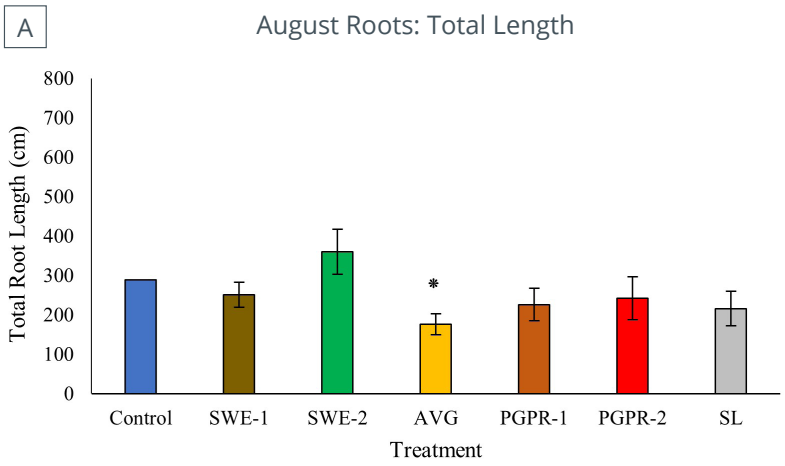
SIDEBAR

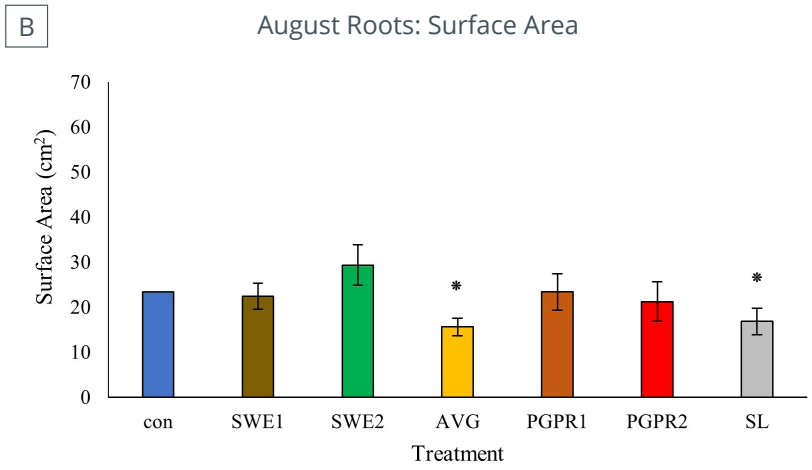
Quick Take on Trial Results

» Seaweed extract products had the greatest effect on promoting *Poa* performance throughout the summer.

» Plant-growth-promoting Rhizobacteria treatments had positive effects on *Poa* performance during the summer.

» Plant-growth-promoting Rhizobacteria also promoted root growth.





FIGURES 4A & 4B

Root characteristics of *Poa* under heat stress taken on August 3 as affected by treatments. Significant differences are indicated by "*".

Special Thanks to Our 2023 Contributors

We'd like to thank our contributors for their generous show of support to the Tri-State Turf Research Foundation. Your contributions go a long way toward helping the foundation continue its mission "to provide turfgrass research for better golf and a safer environment." We hope those of you on the list will continue to support the foundation's work. We also hope you will encourage more of your fellow turfgrass professionals to add their names to the growing list of contributors.

