FOUNDATION NEWS

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PRESIDENT'S MESSAGE

A Little Support Goes a Long Way

I was watching television the other day and a commercial came on where this little boy kept asking his father, a fund manager, questions: *Who?* . . . *What?* . . . *Where?* . . . *Why?* It got me thinking that the same questions could be asked of us.

WHO ARE WE?

Founded in 1990, the Tri-State Turf Research Foundation is one of the leading supporters of turfgrass research in the Northeast. The Tri-State's board is made up of three representatives from each of the six affiliated associations who orchestrate the foundation's activities—the MetGCSA, New Jersey GCSA, Connecticut AGCS, Long Island GCSA, Hudson Valley GCSA, and the MGA—as well as our executive director, Ed Brockner.

Take a look at the back page of this publication and you will see the representatives from your association. This type of involvement allows us to stay in tune with your turf concerns and problems and better represent the research needs of area superintendents.

WHY ARE WE HERE?

The Tri-State Turf Research Foundation was founded with the belief that there is strength in numbers: We knew that if all the local associations joined forces and pooled their resources, we could better fund important research more than any one association or group could do on its own.

At the foundation's start, area superintendents were combating moss and the highly damaging summer patch disease. Thanks to the joint effort of our six affiliated associations, as well as area clubs and vendors, the Tri-State was able to fund research that produced viable solutions to these turf woes. Since then, we have funded numerous research projects that have helped area superintendents find turf-saving controls for turfgrass pests and problems common to tri-state area golf courses.

Unlike any one association, the Tri-State's focus is on research and research alone. We can devote the time needed to solicit and collect donations, canvass area superintendents' research needs, and review research proposals from university professors. Then once committed to funding a project, we monitor that research, making sure to get timely updates so findings can be disseminated to area superintendents.

Few association boards can take time away from their many other duties to regularly secure and manage significant research endeavors on their own. And why should they? With a few representatives from each of the participating associations, the Tri-State Turf Research Foundation is here to do this very important job, which benefits everyone!

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Matt Ceplo, CGCS, President
Tri-State Turf Research Foundation

INSIDE THIS ISSUE

Rutgers Research Team Develops Best Management Practices for Anthracnose Control

First observed in New Jersey in 1930, anthracnose disease continues to plague annual bluegrass (*Poa annua*) putting greens—particularly those that have been subjected to intense maintenance practices, such as decreased mowing heights, reduced irrigation, and minimal nitrogen fertilization to increase green speeds.

Caused by the fungus *Colletotrichum cereale*, the disease infects leaf, crown, stolon, or root tissues of the grass plant, resulting in foliar blight or basal (stem) rot. As the disease's prevalence soared in the mid-'90s, Rutgers' Dr. James Murphy and Dr. Bruce Clarke began to scrutinize the role cultural practices might play in anthracnose severity on annual bluegrass turf.

With prior funding from the Tri-State Turf Research Foundation, the Rutgers research team determined that sand topdressing and both granular and soluble nitrogen fertilization play a significant role in suppressing anthracnose activity.

In 2012, the foundation agreed to provide an additional three years' support to the Rutgers research team in their quest to delve deeper into best management practices (BMPs) for anthracnose control and, ultimately, a more viable solution to this turf-threatening disease.

THE TRIALS

Drs. Murphy and Clarke and graduate assistants Charles Schmid, James Hempfling, and Ruying Wang devoted the past three years to conducting trials that examined the impact of the following factors on anthracnose development and severity:

1. Nitrogen (N) source
2. Potassium (K) fertilization and soil pH
3. Sand topdressing and foot traffic
4. Mowing and rolling
5. Plant growth regulators
6. Irrigation
7. Cultivation practices
8. The effect of combining BMPs on fungicide efficacy and turf quality

A mowing treatment being applied on the annual bluegrass plots.

The research team's most recent findings indicate that nitrogen fertilization is the most influential cultural practice affecting anthracnose severity in annual bluegrass putting greens. N-deficient turf proved to be not only more susceptible to anthracnose, but also less capable of recuperating from disease damage. Also notably influential in suppressing anthracnose activity were increasing mowing height and sand topdressing frequency, as well as maintaining suitable potassium levels.

Other practices the researchers studied—such as foot traffic, irrigation, lightweight rolling, and the application of plant growth regulators—have also been shown to have an impact on anthracnose severity but to a lesser degree.

BMPS FOR ANTHRACNOSE CONTROL

The researchers have organized their findings into a working outline of BMPs for controlling anthracnose on annual bluegrass putting green turf. Here are their recommendations:

NITROGEN

» Nitrogen should be applied to maintain vigor of the putting green turf without overfertilizing. Annual "summer" soluble-N rates totaling approximately 2.4 to 3.6 lbs. N/1000 ft.^{2} should be applied to reduce anthracnose incidence and severity. A rate at the higher end of the range will be needed if N rates have been low historically.

» Beginning soluble-N programs earlier in the spring (April or May) at 0.4 to 0.8 lbs. of N/1000 ft.^{2} per month can build up nitrogen in the turf heading into summer, which can result in decreased anthracnose severity.

» Any granular-N fertilization should be applied in the spring at rates of 1 to 3 lbs./1000 ft.^{2} to reduce disease severity. Again, a rate at the higher end of the range will be needed if N rates have been

Rutgers Research Team Develops Best Management Practices for Anthracnose Control

Mowing treatments being applied during the morning while fungicide treatments are being prepared.

low historically. Use slow-release N or split applications of N when applying higher N rates as granular applications.

POTASSIUM

» Potassium should be applied to maintain at least moderate levels of soil K.

