FOUNDATION NEWS

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PRESIDENT'S MESSAGE

Rich Duggan, President of Tri-State Turf Research Foundation

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The Tri-State Turf Research Foundation's Ongoing Commitment to Keeping Our Courses Alive and Well

As we enter another golf season, there's a lot of activity happening both within and outside the golf industry—locally and nationally. While the ultimate outcomes of these changes are uncertain, one thing remains clear: We all share a professional responsibility to continually improve our profession and the golf courses we care for. This can be achieved through best management practices, ongoing education, supporting research, fostering strong association partnerships, and clear communication.

TRI-STATE'S COMMITMENT TO COMMUNICATION

The Tri-State Turf Research Foundation continues to uphold its mission of "Building better golf and a safer environment through turfgrass research." As we look ahead, we are committed to improving how we serve the tri-state area and to strengthening our partnerships with the six allied associations: CAGCS, GCSANJ, HVGCSA, LIGCSA, MetGCSA, and MGA. In this ever-evolving landscape, effective communication is essential. It's important that we understand how the Tri-State can best serve superintendents and their golf courses and that, moving forward, we connect with those beginning their careers.

With enhanced communication in mind, we are excited to announce upcoming improvements to the Tri-State website (www.tristateturf.org), as well as a greater presence on social media platforms. These changes will help us communicate research, share professional news, and keep our contributors informed about Tri-State Turf Research Foundation activities.

GRATITUDE FOR YOUR CONTINUED SUPPORT

Thank you to the many club and corporate contributors who generously contributed in 2024. If you have already made your $300 contribution for 2025, we deeply appreciate your support. If you have not yet donated, please visit www.tristateturf.org or contact our office at 914-347-4653. You'll also receive an annual contribution letter soon. A simple $300 donation—along with spreading the word to colleagues—helps support our foundation's research initiatives. The Tri-State is a valuable resource for information on disease management, turf health, and many other turf-related challenges, thanks to the research we've funded over the years.

(continued on back cover)

TRI STATE
TURF RESEARCH FOUNDATION

Rutgers Researchers Close in on Viable Solution to ABW Chemical Resistance

As turfgrass managers know all too well, the annual bluegrass weevil (ABW) is one of the most destructive pests of short-mown annual bluegrass *(Poa annua)* and creeping bentgrass (CBG) throughout the eastern U.S. and southeastern Canada. Making the battle to control this pest all the more challenging is its resistance to most available insecticides.

Recognizing the dire need for an effective, sustainable alternative to chemical ABW treatments, Rutgers' Dr. Albrecht Koppenhöfer and his research team focused their efforts on the effects of Silicon (Si) fertilization on ABW management, a mineral that had shown promise in Dr. Koppenhöfer's preliminary research.

With a two-year grant from the Tri-State Turf Research Foundation, the researchers have made great strides in uncovering the efficacy of Silicon in ABW control. They have discovered that Si fertilization, either in the soil or as a topical application, can enhance plant resistance to herbivorous insect pests like the ABW. Si is readily absorbed by plants from the soil, and when transported to their leaves and stems, it forms a kind of shield that impairs the insects' ability to chew and digest leaf tissues, which ultimately impedes their ability to grow and survive. This, in turn, enhances plant resistance to these insects.

Overall, Dr. Koppenhöfer and his team have observed that Si fertilization consistently enhances the resistance of both *Poa annua* and CBG to ABW, with slightly stronger effects in creeping bentgrass than in annual bluegrass, potentially supporting creeping bentgrass to outgrow annual bluegrass in mixed turf 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
Top view of experimental pots in the greenhouse.

The researchers have continued their greenhouse and field tests to determine just how effective Silicon is in reducing egg-laying and larval development and survival in *Poa annua* and creeping bentgrass.

METHODOLOGY

GREENHOUSE EXPERIMENTS ~ YEAR 2

In the greenhouse, wildtype annual bluegrass and creeping bentgrass (cv. 007) were grown in pots for at least two months following Si fertilization and before ABW exposure *(Figure 1)*.

Treatments included:

1: An untreated control (lime).

2: Wollastonite at the label rate (1× = 1,221 kg/ha), twice the label rate (2×), and four times the label rate (4×). Based on Year 1 greenhouse results, the Year 2 protocol called for applying Si with only Wollastonite (Vansil® W-10; Vanderbilt Mineral LLC), a calcium silicate powder containing 24% Si, at three rates.

» Eight weeks after Si application, two male and two female ABWs were released per pot to facilitate egg-laying.

» Adults were removed after one week, and in another four weeks, larvae were extracted from the pots using the saltwater extraction method.

» Larval developmental stages were determined under a dissecting microscope.

» Si concentrations in leaves from insect-free grasses were also measured.