CLUB CONTRIBUTORS

ANGLEBROOK GOLF CLUB
Louis Quick, CGCS

ARCOLA COUNTRY CLUB
Paul Dotti

BALTUSROL GOLF CLUB
Shawn Haverdink

BEDFORD GOLF & TENNIS CLUB
Robert Nielsen, CGCS

BEEKMAN GOLF COURSE
Steve Spontak

BONNIE BRIAR COUNTRY CLUB
Nicholas Lerner

BRAE BURN COUNTRY CLUB
Blake Halderman, CGCS

BROOKLAKE COUNTRY CLUB
Scott Carpenter, CGCS

BROOKVILLE COUNTRY CLUB
Brandon Houghtaling

BURNING TREE COUNTRY CLUB
Stephen Wickstrom

CENTURY COUNTRY CLUB
Kevin Seibel, CGCS

CLINTON COUNTRY CLUB
Richard Negralle

COUNTRY CLUB OF FAIRFIELD
David Koziol

DUE PROCESS GOLF & STABLE
Anthony Hooks

ESSEX FELLS COUNTRY CLUB
Mark Miedler

FAIRMOUNT COUNTRY CLUB
Patrick Quinlan

FAIRVIEW COUNTRY CLUB
Jim Pavonetti, CGCS

FRESH MEADOW COUNTRY CLUB
Joseph Gardner Jr.