» Soluble-K applications made at a 4:1 N:K ratio every 14 days should be sufficient to reduce anthracnose severity. More K was not any more effective or detrimental.

MOWING AND ROLLING

» Avoid mowing below 0.125" when using fixed-head mowers; a slightly lower bench setting might be feasible for flex units. If feasible, raise the cutting height as high as 0.141" for greater suppression of anthracnose. Slight increases in mowing height can significantly reduce the severity of this disease. Therefore, using the solid rollers versus grooved rollers, at the same bench height setting, may also be helpful.

» Roll and/or increase mowing frequency to maintain ball roll distances (green speed) at higher mowing heights. Rolling and double-cutting increase ball roll, but will not increase disease severity.

» Rolling every other day can result in slightly decreased anthracnose severity, regardless of roller type.

» Be wary of the extra traffic stress at the perimeter of putting greens if you adopted the practices of rolling and double-cutting. “Spot” rolling and double cutting only around the hole location of large putting greens may be a method to reduce traffic stress at the perimeters.

PLANT GROWTH REGULATORS

» Routine trinexapac-ethyl (Primo MAXX) use, even at high rates and short intervals, will not increase—and may even reduce—anthracnose severity by improving plant health, as well as turf tolerance to low mowing.

» Mefluidide (Embark) and ethephon (Proxy) can be used to suppress seed-head formation in annual bluegrass turf without increasing anthracnose.

» Mefluidide or ethephon applied in the spring (March or April) at label rates with subsequent applications of trinexapac-ethyl at 0.1 to 0.2 fl. ozs./1000 ft.^{2} every 7 to 14 days throughout the spring and summer will provide the best turf quality and may reduce anthracnose.

IRRIGATION

» Increased anthracnose can result when annual bluegrass is consistently subjected to wilt stress or excessively wet conditions.

» Irrigating to replace 60 to 80 percent of potential evapotranspiration, combined with hand watering to avoid wilt stress, has the dual benefit of providing a quality playing surface while avoiding conditions favorable for anthracnose.

TOPDRESSING AND FOOT TRAFFIC

» Biweekly sand topdressing in the summer with up to 100 lbs./1000 ft.^{2} provides a protective layer of sand around the crown. This slightly raises the effective height of cut, reducing the incidence of anthracnose.

» Topdressing in the spring at 400 to 800 lbs./1000 ft.^{2} is more effective than fall applications in reducing anthracnose severity.

Note: These rates do not take into account the quantity of sand that would be needed to fill coring holes. If coring is done at the same time as topdressing, more sand would be needed. The precise amount will depend on the diameter and spacing of coring holes.

» Anthracnose does not appear to be affected by different sand incorporation techniques, so methods that best incorporate sand should be selected to minimize turf injury and wear on mowing equipment.

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Rutgers Research Team Develops Best Management Practices for Anthracnose Control

» Foot traffic (similar to rolling) appears to reduce anthracnose, regardless of sand topdressing. The benefits of sand topdressing (better wear tolerance and decreased disease) are also seen in areas that receive daily foot traffic.

CULTIVATION PRACTICES

» It is not necessary to avoid the use of verticutting or other cultivation practices (e.g., aerification, scarification, grooming) when disease is present, since wounding from these practices has not been shown to increase anthracnose severity. It is a good idea, however, to apply fungicides close to the time of any cultivation practice when there is active disease.

FUNGICIDE MANAGEMENT

» Avoid the sequential use of any fungicide chemistry. Tank-mix or alternate fungicides with different modes of action to enhance efficacy and reduce the potential that resistant strains of anthracnose will develop.

» Develop fungicide programs that focus on the strengths (efficacy) of fungicide chemistries, and time their application to optimize the control of all major diseases on the site.

» Use as many different fungicide chemistries with proven efficacy against anthracnose as are practical during the growing season to enhance anthracnose control and reduce the potential for fungicide resistance.

Included on this list: the QoI, DMI, Nitrile (chlorothalonil), benzimidazole, dicarboximide (iprodione), phosphonate, antibiotic (polyoxin-D), carboximide (penthiopyrad or fluxapyroxad), and phenylpyrrole fungicides.

FUTURE PLANS

During their trials, the Rutgers research team found that soil pH also appears to influence anthracnose severity. Many years of treatment, however, are required to achieve large changes in soil pH. Therefore, the researchers will devote a fourth year to examining lime and sulfur effects on soil pH and anthracnose severity.

Early assessments indicate that anthracnose is less severe at higher pH levels; however, the range of pH has been relatively small over the first couple years of research. More time and change in pH is needed to be certain of the effect on anthracnose over a large range in soil pH.

For further information on the researchers' trials, you can reach Dr. Murphy at Murphy@aesop.rutgers.edu or Dr. Clarke at Clarke@aesop.rutgers.edu

Playability of annual bluegrass plots being assessed with a Stimpmeter.

SIDEBAR

Anthracnose Control Notables

» Though greater N fertility, mowing height, and sand topdressing reduced disease severity, N fertility had the greatest impact on disease reduction. Sand topdressing and mowing height accounted for similar, but lesser reductions in disease.

» If your goal is to increase green speed—without greatly increasing the risk for anthracnose—it is better to lower mowing height than to reduce N fertility or sand topdressing rates.

» You can get too much of a good thing. Though potassium is an essential plant nutrient that strongly influences the tolerance of turfgrasses to a variety of turfgrass ills and stresses, soil K ranges above 200 lbs. per acre did not increase anthracnose suppression compared to values within the sufficiency range of 100 to 200 lbs. per acre.