The greenhouse experiment was conducted twice.

THE FIELD EXPERIMENT ~ YEAR 2

The field experiment conducted in Year 1 was repeated in Year 2 at Rutgers Horticultural Farm No. 2, using a mixed stand of *Poa annua* and creeping bentgrass (cv. Luminary) maintained as a fairway and naturally infested with ABW.

» Experimental plots comprised 30.5 × 30.5 cm turf areas, separated by 30.5 cm buffer zones.

» In early October 2023, four turf cores (10.8 cm diameter × 2.5 cm depth) of *Poa annua* or creeping bentgrass were implanted into each plot.

» Plots received one of four treatments: lime (control) or wollastonite applied at 1×, 2×, or 4× rates.

» For evaluation, one core per plot was extracted in early, mid-, and late May.

» ABW stages were extracted by submerging soil cores in a warm salt solution and then counted and identified to developmental stages under a dissecting microscope.

» Grasses were then allowed to grow for an additional 15 days without mowing to obtain soil-free clippings for Si analysis.

Rutgers Researchers Close in on Viable Solution to ABW Chemical Resistance

FIGURE 2
Extraction of ABW stages in warm salt solution.

RESULTS

YEAR 2 IN THE GREENHOUSE...

Again, in Year 2, Si fertilization was effective in suppressing ABW population growth in the greenhouse experiments.

» Wollastonite applications at 1×, 2×, and 4× rates reduced larval populations by 46-50%, 50-56%, and 72-73% in *Poa annua* and by 45-54%, 73-77%, and 91-92% in CBG, respectively, across experimental trials *(Figure 3)*.

» *Poa annua* supported higher ABW population growth than creeping bentgrass.

YEAR 2 IN THE FIELD...

In the field, the suppressive effects of Si on ABW performance were less consistent across evaluations.

» Discernible reductions in ABW population were observed only at the higher wollastonite rates (2× and 4×). Wollastonite, at the highest rate, reduced ABW populations by up to 49% in *Poa annua* and 85% in CBG *(Figure 4a)*, although the effects varied across evaluations.

» Si fertilization increased leaf Si concentrations in both turfgrass species, with CBG accumulating more Si than *Poa annua* at 1× and 2× wollastonite rates.

» Specifically, 1×, 2×, and 4× rates increased leaf Si concentrations by 88%, 141%, and 276% in *Poa annua* and by 102%, 158%, and 176% in CBG, respectively, relative to the untreated control *(Figure 4b)*.

Overall, our two-year observations suggest that Si fertilization consistently enhances the resistance of both turfgrass species to ABW, with slightly stronger effects in CBG than *Poa annua*. Given that *Poa annua* is a preferred host of ABW, Si fertilization could further reduce ABW preference for CBG, potentially supporting creeping bentgrass to outgrow *Poa annua* in mixed turf stands.

OUTLOOK

Dr. Koppenhöfer and his team have started to look at the effect of silicon fertilization on other turfgrass pests and the interaction between silicon fertilization and biological control of these pests.

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

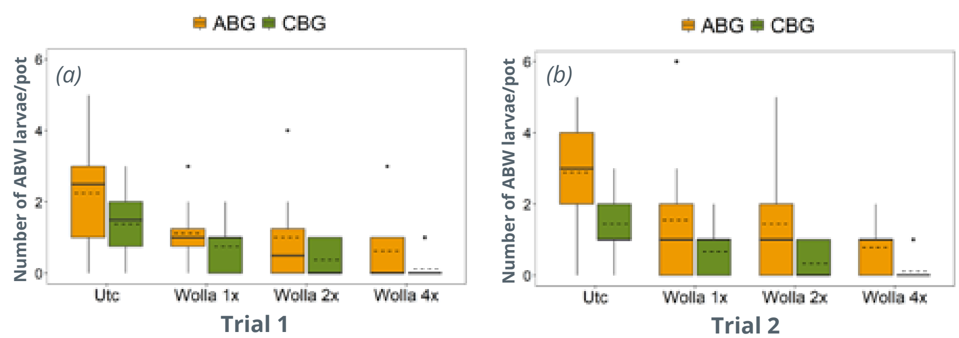

FIGURE 3
Boxplots showing ABW larval counts per pot in greenhouse experiments: *(a)* Trial 1 and *(b)* Trial 2. Treatments included an untreated control (Utc) and wollastonite applied at 1×, 2×, and 4× the label rate. Dashed lines represent the mean values and dots indicate outliers. Annual bluegrass (ABG), Creeping bentgrass (CBG).