GARDEN CITY COUNTRY CLUB
Russell MacPhail

GLEN HEAD COUNTRY CLUB
Kenneth Lochridge

GLENARBOR GOLF CLUB
Joseph Gikis

GLEN OAKS CLUB, INC.
Craig Currier

GOLF CLUB OF PURCHASE
Aaron Crouse

HACKENSACK GOLF CLUB
Richard Lane, CGCS

HAWORTH COUNTRY CLUB
Timothy Garceau

HEMPSTEAD GOLF CLUB
Joe Tamborski, CGCS

HUDSON NATIONAL GOLF CLUB
Brett Scales

HUNTINGTON COUNTRY CLUB
Glenn Creutz

HUNTINGTON CRESCENT CLUB
Peter Cash

INNIS ARDEN GOLF CLUB
Neil Laufenberg

KNICKERBOCKER COUNTRY CLUB
Kyle Hillegrass

KNOLLWOOD COUNTRY CLUB
Scott Olson

LEEWOOD GOLF CLUB
Timothy Walker, CGCS

MAHOPAC GOLF & BEACH CLUB
Jon Ferrucio

MAIDSTONE CLUB
John Genovesi, CGCS

MEADOW BROOK CLUB
John Carlone, CGCS

MENDHAM GOLF & TENNIS CLUB
Christopher Boyle, CGCS

MILL POND GOLF CLUB
James Vogel

MILL RIVER CLUB
Steven Sweet

MOUNT KISCO COUNTRY CLUB
Andrew Agnew

MOUNTAIN RIDGE COUNTRY CLUB
Cliff Moore

NASSAU COUNTRY CLUB
Scott Blough

NATIONAL GOLF LINKS OF AMERICA
William Salinetti III, CGCS

NISSEQUOGUE GOLF CLUB
Jeffrey Hemphill, CGCS

NORTH HEMPSTEAD COUNTRY CLUB
Thomas Kaplun

NORTH HILLS COUNTRY CLUB
Timothy Benedict, CGCS

NOYAC GOLF CLUB
Brian Goleski

OLD OAKS COUNTRY CLUB
Jason Anderson

OLD WESTBURY GOLF & COUNTRY CLUB
Thomas McAvoy

PARAMOUNT COUNTRY CLUB
Matthew Kerens

PELHAM COUNTRY CLUB
Jeffrey Wentworth, CGCS

PINE VALLEY GOLF CLUB
Richard Christian, Jr., CGCS

PLAINFIELD COUNTRY CLUB
Travis Pauley

PREAKNESS VALLEY GOLF COURSE
Douglas Vogel

QUAKER RIDGE GOLF CLUB
Thomas Ashfield

QUOGUE FIELD CLUB
John Bradley

RAMSEY GOLF & COUNTRY CLUB
Jason Struss

REDDING COUNTRY CLUB
Brett Chapin

RIDGEWOOD COUNTRY CLUB
David Kerr, CGCS

ROCKAWAY HUNTING CLUB
Nicholas Brodziak

ROCKRIMMON COUNTRY CLUB
Anthony Girardi, CGCS

ROCKVILLE LINKS CLUB
Lucas Knutson

ROLLING HILLS COUNTRY CLUB
Glenn Perry, CGCS

ROUND HILL CLUB
Sean Foley

ROXITICUS GOLF CLUB
Justin Dorman

SANDS POINT GOLF CLUB
Pat Ryan

SEBONACK GOLF CLUB
Michael Keohan

SHINNECOCK HILLS CLUB
Jonathan Jennings, CGCS

SILVER LAKE GOLF CLUB
Douglas Johnstone

SILVER SPRING COUNTRY CLUB
William Cygan

SIWANOY COUNTRY CLUB
Steven McGlone

SLEEPY HOLLOW COUNTRY CLUB
Jonathan Heywood

SOMERSET HILLS COUNTRY CLUB
Ryan Tuxhorn

SOUTH FORK COUNTRY CLUB
Frank Bellucci IV

SOUTHWARD HO COUNTRY CLUB
Jim Stewart

SS OLD WESTBURY
Ben Parker

ST. ANDREW'S GOLF CLUB
Robert Milar

SUNNINGDALE COUNTRY CLUB
Sean Cain, CGCS

TAMARACK COUNTRY CLUB
Jeffrey Scott, CGCS

THE BRIDGE GOLF CLUB
Gregg Stanley, CGCS

THE CONNECTICUT GOLF CLUB
Vincent Taylor

THE COUNTRY CLUB OF FAIRFIELD
David Koziol

THE MILBROOK CLUB
Richard Duggan

THE PATTERSON CLUB
Jason Meersman

THE STANWICH CLUB
Scott Niven, CGCS

TOWN AND COUNTRY GOLF LINKS
Paul Geer

UPPER MONTCLAIR COUNTRY CLUB
Michael Brunelle, CGCS

WACCABUC COUNTRY CLUB
Patrick Hagan

WEE BURN COUNTRY CLUB
Doug Drugo

WESTCHESTER COUNTRY CLUB
David Dudones

WESTHAMPTON COUNTRY CLUB
Jay Glover

WHEATLEY HILLS GOLF CLUB
Bennett Orlowski III

WHIPPOORWILL CLUB
Paul Gonzalez, CGCS

WINGED FOOT GOLF CLUB
Stephen Rabideau, CGCS

WYKAGYL COUNTRY CLUB
Daniel Rogers

CORPORATE CONTRIBUTORS

BASF
Jared Luknicki

CARRIERE MATERIALS
William Carriere

DELEA SOD FARMS
Richard DeLea

DOUBLE 'D' TURF
Dennis DeSanctis Jr.

DOWNES TREE SERVICE
Kevin Downes

FISHER & SON
Michael Weber

GRASS ROOTS TURF PRODUCTS
Ryan Avery

HELENA AGRI ENTERPRISES
Tim Gerzabek

LABAR GOLF RENOVATONS
Richard LaBar Jr.

METRO TURF SPECIALISTS
Todd Apgar

OCEAN ORGANICS
Kevin Collins / Douglas Middleton

PINNACLE TURF
Steven Renzetti, CGCS

PLANT FOOD COMPANY

SYNGENTA
John Bresnahan

VALLEY GREEN
Greg Moran

PRESIDENT'S MESSAGE
(CONTINUED FROM COVER)

What Your Support Can Do for You!

» Rutgers' Dr. Albrecht Koppenhöfer is looking to wrap up his second and final year of research as he examines how well silicon fertilizer performed in keeping ABW populations below damage thresholds in annual bluegrass and creeping bentgrass stands.

» Dr. Frank Rossi of Cornell will begin a two-year study to investigate the influence of golf footwear on putting surface characteristics in the Tri-State area.

» Rutgers' Dr. Matt Elmore and Dr. James Murphy will integrate phosphorous and pH management with PGRs to better understand ABG and creeping bentgrass population dynamics over the next two years.