» Excellent disease control and playability can be obtained with reduced fungicide inputs when maintaining turf with greater N rates and higher mowing. For instance, over the course of two years, only two threshold-based fungicide applications were required each year for acceptable disease control when turf received greater N and higher mowing (an 80-percent reduction in fungicide use compared to a 14-day, calendar-based spray program). In contrast, up to nine applications were required when turf was maintained under lower N and lower mowing.

Rutgers Researchers Seek Sustainable Approach to ABW Control

Creeping Bentgrass Cultivars Show Promise in ABW Management

The annual bluegrass weevil (ABW), technically known as *Listronotus maculicollis*, continues to plague short-mown golf course turf, with severe infestations now being reported in all states across the Northeast and Mid-Atlantic regions. Though great strides have been made in keeping this highly destructive pest at bay, the ABW seems determined to stay, often eluding the once effective pyrethroid applications, as well as some of the newer chemistries available. With preventive insecticides being applied up to 10 times a year, this is no surprise.

The only insecticide that has not yet shown signs of pesticide resistance is spinosad (Conserve)—but it has been effective only in controlling larvae. Right now, the preferred adulticide alternative is the organophosphate chlorpyrifos. But ABW populations are already showing resistance to this insecticide. Though still more effective in combating ABW than pyrethroids, it's only a matter of time that chlorpyrifos overuse will render this chemistry ineffective as well. Making this all the more troubling is that there is no silver bullet on the horizon for attacking the resistant ABW!

With the threat of growing chemical resistance, the Tri-State Turf Research Foundation has agreed to support Rutgers entomologist Dr. Albrecht Koppenhöfer and his team of researchers in their pursuit of effective alternatives to chemical pesticides for ABW control.

THE PLAN OF ATTACK

Last spring, the researchers set out to explore three different aspects of IPM:

1. Monitoring methods
2. Plant resistance/tolerance
3. Biological controls

Their hope is that, over the course of their three-year study, they could facilitate the development of more sustainable approaches to managing ABW populations. What follows is a look at the researchers' findings in the first leg of their study on plant resistance/tolerance and its implications.

WHICH TURFGRASSES FAIR BEST AGAINST THE ABW

In this phase of the study, the researchers focused on uncovering which grasses were preferred hosts to ABW and/or particularly susceptible to it. They compared annual bluegrass, *Poa annua*, with a variety of bentgrass species/cultivars, including:

1: Creeping bentgrass (CBG) (*Agrostis stolonifera*) cvs. L93 and Penncross (older, still widely used) and 007 and Declaration (newer, high quality)

2: Velvet bentgrass (*A. canina*) cvs. Villa and Greenwich

3: Colonial bentgrass (*A. capillaris*) cvs. Tiger II and Capri

The researchers looked at three areas:

1: ABW oviposition preferences. A series of experiments investigated egg-laying preferences of female ABW in environmental chambers and in small field enclosures. Females were either offered just one core of one of the above grasses or were given a choice among four cores: *Poa annua*, one of the older creeping bentgrasses, one of the newer creeping bentgrasses, the colonial bentgrass cv. Capri, or the velvet bentgrass cv. Greenwich.

When no choice was provided:

» In the environmental chamber experiments, egg-laying in the *Poa annua* was six times higher than in the creeping bentgrasses (data combined across cultivars) and 12 times higher than in the colonial and velvet bentgrasses.

» Among the creeping bentgrasses, egg-laying tended to be higher in the older cultivars (L-93 and Penncross) than in the newer ones (Declaration and 007).

» In field experiments, egg-laying in cv. Capri and particularly in *Poa annua* was higher than in the four creeping bentgrasses and cv. Villa.

When a choice *was* provided:

» ABW females clearly preferred *Poa annua* to all bentgrass cultivars for egg-laying with at least six times more eggs found in the *Poa* than in any bentgrass cultivar in both the environmental chambers and the field experiments *(Figure 1)*.

» The only bentgrass cultivar that showed a trend (not in all experiments, though) toward lower egg-laying than in other bentgrasses was cv. Declaration.

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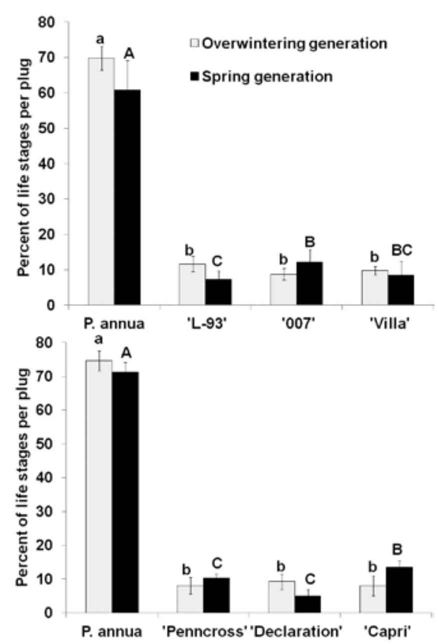

FIGURE 1
Oviposition choices of ABW females from two phenologically different populations in two field experiments. Means with same letter within populations are not statically different (α=0.05).

Rutgers Researchers Seek Sustainable Approach to ABW Control

2: Host suitability of bentgrasses for the ABW. In two greenhouse pot experiments, ABW females were allowed to lay eggs for one week, and the grass was examined for ABW larvae and pupae after another four weeks.

The number of stages recovered differed significantly among grass species:

» Averaged across experiments and grass species, *Poa annua* had the highest average number of ABW life stages per pot, followed by colonial bentgrasses (cvs. Capri and Tiger II) and velvets (cvs. Villa and Greenwich), with the lowest numbers in the creeping bentgrasses *(Table 1)*.

» Among individual cultivars, the most consistently low larval densities were observed in creeping bentgrass cvs. L93 and Penncross.