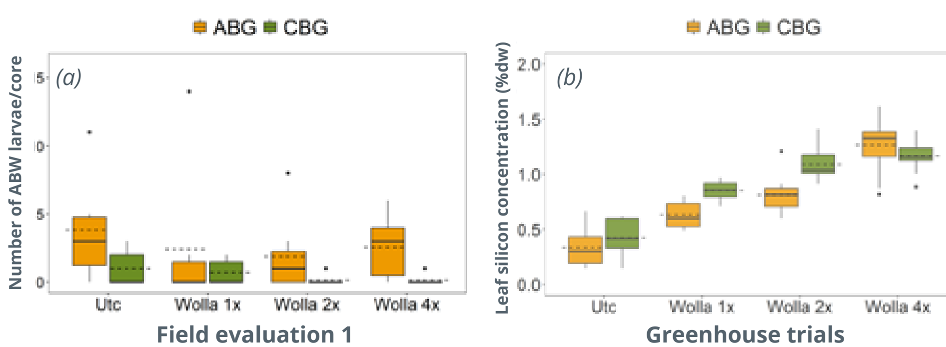

FIGURE 4
(a) Boxplots showing ABW larval counts per core from the first field evaluation in year 2 and *(b)* leaf Si concentration (% dry weight) in grasses grown in the greenhouse. Treatments included an untreated control (Utc) and wollastonite applied at 1×, 2×, and 4× of label rate. Dashed lines represent the mean values, and dots indicate outliers. Annual bluegrass (ABG), Creeping bentgrass (CBG).

Putting Cultural and Chemical Management Practices to the Test in *Poa* and Creeping Bentgrass Management

Researchers have long had their eye on refining ways to help turfgrass managers cultivate healthy populations of either annual bluegrass or creeping bentgrass on their putting greens. With a two-year grant from the Tri-State Turf Research Foundation, Rutgers' Dr. Matthew Elmore and Dr. James Murphy are working to evaluate a combination of cultural (phosphorus and pH), chemical (paclobutrazol), and variety (Penncross vs. Oakley) factors to understand annual bluegrass and creeping bentgrass population dynamics.

In preliminary research, Rutgers' Dr. Albrecht Koppenhöfer and his research team observed the positive effects of silicon (Si) fertilization in repelling insect herbivores. *(See page 2.)* No previous studies, however, had investigated its impact on the survival, development, and performance of the ABW.

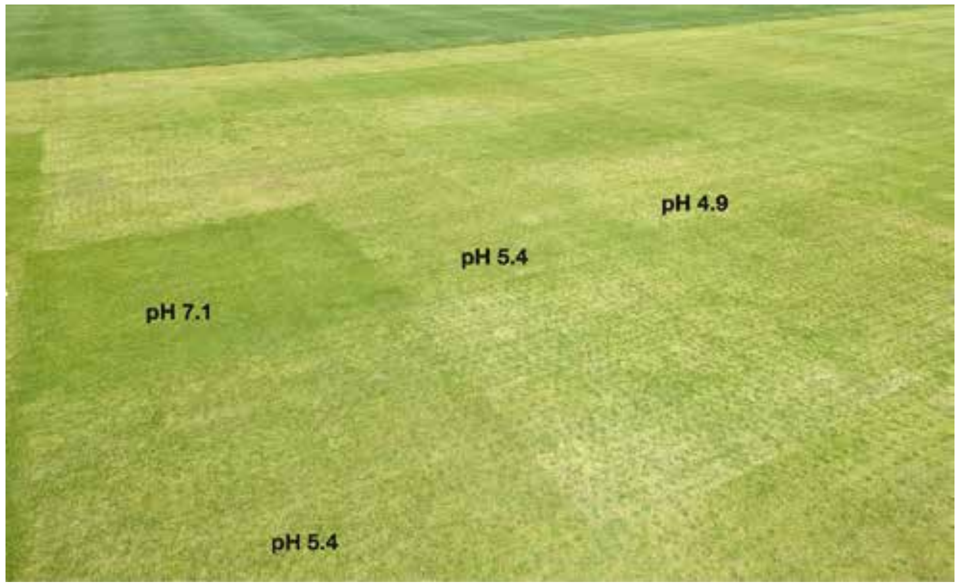

FIGURE 1

Visible differences in turfgrass color on September 4, 2024 for *Project 2*. Select plots are labeled with the mat layer pH according to June 2024 sampling.

Project 1 will explore the combined impact of low or neutral pH, low or adequate rootzone phosphorus, and two different plant growth regulators. Project 2 will explore encroachment of an old bentgrass cultivar (Penncross) compared to a new one (Oakley) in an annual bluegrass putting green along a rootzone pH gradient (~5.0 to 7.0).

They hypothesize that a strongly acidic rootzone (pH < 5.5) combined with relatively low rootzone phosphorus (6 to 10 ppm) will promote creeping bentgrass encroachment into annual bluegrass, while a more neutral (~6.5) pH will promote annual bluegrass.