For those seeking advice on resolving a particular turf issue our research has addressed in the past, you will find what you're looking for on the Tri-State website, www.tristateturf.org, which houses archived research articles addressing such turf problems as anthracnose, dollar spot, summer patch, fertilizer usage, additional ABW studies, and more.

FINAL THOUGHTS

As I assume the reigns as Tri-State Turf Research Foundation president, I'd like to thank now Past President Tim Walker of Leewood Golf Club for his years of dedicated service to the board. I am pleased to work alongside Tim in his role as past president.

I am equally pleased to accept the challenge of furthering the foundation's many efforts and endeavors, and, ultimately, supplying each of you with the most up-to-date tools of the trade. Thank you all for your support. Wishing you all a successful and safe season ahead!

Rich Duggan
President
Tri-State Turf Research Foundation

Rutgers Researchers Put Silicon to the Test in ABW Management

Most of us know well that the annual bluegrass weevil (ABW) is one of the most devastating and difficult-to-manage turfgrass insects in short-mown annual bluegrass (*Poa annua)* and creeping bentgrass (CBG) across the eastern U.S. and southeastern Canada. Making matters worse is the ABW's ability to develop resistance to most available insecticides.

In preliminary research, Rutgers' Dr. Albrecht Koppenhöfer and his research team observed the positive effects of silicon (Si) fertilization in repelling insect herbivores. No previous studies, however, had investigated its impact on the survival, development, and performance of the ABW.

With silicon showing promise as a reliable and environmentally friendly solution to ABW, the Tri-State Turf Research Foundation granted Dr. Koppenhöfer funding for a two-year study on how Si fertilization of *Poa annua* and CBG affects ABW and impacts plant tolerance to ABW herbivory.

In year one of the study, the Rutgers team conducted both greenhouse and field studies that confirmed that silicon accumulation in plants, specifically in grasses, is, in fact, a potent defense against ABW. Plant roots take up Si from the soil solution which causes tissues to become abrasive and tougher and reduces the digestibility and palatability of tissues to ABW and other insect herbivores. This, in turn, enhances plant resistance to these insects.

Among their findings is that ABW populations were significantly higher in *Poa annua* than in CBG plots but were not significantly affected by Si fertilization. The researchers have conducted another greenhouse experiment using the same fertilization rates used in the first field experiment. Based on the results, they have selected fertilization rates for the second field experiment, which is underway now. If the stronger negative effects of Si against ABW on CBG can be confirmed, it could help CBG to outgrow *Poa annua* in mixed stands. Given that *Poa annua* is often considered a problematic weed in CBG fairways, Si fertilization could potentially help turn ABW into a biological weed control agent.

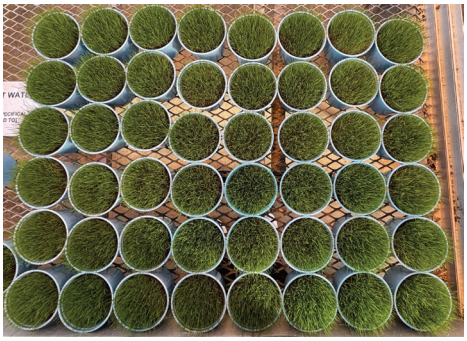


FIGURE 1
Greenhouse experiment pots with grass.

OBJECTIVE

The objective of this study is to determine if the application of silicon induces resistance to ABW by reducing egg-laying and larval development and survival in *Poa annua* and creeping bentgrass.

METHODOLOGY

GREENHOUSE EXPERIMENTS

In the greenhouse, CBG (cv. 007) and wildtype *Poa annua* were grown for at least 2 months in pots before Si fertilization *(Figure 1)*.