Third- through fifth-stage larvae and pupae were recovered from the pots:

» The average life stage reached was higher in *Poa annua* than in any of the bentgrass species.

» Among cultivars, L-93 and Penncross consistently had the lowest average life stage.

» The cultivars Capri, Greenwich, Villa, and Tiger II did not differ significantly from the *Poa*.

» The cultivars Declaration and 007 fell between the first two groups.

» Populations of fifth-stage larvae grown on the *Poa annua* were significantly heavier than in most bentgrasses; there were no significant differences among bentgrasses.

» Damage ratings were the highest for *Poa annua*.

Overall, these findings show that ABW larvae grow better and develop faster if feeding on *Poa annua* than any of the other tested bentgrass cultivars.

3: Tolerance of bentgrasses to ABW larval feeding. Greenhouse-reared fourth-stage larvae were placed onto potted turf cores in the greenhouse. Grasses were exposed to 0, 6, 12, and 24 larvae per pot (= 0, 71, 142, 284/ft.^{2}). Turf quality was evaluated 7 and again 14 days after release. After the 14-day rating, the number of ABW stages present in the turf was determined.

» At the lowest larval density, all grasses had low-to-moderate damage ratings (2 to 13 percent at 7 days; 5 to 23 percent at 14 days), which were not significantly different from the control pots *(Figure 2)*.

» At 12 and 24 larvae per pot, *Poa annua* had the highest damage ratings after 7 and 14 days. Overall, bentgrasses were more tolerant of ABW feeding than the *Poa*.

TABLE 1
Mean number per pot of ABW immatures recovered from Poa annua or cultivars of three bentgrass species in two greenhouse larval survival pot experiments.

Grass species/ cultivars	No. of larvae and pupae per arena	
	Expt. 1	Expt. 2
Poa annua	31.2 Aab	34.4 Aa
A. stolonifera	13.1 C	6.5 0.6 C
L93	11.1 d	4.8 d
Penncross	9.8 d	5.3 d
Declaration	13.8 cd	8.4 cd
007	17.6 c	7.7 cd
A. capillaris	18.0 B	12.5 B
Tiger II	10.8 d	12.3 bc
Capri	25.2 b	13.8 b
A. canina	21.8 B	11.2 B
Villa	38.1 a	10.0 bc
Greenwich	18.1c	11.3 bc

Means within columns followed by the same upper (lower) case letter did not differ among grass species (cultivars) (α=0.05).

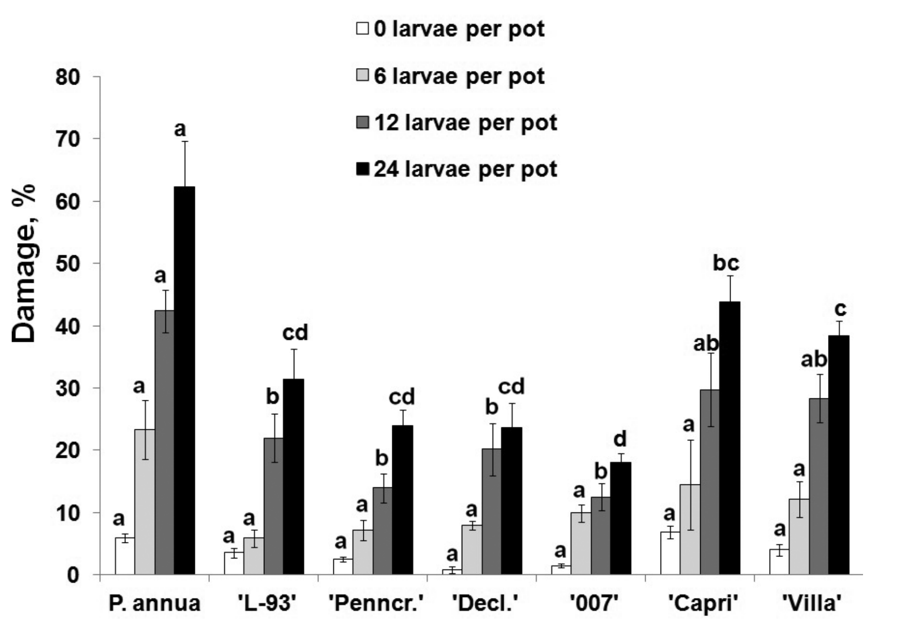

FIGURE 2
Percent damage caused by ABW larval feeding (0, 6, 12, and 24 larvae per pot) on *Poa annua* and selected bentgrass cultivars 14 days after introduction of larvae into the pots. Means marked with the same letter did not differ significantly between cultivars at same larval densitiy (α = 0.05).

» In the *Poa annua,* damage became apparent after 7 days at higher ABW densities and reached 64 percent at 24 larvae per pot after 14 days.

» In contrast, it took the highest larval density and 14 days to express damage in some creeping bentgrasses.

» Cultivars Capri and Villa seem to be the least tolerant among bentgrasses.

Confirming previous field observations, the researchers' data to date seems to indicate that bentgrasses generally can tolerate two to three times higher densities of ABW larvae than *Poa annua* before sustaining the same damage level (20 percent).

WHAT WE CAN CONCLUDE

» *Poa annua* is clearly preferred for egg-laying over bentgrasses by ABW females and is also a better host for ABW development.

» Creeping bentgrasses tend to be preferred for egg-laying over colonial and velvet bentgrasses. However, larval survival is lower in creeping bentgrasses than in colonial and velvet bentgrasses.

» With larval densities lowest in creeping bentgrasses, these grasses also tend to suffer the least amount of damage.

» Among the four creeping bentgrasses tested, none stands out significantly with regard to their ability to withstand damage by ABW. Hence newer bentgrass cultivars should be preferable over older ones due to their improved performance with other stresses.

