FOUNDATION NEWS

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PRESIDENT'S MESSAGE

Our Work Is Never Done

The Tri-State Turf Research Foundation has supported critical research projects for the past 20 years, and we don't intend to stop now! We've continued our fundraising efforts in 2012, working hard to increase awareness and support from all clubs, businesses, and individual golfers in the tri-state area.

As part of our commitment to communicating the important work we do, we have launched a new website homepage—tristateturf.org—that will not only showcase our research efforts, but also serve as a go-to source for area superintendents looking for answers to turf pests or problems or current trends in turf management. As with everything we do, we will continue to invest in this site with an eye toward ongoing improvement.

Another step forward is our new invoice, which more accurately reflects what your contributions to the Tri-State Turf Research Foundation actually represent: research vital to the ongoing improvement of course conditions—and the environment. A $200 annual donation is a line item in the golf course superintendent's budget, that, collectively, adds up to turf-enhancing—and in many cases, turf-*saving*—research that would not have been available to tri-state area superintendents without the foundation's support.

YOUR DOLLARS AT WORK

In this issue of *Foundation News*, you will read about four worthy research endeavors the Tri-State is funding. At the University of Rhode Island, we are continuing to support Dr. Steven Alm's work to uncover viable methods for combating the pyrethroid-resistant annual bluegrass weevil.

In addition, the board has approved funding for three new and exciting projects:

» Rutgers' Drs. Bruce Clarke and James Murphy are seeking to improve previously established best management practices for anthracnose control on *Poa* putting greens.

Les Kennedy Jr., CGCS, President
Tri-State Turf Research Foundation

» Rutgers' Dr. Bingru Huang will explore the use of plant growth regulators and biostimulants in both alleviating summer decline and promoting the recovery of creeping bentgrass greens.

» Cornell's Dr. Frank Rossi will analyze the effect of chemical and mechanical putting green management programs on ball roll.

The Tri-State Turf Research Foundation's fundraising efforts not only provide tri-state area superintendents with vital solutions to challenging turf problems, but also play a key role in supporting university-driven studies during a time when overall research funding has become increasingly limited.

If you have not yet responded to the Tri-State's fundraising efforts, please take a moment, now, to complete the form included with this mailing. (We can also email you a personalized contribution

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INSIDE THIS ISSUE

Putting the Brakes on the ABW

URI Researchers Draw Closer to a Formula for Control of the Turf-Threatening Annual Bluegrass Weevil

When the highly destructive annual bluegrass weevil (ABW) began to show signs, half a decade ago, of resistance to the once highly effective synthetic pyrethroids (bifenthrin and cyhalothrin), the Tri-State Turf Research Foundation agreed to support University of Rhode Island's Dr. Steven Alm and his team of researchers in their pursuit of more effective alternatives to the commonly used ABW controls.

Now in their fifth and final foundation-funded year of ABW trials, the URI research team is still in hot pursuit—both on golf courses and in the lab—of the ultimate formula for stopping ABW in its tracks.

What follows are the results of their ongoing study.

IT'S ALL IN THE TIMING

If there's one thing the researchers' trials have driven home about ABW control, it's that timing is everything.

According to Dr. Alm, there are three basic "targets" you can try to hit with insecticides to control the annual bluegrass weevil:

Target #1: When ABW adults emerge from overwintering sites to migrate to the *Poa annua* to lay eggs.
Solution: An adulticide: pyrethroid, chlorpyrifos, or trichlorfon.

Target #2: First-, second-, and third-instar larvae developing inside *Poa* plants.
Solution: A systemic insecticide: neonicotinoid or chlorantraniliprole.

Target #3: Fourth and fifth instars feeding on the plant crowns.
Solution: Pyrethroids, chlorpyrifos, spinosad, indoxacarb, or trichlorfon.

To ensure maximum chemical efficacy, the researchers continue to emphasize the importance of:

» alternating the insecticide modes-of-action to prevent resistance development

» monitoring weevil activity to ensure that the timing of treatment coincides with the various ABW life stages: adults and early-stage or late-stage larvae

The most reliable monitoring techniques:

» *Soapy flush:* A reliable method for monitoring adult activity is the soapy flush in which 2 ounces of lemon-scented dish liquid is combined with 2 gallons of water and then poured over an 8-square-foot area. The soap irritates the adult weevils lying deep within the turf thatch layer, causing them to rise to the surface within 5 minutes.