Si was provided in two forms:

» Wollastonite (Vansil® W-10; Vanderbilt Mineral LLC), which is calcium silicate powder containing 24% Si

» AB Yellow (ReXil Agro BV), a liquid fertilizer based on stabilized, bioavailable silicic acid (2.5%) and a mixture of micronutrients

Treatments in all greenhouse experiments consisted of:

1: Control (lime)

2: Wollastonite at label rate (1,221 kg/ha) once at 7 days before adult release

3: Wollastonite at 1.5x label rate once at 7 days before adult release

4: Silicic acid foliar spray at 0.8 L/ha at 7 days before adult release followed by 1 L/ha a week later

» To test the effect of Si on ABW oviposition, cores of greenhouse-grown grass were fitted into 120-ml plastic vials.

» Seven days after the Si application, 2 male and 2 female ABWs were released per vial for 1 week to allow for egg-laying.

» The plugs were then examined under a dissecting microscope to determine the number of eggs deposited.

» To determine larval development and survival after Si treatment application, ABW adults (4 males and 4 females per container) were caged in containers with the treated grass for 1 week.

» After another 4 weeks, the number of ABW larvae per cup and their stages were determined by standard saltwater extraction and examination under a dissecting microscope.

» Greenhouse experiments were conducted twice.

THE FIELD EXPERIMENT

The Field Experiment was performed at Rutgers Horticultural Farm No. 2 with a mix of *Poa annua* and CBG maintained as a fairway and naturally infested with ABW.

Rutgers Researchers Put Silicon to the Test in ABW Management

FIGURE 2
Turf cores implanted in the field.

» Plots consisted of 30.5 x 30.5 cm turf areas separated from each other by 30.5 cm.

» Into each plot, 4 cores (10.8 cm diam. x 2.5 cm depth) of *Poa annua* or CBG (cv Luminary) were implanted in early April *(Figure 2)*.

» Plots were treated with lime (control), and 1x (1,221 kg/ha), 2x, and 4x of the wollastonite label rate.

» For evaluation, one core per replicate was extracted in mid-May, late May, and mid-June. ABW stages were saltwater-extracted from the cores and counted, and developmental stages were determined under a dissecting microscope. Grasses were further allowed to grow for another 10 days to get soil-free grass clippings for Si analysis.

RESULTS

IN THE GREENHOUSE…

» Si fertilization had a stronger suppressive effect on ABW biology in CBG than in *Poa annua*.

» In *Poa annua*, Si fertilization reduced egg-laying by 12–37% *(Figure 3a)* and the number of larvae developing by 0–35% *(Figure 3b)*; developmental speed was unaffected.

» In CBG, Si fertilization reduced egg-laying by 22–37% and larval numbers by 68–85%, and it slowed larval development *(Figures 3a and 3b)*.

IN THE FIELD…

» Si supplementation increased Si concentrations in the grass clippings regardless of grass species.

» Si concentration rose from 0.37-0.47% in control plots to 1.54–2.48% in wollastonite-treated plots *(Figure 4a)*.

» ABW populations were significantly higher in *Poa annua* than in CBG plots but were not significantly affected by Si fertilization *(Figure 4b)*.

(continued on page 12)

FIGURE 3
Effects of different Si treatments on **(a)** ABW oviposition and **(b)** larval density under greenhouse conditions. Dashed lines represent mean values. Treatment means were compared using one-way ANOVAs. Asterisks indicate the level of statistical significance (*p < 0.05, ***p < 0.001) at 95% confidence intervals. Creeping bentgrass (CBG), annual bluegrass *(Poa annua)*.