The final conclusion to date: Replacement of *Poa annua* with new creeping bentgrass cultivars should be the most effective, sustainable, and environmentally acceptable tactic for ABW management.

RECOMMENDED COURSE OF ACTION

In addition to replacing *Poa annua* with new creeping bentgras cultivars, the researchers recommend that superintendents start with fairways where the percentage of *Poa* tends to be lower than in lower-cut areas.

Their rationale: By first converting fairways, the largest area of turf on the golf course, you are greatly reducing the amount of insecticides applied. The much greater tolerance of creeping bentgrasses to ABW and other stresses will allow for fewer applications, which will, in turn, reduce the selection pressure for insecticide resistance.

Other benefits of more sparingly treating fairways:

» Natural enemies of the ABW and other turfgrass insect pests will be allowed to thrive and play a greater role in the control of ABW, thereby further reducing the need for insecticide applications.

» Fairways could also serve as a breeding ground for insecticide-susceptible ABW that might outbreed the resistant ABW living in the more intensely treated areas.

» Superintendents worried about ABW causing damage to creeping bentgrass should keep in mind that bentgrass is not only less susceptible to ABW damage than *Poa annua*, but also much better able to recover from any damage.

THE RESEARCHERS' NEXT STEPS

In the next phases of the study, the researchers will continue to:

1. Study plant resistance/tolerance, examining the role plant secondary chemicals might play in deterring ABW feeding and oviposition. The researchers hope that gaining a better understanding in this area will simplify their evaluation of grass cultivars for resistance to ABW and, ultimately, help in breeding bentgrasses with enhanced ABW resistance.

2. Delve into ABW chemical ecology (presence and effects of pheromones and plant volatiles) with the long-term goal of developing attractant-based monitoring and/or management tools.

3. Examine combinations of biological control agents with standard insecticides for improved ABW control and reduced selection for insecticide resistance. The researchers have also recently expanded their studies to include several biorational products. These are pesticides of natural origin, including such biological sources as bacteria, viruses, fungi, and protozoa that have limited or no adverse effects on the environment or beneficial organisms.

For further information on the Rutgers team's ABW research results and future plans, you can reach Dr. Albrecht Koppenhöfer at koppenhofer@aesop.rutgers.edu.

SIDEBAR

ABW Study Snapshot

Dr. Albrecht Koppenhöfer and his team of researchers obtained clear evidence of bentgrass resistance or tolerance to the annual bluegrass weevil (ABW):

» Compared to annual bluegrass, bentgrasses were less preferred for oviposition; less suitable for larval growth and development; and could tolerate higher densities of larvae with less visible damage.

» Females, however, laid eggs in all bentgrasses, even if annual bluegrass was available, and ABW could develop from eggs to pupae on all bentgrasses tested.

» Among the tested bentgrasses, the creeping bentgrasses were most resistant and tolerant to ABW.

Ball Roll: The Measure of Success

Cornell Researchers Search for Key to Producing High-Performance Putting Surfaces

Fast, true, and visually appealing putting surfaces make a good course great. Yet producing consistently high-performing putting greens has proved challenging at best.

Turfgrass managers have experimented with a variety of mechanical and chemical maintenance practices designed to maximize performance while minimizing stress. It's been found, however, that while these practices may improve performance, they fail to prevent turf loss from stress-induced turf ills, not the least of which is anthracnose.

There have been studies conducted in the past that have concluded that rolling, plant growth regulators, and fertilizers have significant effects on ball roll distance, while reducing stress-related problems. One such study, a classic experiment conducted in the early 1980s by Professor Clark Throssell, found that tripling the N fertilizer rate produced shorter ball roll distances, i.e., slower greens. On closer inspection, however, speeds dropped less than six inches with ball roll measured once per week *(Figure 1)*.

Unfortunately, this, and other similar bodies of research, lack the intensive and precise measurements, along with the consistent implementation of management systems, to deem their findings reliable.

With this in mind, the Tri-State Turf Research Foundation has, over the past three years, supported Cornell's Dr. Frank Rossi in his pursuit of a formula for improving ball roll without subjecting putting green turf to undue stress and disease.

BACKGROUND

In 2012, the Cornell research team set out to develop and validate a system for measuring the influence of management practices on turfgrass growth and, in turn, ball roll distance. Field trials were conducted on a putting green constructed in 1997 to USGA specifications and consisting of 30 percent annual bluegrass and 70 percent creeping bentgrass.

Their regime, in short:

» Mow; collect and then weigh clippings; measure ball roll; speed-roll plots; measure ball roll again; impose 125 rounds of simulated golf traffic; 10 hours later, measure ball roll again, every day for 10 days.

» Record climatic measurements, such as temperature, humidity, soil moisture, and wind speed, exploring any correlations.

Over the course of four months, the researchers employed this regime three times. This same regime has been followed for four years or 120 days at three measures per day or 360 ball-roll measures per treatment.

EARLY FINDINGS

The first two years of the trial had very little disruption in data collection due to rainfall. The researchers were able to sustain firm, dry surfaces throughout, noting the following:

ON PLANT GROWTH REGULATORS...
Starting in 2012, the researchers focused specifically on the use of plant growth regulators (PGRs) to enhance ball roll. Dr. Rossi's conclusion:

» At normal use rates of the three most commonly used PGRs—trinexapac-ethyl (Primo), paclobutrazol (Trimmit), and flurprimidol (Cutless)—annual bluegrass and creeping bentgrass growth can be suppressed between 15 to 20 percent.

» This reduction in growth (as measured by clipping yield), however, does not translate into increased performance, i.e., faster, truer, more visually appealing surfaces.