OBJECTIVE

The primary objective for 2024 was to adjust the phosphorus and pH levels on an annual bluegrass putting green. In 2025, the researchers will install bentgrass into the putting green to measure how bentgrass encroachment is affected by the various management factors.

METHODOLOGY

SITE MANAGEMENT

» The site is a 15-year-old annual bluegrass green mown at 0.110" and rolled 3 times per week. Irrigation was monitored daily during the summer, typically with overhead irrigation to 60% of ET and hand-watering where needed to maintain VWC at 20 to 25% in mid-summer.

» Nitrogen was applied by spoonfeeding ammonium sulfate to acidify the rootzone. To counteract the ammonium sulfate and raise the pH for certain treatments, lime was applied as described under Amendments. Fungicides were applied preventively, and trinexapac-ethyl was applied weekly during the growing season.

» The site for *Projects 1* and *2* was core-cultivated on September 17, 2024, using 0.5"-diameter tines on a 2" x 2" spacing. The site for *Project 1* was core cultivated again on October 17, 2024, using 0.5" diameter tines on a 2" x 3" spacing to accelerate phosphorus removal.

AMENDMENTS

In Project 1…

» Lime (75 lbs/1000 ft^2) was applied to the neutral pH plots on June 13 and November 8, 2024.

» Gypsum (19 lbs/1000 ft^2) was applied to the acidic pH plots on June 13, August 7, and November 8, 2024 to supply calcium without affecting pH *(Figure 1)*.

In Project 2…

» Lime was applied at 2, 5, 14, 43, and 130 lbs/1000 ft^2 on November 8, 2024 to adjust pH.

» Gypsum was applied to both gypsum treatments at 19 lbs/1000 ft^2 on August 29

Putting Cultural and Chemical Management Practices to the Test in *Poa* and Creeping Bentgrass Management

FIGURE 2
Amendments being applied for *Project 2* on November 8, 2024.

and November 8, 2024 to supply calcium without affecting pH *(Figure 2)*.

DATA COLLECTION

Sampling of the mat layer (layer of sand and organic matter) took place before amendments were applied in May and November 2024.

» Six samples were taken from each plot using a 0.7 diameter probe, and combined to create one composite sample per plot.

» The samples were then sent to the Rutgers Soil Testing Lab for analysis of pH and nutrients (Mehlich III extractant). Results were used to measure progress of pH adjustment and guide amendment rates.

» Turfgrass quality was visually rated on a scale from 1 (poor) to 9 (excellent). The ratings were based on factors like turf density, texture, smoothness, and uniformity, more so than color.

» The data were subjected to statistical analysis.

RESULTS

PROJECT 1

Amendments affected mat layer's pH for both sampling periods (May and November) *(Table 1)*.

» This means that using ammonium sulfate to lower the pH and lime to raise the pH had the intended effect: The plots treated with ammonium sulfate had a lower pH (more acidic), while those treated with lime had a higher pH (more neutral).

» Turfgrass quality was also affected by pH. The acidic plots (pH 6.2) had lower quality compared to neutral plots (pH 7.3) when evaluated on September 15.

» The site was monitored daily over the summer, ruling out factors like drought or disease as causes for lower turfgrass quality. The poor quality in acidic plots was more likely due to long-term stress from low mat layer pH.

» The pH treatment also affected the amount of calcium (Mehlich III) in the mat layer. Plots with the soil amendment gypsum, which is highly water soluble, had less calcium compared to those treated with lime *(Table 1)*. However, the calcium levels were within the moderate range of 375 to 750 ppm, so they and were not agronomically meaningful.

» No phosphorus was applied to the plots, but phosphorus levels in the mat layer increased from 38 ppm to 47 ppm between May and November 2024. This was unexpected, since no phosphorus had been applied to the site since May 2023.

(continued on page 6)

	May 2024		November 2024	
pH Treatment	pH	Calcium (ppm)	pH	Calcium (ppm)
Acidic	5.7	426	5.3	624
Neutral	6.2	487	6.3	772
P-value	< 0.001	< 0.001	< 0.001	<0.001

TABLE 1
Mat layer pH and calcium as affected by pH treatment for *Project 1*. Means (n=16) are pooled across phosphorus and PGR treatment since those treatments will be initiated in 2025. Note: 375 to 750 ppm of Ca is considered a moderate level for the Mehlich III extractant.

Putting Cultural and Chemical Management Practices to the Test in *Poa* and Creeping Bentgrass Management

SIDEBAR

Trial Results Quick Take

» The mat layer pH has been adjusted from 6.0 - 6.3 to a mean of 5.3 in acidic plots and 6.3 in neutral pH plots (since November 2024). The acidic treatments are exhibiting poorer turfgrass quality in summer.