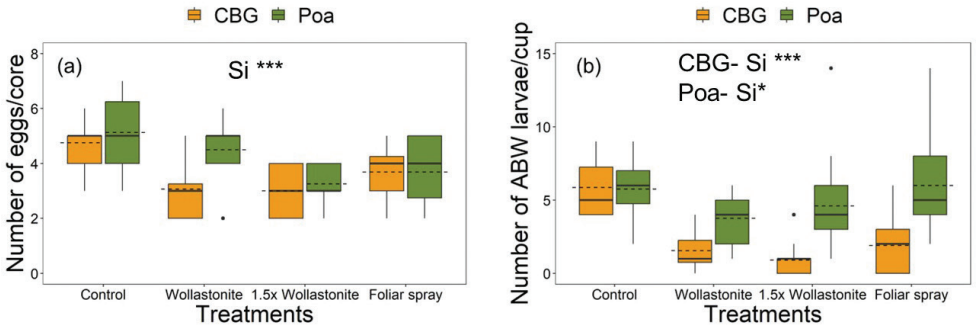
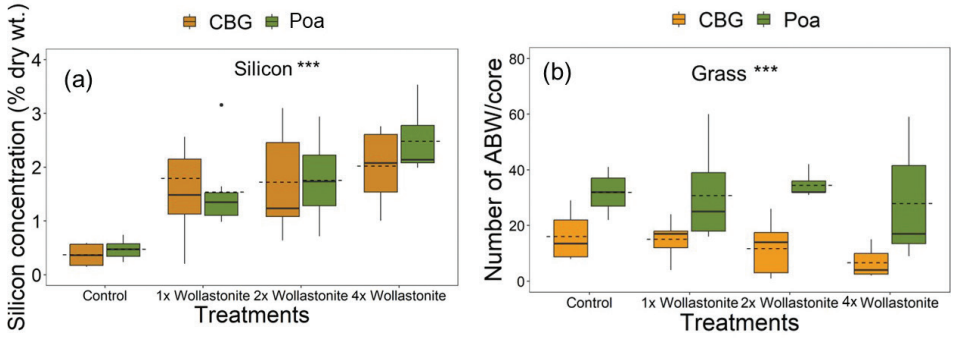


FIGURE 4
(a) Total Si concentrations (% dry weight) in grass clippings and **(b)** effects of different Si treatments on ABW population density under field conditions. Dashed lines represent mean values. Treatment means were compared using two-way ANOVAs. Asterisks indicate the level of statistical significance (***p < 0.001) at 95% confidence intervals. Creeping bentgrass (CBG), annual bluegrass *(Poa annua)*.



Seeking a Tried-and-True Formula for Managing *Poa* and Creeping Bentgrass on Golf Course Putting Greens

Rutgers' Researchers Integrate Phosphorus and pH Management With Plant Growth Regulation to Better Understand Annual Bluegrass and Creeping Bentgrass Population Dynamics

Attempting to manage annual bluegrass and creeping bentgrass populations on putting greens is an age-old battle for golf course superintendents. While plant growth regulators (e.g., paclobutrazol and trinexapac-ethyl) are well understood for annual bluegrass suppression or promotion, many aspects of fertility management are not. For example, the concept of soil acidification and withholding phosphorus (P) to reduce annual bluegrass was first explored almost 100 years ago, and more recently by others. But research on the topic has not advanced to produce actionable pH or P guidelines for turfgrass managers to promote or suppress annual bluegrass mixed with creeping bentgrass.

A better understanding of the influence of these factors on competitiveness of these two species would be highly useful for superintendents who desire primarily bentgrass, as well as those who prefer annual bluegrass. Recognizing the value of helping turfgrass managers find a reliable and environmentally sound solution to managing annual bluegrass and creeping bentgrass populations on their putting greens, the Tri-State Turf Research Foundation has granted Rutgers researchers Dr. Matthew Elmore and Dr. James Murphy funding in 2024 for a two-year study.

More specifically the researchers will evaluate a combination of low- and adequate-rootzone phosphorus, acidic and neutral rootzone pH, and the plant growth regulators, paclobutrazol and trinexapac-ethyl, for annual bluegrass suppression or promotion on putting greens.