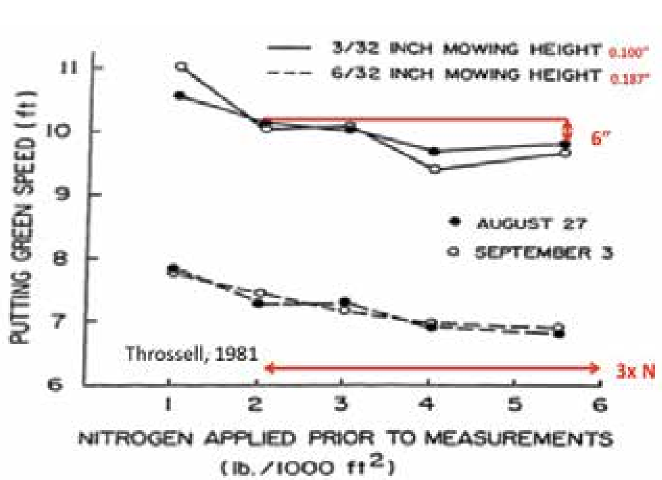

FIGURE 1
Influence of Cutting Height on Ball Roll Distance at Various N Fertilizer Rates.

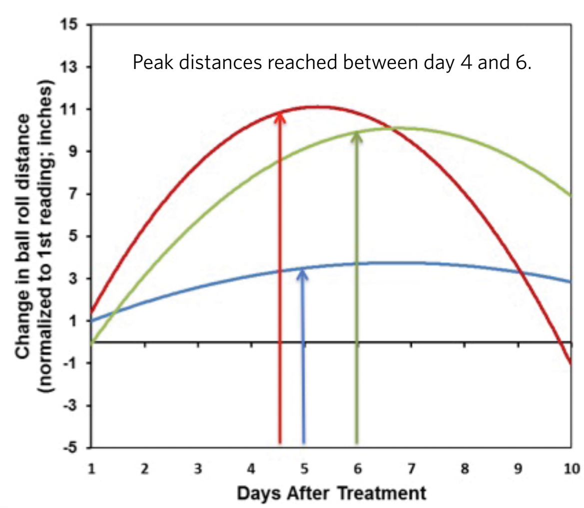

FIGURE 2
Typical Ball Roll Distance Response After 10 Days of Single Cut and Single Roll.

Ball Roll: The Measure of Success

ON MOWING AND ROLLING...
Ball roll distance was observed over time after a single cut and a single roll. The researchers concluded, unequivocally, that utilizing this low-stress approach to surface management allows for peak, sustainable green speeds within four to five days *(Figure 2)*.

» Speeds remained consistent over the next five to six days, with little increase.

» Because green speed will, undoubtedly, be determined by cutting height, the researchers suggest establishing a height that can be sustained without creating severe stress-related problems and that allows for a consistent ball roll from green to green. Consistency, after all, is the hallmark of high-performance putting surfaces.

ON BALL ROLL, IN GENERAL...
» Ball roll consistently responded by getting shorter (slower) over the course of a 10-hour day—independent of treatment.

» With that said, it's rare that greens slow more than can be detected by a golfer, i.e., ball roll generally does not decrease by more than six inches.

SIGNIFICANT FINDINGS IN 2014

ON ALTERNATIVE SURFACE PREPRATIONS AND PGRS...
This past season, the researchers explored alternative surface preparation treatments with and without PGRs. Specifically, they compared a single-cut and double-roll daily to a double-cut and single-roll daily under various PGR programs.

Applying PGRs generally in 10- to 12-day intervals, the researchers noted:

» Growth reductions in putting surfaces treated with PGRs were rarely significant compared to those left untreated—even with excessive moisture that often prevented mowing.

These results were achieved using low-labeled rates and precise temperature-dependent intervals. The effects will undoubtedly be different as rates increase and application intervals decrease.

Anecdotally, the 2014 surface preparation treatments responded differently than the single-cut and single-roll programs in the first two years. Specifically:

» The speeds kept increasing over time during the three, 10-day collections over four months.

» By contrast, the single-cut and single-roll treatments gained most of the increase during the first five days, then leveled out.

Also interesting was the effect of the individual treatments within a day *(Figure 3)*:

» Double cutting increased speeds nine inches (golfer detectable) over single cutting.

» That difference dropped to four inches (undetectable) after either a single- or double-roll.

» After 10 hours, there was only a six-inch difference (detectable).

THE NET: It appears that double cutting, which did not remove significantly more clippings than single cutting, provides an extra roll but, overall, no meaningful increase in green speed during the day.

When determining appropriate surface preparation strategies, it remains best to assess putting surface stress and adjust cutting heights and frequencies to sustain maximum performance.

ON CLIMATIC INFLUENCES...
Unlike much of the coastal Northeast, Central New York received 200 percent of the normal rainfall in 2014. This caused widespread disruption in data collection, but allowed the researchers to explore the influence of soil moisture, relative humidity, and dew point on the PGR and surface preparation treatments. The researchers discovered that as the putting surfaces dry, green speed increases—not within a day, but over time.

NEXT STEPS

Moving forward, the Cornell research team intends to explore the effect of tissue N level, PGR rate, and various brushing programs on putting surface canopy orientation and on ball roll distance.

For further information on Dr. Rossi's trials, you can reach him at fsr3@cornell.edu.