» A range of pH levels from 4.8 to 7.0 has been established for Project 2. Large differences in turfgrass quality across the pH gradient are evident.

» The phosphorus depletion target for Project 1 has not been achieved despite phosphorus not being applied in over 2 years. Mat layer P averaged 47 ppm (Mehlich III) across the site in November 2024, an increase from 38 ppm in May 2024.

» Two types of creeping bentgrass, Penncross and Oakley, were established in 2024 for transplant in 2025.

» This research will continue until 2027 with additional support from the USGA Davis program.

» The researchers are investigating possible sources of this phosphorus. One possibility is that small particles of phosphorus-rich soil from the native sandy loam underlying the mat layer were dislodged during soil core cultivation, brought to the surface, and reintegrated into the turf. This could explain the increase in phosphorus from 38 to 47 ppm. Note: These numbers are within the medium (27-54 ppm) range of sufficiency.

PROJECT 2

» Mat layer sampling from both May and November 2024 showed that the pH levels were sufficient for introducing bentgrass in 2025 *(Table 2).*

» The effect of pH on turfgrass quality was substantial and most apparent at the September rating.

» Because the site was monitored daily during the summer, the researchers can be fairly certain that differences in turfgrass quality were not attributed to any acute stressor, but rather the cumulative effects of poor vigor and summer stress in plots with low mat layer pH.

PLANS FOR 2025

» The pH levels from Project 1 and the pH gradient from Project 2 have now been set, allowing for bentgrass to be planted on the annual bluegrass putting green in spring 2025.

» The plant growth regulator (PGR) regimen for Project 1 will also begin in spring 2025, and the lack of phosphorus depletion in Project 1 will be evaluated further before spring.

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

TABLE 2

Mat layer pH in June and November 2024 and turfgrass quality on September 15, 2024 as affected by amendments for *Project 2*. Turfgrass quality values >7 are shaded in green, and those <6 are shaded in red.

	pH		Turfgrass quality (1 to 9)			
pH Treatment	June	Nov	June	July	Sep	Nov
Non-treated	5.2	4.9	6.0	5.8	5.1	5.8
Lime (2 lbs/1000 ft²)	5.3	5.2	6.3	6.0	5.3	5.5
Lime (5 lbs/1000 ft²)	5.5	5.3	7.0	6.8	5.9	6.5
Lime (14 lbs/1000 ft²)	6.3	5.9	7.8	7.7	7.9	7.4
Lime (43 lbs/1000 ft²)	7.1	6.7	7.1	7.5	7.9	7.1
Lime (130 lbs/1000 ft²)	7.3	7.0	6.7	7.7	7.6	7.1
Sulfur	5.1	5.1	5.5	5.9	5.1	6.0
Sulfur	4.8	5.1	4.8	4.3	4.2	6.3
Gypsum	5.1	4.6	5.0	5.3	5.4	6.1
Gypsum	5.2	5.1	5.4	5.5	5.6	6.8
$LSD_{0.05}$	0.18	0.4	0.9	0.9	0.76	0.82
P-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Stepping Up the Game: Investigating the Impact of Golf Footwear on Putting Surface Quality

Golf course superintendents strive for optimal playing conditions, but many now suspect that their efforts are made more challenging by the wear and tear created by golf footwear, especially the newer footwear designs that maximize traction to increase clubhead speed.

With a two-year grant from the Tri-State Turf Research Foundation, Cornell's Dr. Frank Rossi has devoted the past year to investigating the influence of the latest in golf footwear on various putting surface types, managed to various standards throughout Met-area golf courses. The focus is on grass types like bentgrass *(Agrostis spp.), Poa annua (Poa annua L.),* and a combination of both, using the USGA GS3 surface measurement device.