EXPECTED OUTCOME

Drs. Elmore and Murphy hypothesize that an acidic rootzone (pH ~5.5) combined with relatively low rootzone phosphorus (6 to 10 ppm) will promote creeping bentgrass encroachment into annual bluegrass, a promotion that will be enhanced by paclobutrazol more than trinexapac-ethyl.

Recent greenhouse trials found creeping bentgrass four times more competitive than annual bluegrass when Mehlich-3 phosphorus was 4 to 6 ppm in an acidic (pH ~5.5) sand, whereas the two species were equally competitive at pH 6.5 and >9 ppm P. The proposed experiment will explore this concept in the field and is the first in what the researchers expect will develop into a multi-experiment effort to better understand the influence of nutrient management integrated with plant growth regulators on annual bluegrass and creeping bentgrass population dynamics in golf course putting greens.

OBJECTIVE

The objective of this study is to determine best practices for soil pH, phosphorus, and PGR management specific to the species desired, whether it's annual bluegrass or creeping bentgrass.

METHODOLOGY

This experiment will be a complete three-way factorial of pH (acidic and neutral), phosphorus (low and adequate), and plant growth regulator (paclobutrazol or trinexapac-ethyl).

The 2024 growing season will attempt to bring the pH and phosphorus treatments into target ranges required to initiate the experiment and rootzone sampling from all 32 plots in May and October to determine pH and nutrient concentrations.

» The *acidic and neutral pH treatments* will be managed to a target pH of 5.2 to 5.5 and 6.5 to 7.0, respectively.

» The *low phosphorus treatment* target will be 6 to 10 ppm mat layer Mehlich-3 phosphorus unless deficiency symptoms are observed.

» The *high phosphorus treatment* target will be 30 to 40 ppm, typical of most putting green rootzones.

In September or October 2024, mature "Oakley" creeping bentgrass plugs (2□ in diameter) will be installed on 1□ centers in each plot, for a total of 20 plugs per plot and 1% of the total plot area.

» *PGR treatments* (paclobutrazol or trinexapac-ethyl) will be initiated on respective plots in 2025 and continued through 2026.

- The *trinexapac-ethyl* program will consist of Primo Maxx® applied at 0.125 oz/1000 ft^2 every 200 growing degree-days following the spring seedhead suppression program until June 1, then weekly through mid-September, and then every 200 GDD until November.

- The *paclobutrazol* program will consist of Trimmit® applied at 0.18 oz/1000 ft^2 every 300 GDD following the spring seedhead suppression program until June 1, then bi-weekly at 0.25 oz/1000 ft^2 through mid-September, and then every 300 GDD at 0.18 oz/1000 ft^2 until November.

» Creeping bentgrass encroachment into the annual bluegrass will be measured during 2025 and 2026 using quantitative and visual estimates.

THE FIELD TEST SITE

The site is a more than 10-year-old annual bluegrass putting green grown on a sand-topdressed mat layer (3 inches deep) overlaying a Nixon sandy loam soil at Rutgers Horticultural Farm No. 2.

» The annual bluegrass is characteristic of *Poa annua* var. *reptans* (perennial, creeping biotype).

» The site is mowed 6 days per week at 0.110-inch and rolled two to three times weekly.

(continued on page 12)

Investigating the Influence of Golf Footwear on Putting Surface Characteristics

Though metal spikes have long been taken out of play, some golf course superintendents feel that newer golf cleat and sole designs are equally, if not more, aggressive on their courses' putting surfaces. To end any debate, the Tri-State Turf Research Foundation has agreed to offer Cornell's Dr. Frank Rossi two years of funding to investigate the influence of the latest in golf footwear on various putting surface types, managed to various standards throughout Met area golf courses. Dr. Rossi will run trials on bentgrass *(Agros's spp.), Poa annua (Poa annua L.),* and a combination of both, using the USGA GS3 surface measurement device.

OBJECTIVES

The objectives of this study are to:

1: Assess the impact of different types of golf footwear on putting surface characteristics, including firmness, ball roll distance, smoothness, and trueness.