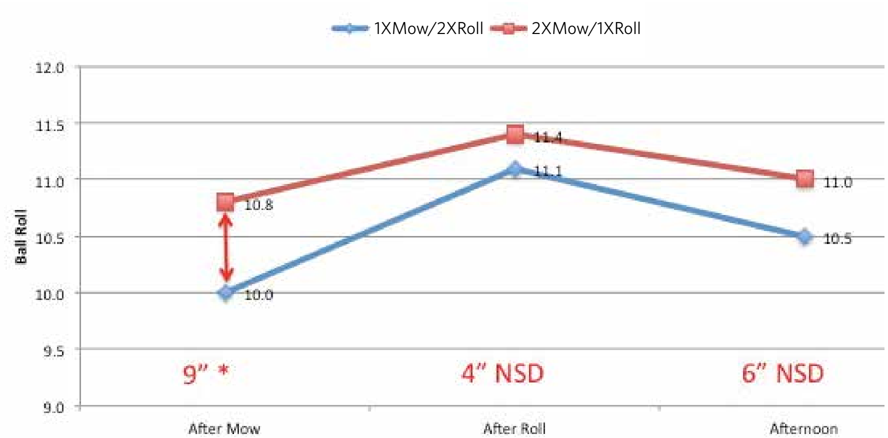

FIGURE 3
Response of Ball Roll Distance to Daily Surface Preparation Treatments (* denotes statistically significant difference NSD=Not Different).

Prepping Greens for Tournament Play

Penn State Researchers Set Out to Find the Ultimate Formula for Success

Whether preparing for a member/guest or a major USGA Championship or PGA Tournament, golf course managers' prime concern is to produce consistently fast and smooth greens while endeavoring to maintain high-quality turf. Because players ask more often about green speed than they do about any other golf course condition (Nikolai, 2005), it's only natural that superintendents are laser-focused on green speed and how to best achieve it.

To date, research involving green speed has focused mostly on quantifying *individual* cultural practices on ball roll distance, rather than focusing on *a specific set* of cultural practices. The reality is that when turfgrass managers are preparing greens for a tournament, they're faced with integrating *a variety* of cultural practices into a program to develop the best possible playing surface for a short period of time.

Some of the components of a tournament preparation program may include adjustments to height and frequency of cut, lightweight rolling, topdressing, grooming, or vertical mowing. Additional factors include adjustments in fertility and irrigation regimes (Nikolai, 2005; Zontec, 1997).

Integrating all of these potential cultural practices into an effective program that produces the required greens conditions for a short time period is the goal of a tournament preparation program.

It only follows, then, that quantifying and comparing the effects of all of these tournament prep practices, collectively, on the playability of greens would provide a great resource to golf course managers looking to maximize speeds with the least possible negative impact on plant health.

While previous research has shown that a number of factors improve green speed, little research is available that investigates the influence of *multiple* factors on increasing speeds. There is also limited information on the law of diminishing returns of these practices as it relates to increasing green speed at the expense of plant health.

With funding from the Tri-State Turf Research Foundation, Pennsylvania State University Associate Professor of Turfgrass Management Dr. John Kaminski and graduate research assistant Timothy Lulis hope to uncover the ideal formula for prepping greens for tournament play. They plan to:

1. Explore the influence of various cultural and chemical practices on golf course putting green playability
2. Examine the impact of these cultural practices on turfgrass quality
3. Correlate the influence of various cultural programs with green speed from data collected from golf course superintendents

Ultimately, the researchers' goal is to identify ways to maximize tournament conditions without adding additional negative stress to plant health from practices that are not resulting in playability improvements.

WHAT THE RESEARCHERS KNOW…

ABOUT MOWING HEIGHT. A common practice in achieving faster green speeds is to lower mowing heights.

» Research has indicated that a decrease in mowing height by .031" can be expected to produce a gain in ball roll of six inches (Richards, 2008).

» As mowing height is lowered further, however, increases in ball roll distances diminish.

» Reducing mowing heights from 0.156" to 0.125" may increase ball roll by as much as six inches, while an additional increase of six inches in ball roll would require dropping the mower height twice the previous increment to 0.063" (Nikolai, 2005).

ABOUT MOWING FREQUENCY. In addition to height of cut, golf course managers commonly adjust mowing frequency as they intensify their management practices leading up to the start of a tournament. Most research on frequency of mowing and ball roll distance has focused on identifying procedures that reduce the frequency of mowing while maintaining an acceptable green speed. Turfgrass managers subscribe to a variety of mowing frequencies in an effort to increase speed.

Some of these include:

» single mowing in the morning

» single mowing in the morning and evening

» integrating double cutting into either or both morning and evening mowing events

Double cutting while maintaining a consistent height of cut has been shown to increase ball roll distance (Nikolai, 2004).

There are many unknowns, however, relating to the timing of these increased mowing frequencies on green speed and plant health. How long, for instance, do these practices need to be implemented prior to the start of an event before any additional benefits are noticed?

ABOUT LIGHTWEIGHT ROLLING. This is another common practice employed to increase ball roll distances on greens. Research has shown an increase of as much as one foot in ball roll distance due to a rolling event (Nikolai, 2004). Most research has set out to determine how to maintain an adequate green speed while reducing mowing events on golf course greens in order to alleviate some of the stress on turfgrass due to mowing. This is not necessarily the goal during tournament preparation when greens are

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being maintained to produce unsustainable speeds for a short period of time.

Research has also shown that rolling is more effective at increasing ball roll distances when compared to lowering mowing height (Richards, 2007) and that more frequent rolling events per week produced greater gains in ball roll distance. But researchers are divided on this point:

» There is research that shows increasing the number of rolling events actually has a negative impact on turfgrass quality (Hartwiger, 2001) and that turfgrass managers should roll greens, at most, once every other day to spare their greens from any negative impact (Hartwiger, 2001; Nikolai, 2004).

» Still other research shows that when implemented for short periods of time, rolling daily has been shown to have a limited negative impact on turfgrass quality (Richards, 2007).