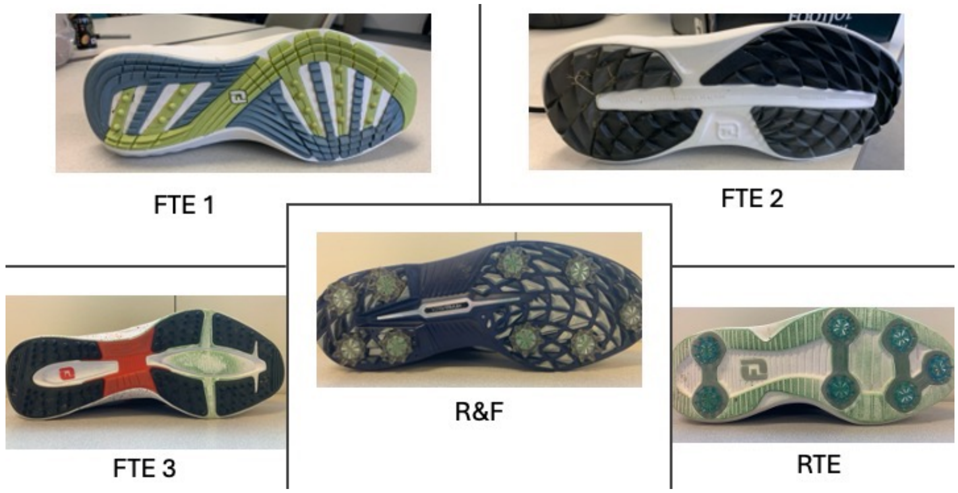

FIGURE 1
Golf footwear with associated tread designs tested in 2024.

OBJECTIVES

1: Measure how different footwear types influence putting surface characteristics like firmness, ball roll distance, smoothness, and trueness.

2: Evaluate how different putting surface types and maintenance programs interact with various footwear designs in golf courses throughout the Met area.

METHODOLOGY

Traffic trials were completed at nine championship-level golf facilities:

1: Two in Connecticut (Fairview Country Club and The Stanwich Club)

2: Two in New Jersey (Arcola Country Club and Ridgewood Country Club)

3: Four in New York (Bethpage Black, Glen Oaks Club, Westchester Country Club, and Winged Foot Golf Club)

4: One additional facility in Minnesota (Hazeltine National Golf Club) during the United States Amateur golf competition.

At each facility, plots were marked to apply five different footwear treatments. Footwear shown in *Figure 1* range across three general types:

1: Traditional Spiked Shoes (RTE): Shoes with traction elements that can be taken off and replaced.

2: Spikeless Shoes (FTE): Shoes with fixed-traction elements that cannot be removed. Three separate designs in this category were tested.

3: Combination Shoes (FTE+RTE): Shoes with both removable and fixed-traction elements.

» A test subject, known for aggressive walking, completed 140 simulated rounds on each footwear type to observe surface impacts. Nontrafficked control plots were used for comparison.

» The surface performance ranges across all facilities tested in 2024 are listed in *Table 1*.

DATA COLLECTION

PUTTING SURFACES

Researchers assessed the impact of footwear on the putting surface through various tests *(Table 2)*.

(continued on page 8)

GS3 Stimp (ft)	Smoothness (GS3)	Trueness (GS3)	Firmness (GS3)	Bobble Test	Soil Moisture (TDR 350, 3")	*Poa* Percentage	OM2 Values
10.0 to 14.25	2.06 to 6.09	0.45 to 0.95	0.376 to 0.499	8 to 10	10.9% to 24.1%	0% to 100%	4.39 to 12.64

TABLE 1
Putting Surface Characteristics of Surfaces Measured in 2024 (nontrafficked).

Stepping Up the Game: Investigating the Impact of Golf Footwear on Putting Surface Quality

1: Spike Damage: Visually assessed on a scale of 1 to 5 where 1 = extreme disruption, 2 = severe disruption, 3 = moderate disruption, 4 = mild disruption, and 5 = no visible disruption.

2: The Bobble Test: Assessed according to Linde et. al, (2017) where 1 = many bobbles and much snaking, 5 = some bobbles and snaking, 9 = one bobble or snake, and 10 = no bobble or snaking.

3: USGA GS3 Ball Measurements: The GS3 ball measured surface disruption by tracking speed, smoothness, and trueness. Smoothness and trueness values are both more desirable when they are lower.

» The ball was rolled six times in each plot (three in one direction, three in the opposing direction), with the average for each metric taken across the six rolls.

4: Soil Moisture: Soil moisture values, using a Spectrum TDR 350 probe, were taken to a 3-inch depth.

5: Soil Firmness: Firmness was measured in nontrafficked plots using the GS3 ball dropped from the USGA drop housing. The average was taken from three drops in each nontrafficked plot.

6: *Poa* Percentage: The percentage of *Poa* was visually estimated in each trafficked and nontrafficked plot.

7: Soil Samples: Samples were taken from each nontrafficked plot and submitted for analysis under the OM2 method. This method combusts the entire soil sample, including live tissue, to determine the total percent, by weight, of organic material in the top two centimeters of soil.

MAINTENANCE PRACTICES

Superintendents of each golf course provided information on maintenance practices that might affect the putting surface resiliency to traffic, such as mowing frequency, irrigation, and fertilization.

Questions asked were:

1: What is the height of cut?

2: How many times per week are greens mowed?

3: Is the surface walk-mown or triplexed?

4: How many times per week are greens rolled?

5: What type of roller is used?

6: How often and at what rate is Nitrogen applied?

7: How often and at what rates are growth regulators applied?

8: How often is the surface irrigated?