2: Evaluate how the latest golf footwear affects the various putting surface types and management programs in the Met area.

METHODOLOGY

1: Experimental Design

» Establish baseline test plots in Ithaca, NY, with bentgrass only, *Poa annua* only, and a mixed surface.

» Identify10 golf courses in the Met area that offer a wide range of putting surface types and management programs.

» Collect baseline data from each of the 10 courses on the soil's physical and chemical properties, as well as soil moisture at time of testing.

2: Surface Measurements

» Utilize the USGA GS3 to collect data on firmness, ball roll distance, smoothness, and trueness, with and without traffic.

» Conduct measurements on a range of golf footwear with different traction elements.

3: Data Analysis

» Employ statistical methods to analyze the impact of golf footwear on putting surface characteristics.

» Assess the interaction effects between different putting surface types and golf footwear.

EXPECTED OUTCOMES

1: Insight Into Footwear Impact

Provide golf course superintendents with valuable insight into how different golf footwear affects putting surface characteristics.

2: Turfgrass Management Recommendations

Develop recommendations for turfgrass management practices based on the study's findings, enhancing golf course playability.

3: Educational Outreach

Disseminate results through industry publications, workshops, and webinars to educate golf course professionals on optimizing putting surface conditions.

CONCLUSION

Dr. Rossi and his team expect that this research project will offer essential knowledge to the turfgrass management community, informing superintendents about the impact of golf footwear on putting surface characteristics. The outcomes will aid in the development of evidence-based practices, improving golf course playability and golfer satisfaction.

Be sure to catch the next issue of *Foundation News* as Dr. Rossi and his team bring you up-to-date on their findings.

For further information, you can reach Dr. Frank Rossi at fsr3@cornell.edu.

RESEARCH UPDATE
(CONTINUED FROM PAGE 9)

Rutgers Researchers Put Silicon to the Test in ABW Management

OUTLOOK

Dr. Koppenhöfer and his team are planning to conduct another greenhouse experiment using the same wollastonite rates used in the first field experiment. Based on the results, they will select wollastonite rates for the second field experiment throughout the spring.

» Turf cores for the second field experiment were implanted in October 2023 to allow grasses to be better established than in the first experiment.

» The researchers' observations so far suggest that Si fertilization has a more negative effect on ABW performance and biology on CBG than on *Poa annua*. It seems to confirm, then, that Si fertilization enhances CBG resistance to ABW and could assist CBG in outgrowing *Poa annua* in mixed CBG-Poa annua fairways.

■

For further information, you can reach Dr. Albrecht Koppenhöfer at a.koppenhofer@rutgers.edu.

NEW RESEARCH
(CONTINUED FROM PAGE 10)

Seeking a Tried-and-True Formula for Managing *Poa* and Creeping Bentgrass on Golf Course Putting Greens

FIGURE 1
Applying calcitic limestone to neutral pH plots and gypsum to acidic pH plots on October 23, 2023.

» Nitrogen fertilizer is applied every 2 weeks for a target annual total of 2 to 3 lb/1000-ft^2.

» Fungicides are applied preventively to stave off diseases of annual bluegrass and creeping bentgrass.

» A trinexapac-ethyl + ethephon program is used to suppress annual bluegrass seedhead production.

» To begin the process of rootzone acidification, ammonium sulfate was used as the sole source of nitrogen on the site in 2023 and lime 72 lb/1000-ft^2 was applied to the neutral pH plots in October 2023 *(Figure 1)*.

Watch for the outcomes of year one of the Rutgers research team's trials in the next issue of *Foundation News*.

■

For further information, you can reach Dr. Matthew Elmore at matthew.elmore@rutgers.edu.

FOUNDATION NEWS is published by the Tri-State Turf Research Foundation
49 Knollwood Road, Elmsford, NY 10523-2819
TEL: 914-347-4653 FAX: 914-347-3437