» Despite these differences of opinion, there does seem to be consensus on the fact that rolling during periods of high temperature stress will put your turfgrass quality at risk (Young, 2012).

Additional research under varying environmental conditions is necessary to fine-tune the influence of rolling on green speed and plant health.

ABOUT TOPDRESSING, GROOMING, OR BRUSHING. These cultural practices generally are used to lift prostrate leaf blades into a vertical position thereby allowing a more even cut with a mower and a smoother surface.

» Grooming and vertical mowing are also capable of removing leaf and thatch. There is limited research on the effect of each of these practices on ball roll distance, but it appears that they may have little, if any, affect on green speed (Salaiz, 1995).

» While topdressing has the additional benefit of filling voids and firming up the soil surface (Zontec, 1997), it has been shown to actually decrease ball roll distance for as much as a week, only to have ball roll distance increase to *greater* than pretopdressing distances (Nikolai, 2005).

ABOUT PLANT GROWTH REGULATORS. Like mowing and rolling, plant growth regulators (PGRs) also influence green speed, creating both long-term and diurnal effects on ball roll distances.

» Research on the effect of plant growth regulators on ball roll distance is limited, with some implying that the use of PGRs may have only a temporary effect (McCullough, 2005).

» Plant growth regulator use, however, has shown to consistently improve ball roll distances when diurnal turfgrass growth is considered (McCullough, 2005). And we all know that consistency in green speed throughout the day is an important factor when trying to produce optimal conditions throughout the duration of a tournament.

PLAN OF ACTION

The researchers plan to spend the next three years obtaining the preliminary data needed to then focus their efforts on finding the ultimate formula for maximizing green speeds while maintaining golf course putting green playability during tournament play. Here is their plan of action.

1: **Evaluate the effect of chemical and cultural practices on green speed and maintenance programs.** During the 2014 growing season, Dr. Kaminski and Lulis began their research with a field study to examine the influence of mowing heights and mowing frequency on putting green playability. The study evaluated:

» three mowing heights: 0.085", 0.100", and 0.115"

» several mowing frequencies: single cut, double cut, and double-double cut

Data collected, and currently being analyzed, include ball roll distance, firmness, soil moisture, and turfgrass quality. Trials in 2015 will be based on the results of this preliminary study.

The researchers will continue to investigate such factors as mowing height and mowing frequency, as well as rolling frequencies, topdressing, brushing, and grooming. The particulars:

» Trials will be conducted on various research putting greens at the Valentine Turfgrass Research Facility located in University Park, PA.

» Sites have been established with either Penn A-4 creeping bentgrass (*Agrostis stolonifera* L.) or annual bluegrass (*Poa annua* L.).

» Studies will be repeated on the different turfgrass species in an effort to evaluate the influence of two species commonly used on golf course putting greens in the northern United States.

» Studies will also be conducted at various times of the year to represent seasonal variation in environmental conditions.

2: **Conduct a superintendent survey.** Numerous golf course superintendents host tournaments of varying levels, and routinely, numerous data are collected. When pooled, this data could provide valuable insight into the management practices and environmental conditions that influence ball roll, as well as plant health.

» In 2015, a survey will be developed and delivered to golf course superintendents to assess the impact of these individual and combined management practices on green speed.

» Future plans, pending preliminary information, will be to develop a more refined data collection method in

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NEW RESEARCH (CONTINUED FROM PAGE 11)

cooperation with the PGA and USGA to take advantage of the copious data collected during weekly events on the respective tours.

EXPECTATIONS

In the end, the researchers hope to fine-tune the management practices into a definitive program that will help golf course superintendents maximize their green speeds and golf course putting green playability during short periods of time, such as those needed to host a tournament. Recommendations will ultimately be developed that can be adapted to the environmental conditions, turfgrass species, and other factors commonly influencing putting green speed.

For further information on Dr. Kaminski's research, you can reach him at jek156@psu.edu.

PRESIDENT'S MESSAGE (CONTINUED FROM PAGE 1)

A Little Support Goes a Long Way

WHERE DOES OUR RESEARCH COME FROM?

We support research projects from all local universities conducting trials pertinent to the research needs of superintendents in our area. As you will see in this issue, we are currently funding two research studies at Rutgers, another at Penn State, and another at Cornell. We have also supported research at both URI and the University of Connecticut and have worked with well-respected researchers from each of these universities, including Dr. James Murphy, Dr. Bruce Clarke, Dr. Albrecht Koppenhoffer, Dr. Frank Rossi, Dr. Jason Henderson, Dr. John Kaminski, Dr. Stephen Alm, and Dr. Bingru Huang. These are some of the best turf minds in all of turf research. We are fortunate to be surrounded by such great institutions and researchers.

WHAT IS KEY TO THE TRI-STATE'S SUCCESS?

Our ability to successfully fund the research we need to combat new turf diseases and issues comes down to one thing: Your financial support.

With your contributions over the past decade and a half, we have committed well over half a million dollars to research designed to produce exemplary golf courses. But this has not been done with ease. For as long as I can remember, we have been trying to accumulate enough savings to essentially "live off the interest." But instead, we have been essentially living hand-to-mouth—able to support projects but not grow our savings.

Making matters worse is that donations have dropped over the past several years while costs have risen. That is why I am asking you, now, to join the list of contributors you see in the center of this newsletter. To all of you listed there, I'd like to extend a big thank you. If your name is not on the list, please think seriously about making a Tri-State Turf Research Foundation donation a line item in your budget. It is truly such a small price to pay for the valuable research you receive in return. Together, we can work toward supporting the research we need to preserve not only the quality of golf turf, but also the vitality and integrity of the game of golf.

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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.

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