9: Do you measure clip volume? If so, what are typical clipping volumes?

10: When was the surface last verticut?

11: When was the surface last topdressed?

12: When was the surface last aerated?

13: Have organic matter levels been tested in the last six months?

	Putting Surface Disruption Variable				
Predicator variable	**Spike Damage**	**Bobble Test**	**GS3 Stimp**	**GS3 Trueness**	**GS3 Smoothness**
Poa percentage	0.26*	**0.31****	**0.48*****	-0.13	0.09
Volumetric water content	0.26*	0.11	0.12	-0.07	0.19
Firmness	**0.38*****	-0.13	-0.16	0.11	0.28*
Height of cut	0.05	0.26*	**0.40*****	0.06	0.11
Mowing events per week	**-0.37****	-0.16	-0.29*	-0.17	-0.27*
Rolling events per week	0.08	-0.03	-0.04	-0.23*	**-0.37****
Nitrogen rate per month	0.29*	-0.04	-0.17	-0.15	-0.28*
Maximum rate of growth supression	-0.1	-0.03	0.08	0.05	-0.01
Organic material in top 2 cm (OM2)	**0.31****	0.09	0.07	-0.06	0

*p-value < 0.05 **p-value < 0.01 ***p-value < 0.001

TABLE 2
Measures of putting surface disruption after traffic relative to non-trafficked control.

Stepping Up the Game: Investigating the Impact of Golf Footwear on Putting Surface Quality

PRELIMINARY FINDINGS

PUTTING SURFACE AND MAINTENANCE PRACTICES

1: *Poa Annua's* Role: Courses with higher *Poa annua* content showed better resilience to traffic. These surfaces had less visible spike damage and retained better ball roll distance after traffic. Data suggests there might be a critical threshold at 60 percent *Poa* where traffic resilience notably improves, though further investigation is warranted.

2: Surface Firmness: Softer surfaces, often associated with *Poa*, showed less visible damage from foot traffic, likely due to increased watering requirements for *Poa* and higher organic content.

3: Maintenance Practices: More intensive maintenance (e.g., frequent mowing and rolling) led to increased surface disruption, as did lower mowing heights. This suggests that highly maintained, fast greens might show more visible and measurable damage from foot traffic compared to slower greens.

4: Green Speed: While traffic significantly affects how a ball rolls in terms of smoothness and trueness, it has minimal impact on overall ball roll distance (speed) *(Figure 2)*.

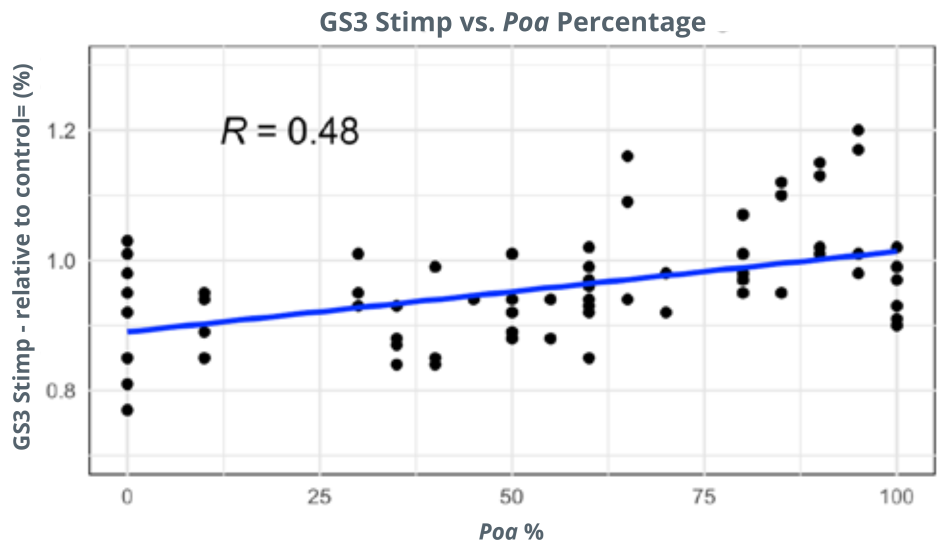

FIGURE 2

Stimpmeter readings using the USGA GS3 as a function of the *Poa annua* percentage of the surfaces tested.

FOOTWEAR

1: Spikeless Shoes (FTE): These shoes caused less disruption compared to traditional spiked shoes (RTE), especially in terms of visual spike damage.

2: Combination Shoes (FTE+RTE): These shoes, which combine flat traction elements with supporting traction elements, showed reduced damage compared to pure spiked designs. The differences between FTE and FTE+RTE were only statistically significant in visual spike damage, not in objective measurements.

3: Nuances in Performance: Although spikeless shoes generally performed better, not all spikeless shoes were equal. Some designs (FTE 1 and FTE 2) performed better than others (FTE 3), highlighting that simply banning spiked shoes may not be the best solution. *(Table 3)*

(continued on page 11)

Putting Surface Disruption by Tread Type					
Shoe Type	**Bobble Test**	**GS3 Smoothness**	**GS3 Trueness**	**GS3 Stimp**	**Spike Damage**
	reduction relative to control (%)				**
FTE	21% a	25% a	15% a	3% a	3.8 a
FTE+RTE	27% a	24% a	17% ab	6% a	2.6 b
RTE	39% b	40% b	37% b	5% a	2.4 b

* Lettered differences specific to each variable ** SD Rating: 5=no spike damage, 3=moderate spike damage, 1=extreme spike damage

TABLE 3

Measures of putting surface disruption after traffic relative to nontrafficked control.

Special Thanks to Our 2024 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

ADVANCED TURF SOLUTIONS
Greg Moran

ALPINE COUNTRY CLUB
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ANGLEBROOK GOLF CLUB
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RESEARCH UPDATE
(CONTINUED FROM PAGE 9)

Stepping Up the Game: Investigating the Impact of Golf Footwear on Putting Surface Quality

SUMMARY OF PRELIMINARY FINDINGS

» **Impact of Spikeless Shoes:** Spikeless shoes (FTE) led to less surface damage than traditional spiked shoes.

» **Combination Shoes (FTE+RTE) Benefits:** Spike shoes incorporating supporting traction elements showed reduced damage, which validated the design principles behind the Premier model's traction system.

» **Objective vs. Visual Measurements:** While some footwear designs showed clear differences in terms of visual damage, objective tests like the GS3 ball and Bobble test revealed fewer differences in performance, suggesting that appearance alone may not fully capture the functional impact of footwear on surface quality.

» **Course Management Insights:** The study highlights the need for golf courses to carefully balance footwear types and maintenance practices to preserve putting surface quality. Managers may want to focus on *Poa annua's* positive impact on surface resilience while considering the benefits of spikeless or combination footwear.

CONCLUSION

This research provides valuable insights into how golf footwear affects putting surfaces, suggesting that spikeless shoes and combination designs may help reduce surface disruption without sacrificing performance.

It also shows the importance of surface type and maintenance practices in determining how resilient a green is to foot traffic.

These findings are useful for both golf shoe manufacturers and course managers aiming to optimize playability and surface longevity.

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

The Tri-State Turf Research Foundation's Ongoing Commitment to Keeping Our Courses Alive and Well

RESEARCH UPDATES AND FUTURE OPPORTUNITIES

Looking ahead, 2025 will be a year of transition, as our current research projects approach the finish line:

» **Dr. Matt Elmore** and **Dr. James Murphy** at Rutgers University continue their work on integrating phosphorus and pH management with plant growth regulators (PGRs) to better understand annual bluegrass (ABG) and creeping bentgrass population dynamics.

» **Dr. Frank Rossi** at Cornell University is now in the second year of a project examining how golf footwear impacts the characteristics of putting surfaces in the tri-state area.

» **Dr. Albrecht Koppenhöfer** and his team at Rutgers University have completed their final year of research with the Tri-State and have offered important insight into the effects of Silicon (Si) fertilization on ABW management, a mineral that has shown promise as an alternative to ABW-resistant chemical treatments.

All these researchers are making great strides in helping turfgrass managers resolve a number of long-standing issues on their courses. We hope you'll take advantage of their findings.

In addition to these research initiatives, we are proud of our contribution to the **Dr. Bruce Clarke Endowed Graduate Fellowship**. Over the past five years, the Tri-State has been a key partner in raising $30,000 to support the next generation of turfgrass scientists in honor of Dr. Clarke's distinguished career.

We will be issuing a request for proposals this fall. Your continued support through the $300 contribution will be vital to sustaining this next phase of research. Be sure to look for updates in this and future issues of *Foundation News*.

ACKNOWLEDGING BEHIND-THE-SCENES EFFORTS

We often go about our day-to-day work without pausing to recognize the individuals who make a difference behind the scenes. I would like to take this moment to recognize **Susan O'Dowd**, our executive secretary, for her invaluable contributions to the operation and success of the Tri-State Turf Research Foundation. Susan's dedication is a constant source of strength for us, and I look forward to continuing to work with her in the years ahead.

LOOKING TO THE FUTURE

As we move forward through these changes and prepare for the 2025 season, we can count on a few key pillars: research to guide best management practices, communication to strengthen our network, and collective support to ensure the growth and longevity of our industry.

Thank you all for your continued support. Wishing you all a successful and safe season ahead!

Rich Duggan
President
Tri-State Turf Research Foundation

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