» *Pitfall traps:* This option seems to work best to monitor overwintering adult movement into fairways but is not as effective in monitoring first- or second-generation adults.

» *A saturated salt solution:* This is a good way to monitor for larval activity. Mix 4 cups of salt with a gallon of water. Then pull plugs, break them apart, and submerge them in the salt solution. If you have larvae, they will float to the surface.

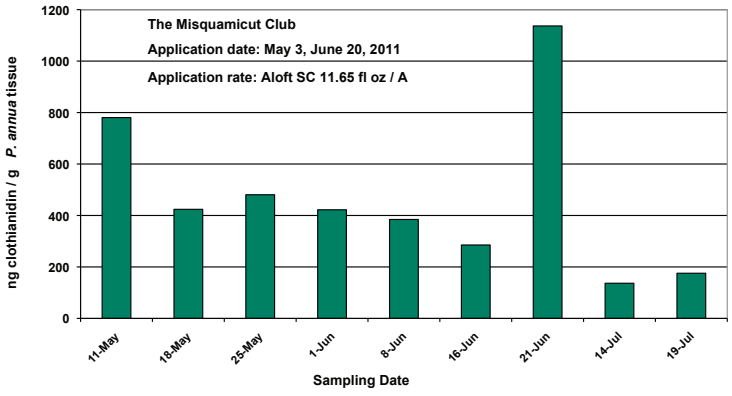

FIGURE 1
Nanograms of clothianidin/gram *Poa annua* tissue after applications of 11.65 fl. oz./A of Aloft SC on May 3 and June 20, 2011.

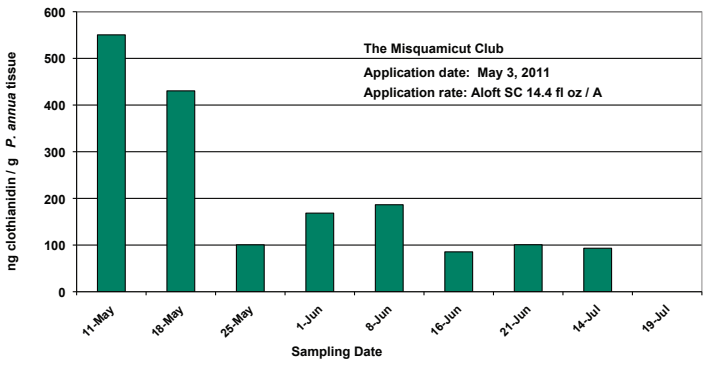

FIGURE 2
Nanograms of clothianidin/gram *Poa annua* tissue after one application of 14.4 fl. oz./A of Aloft SC on May 3, 2011.

Putting the Brakes on the ABW

Early-stage larvae feeding inside the plant stem will take longer to emerge and float.

Another method of monitoring: Sign on to DuPont's Weevil Trak website, http://www.weeviltrak.com/. This will allow you to see what researchers are recommending for weevil control in your particular area. Though the season for Weevil Trak will be coming to a close, be sure to check out this site next year to stay on top of any weevil activity and the most up-to-date controls in your area.

SIGNIFICANT FINDINGS IN 2011

Control, as you might expect, was most difficult when only a portion of the target population was controlled and/or the insecticide broke down before control was achieved.

The researchers discovered, in particular, that:

» *Neonicotinoid and neonicotinoid/pyrethroid combination products should not be applied too early in the season.* The researchers applied Aloft (14.4 and 2 x 11.65 fl. oz./A), Arena (6.4 and 12.8 dry oz./A), Merit 2F (1.2 pts./A), and Allectus (3.8 pts./A) to two golf course fairways. They took turf plugs weekly throughout the season and placed ABW adults on the plugs to feed. Other than right after the applications, there was no significant difference in weevil mortality between treated and control plugs.

If you apply a neonicotinoid/pyrethroid combination too early in the season, you will control only a small number of first-emerging adults. It makes better sense to make applications later, when a greater number of adults are active—and when larvae are beginning to develop inside the plant tissue.

A feeding study conducted by Drs. Pat Vittum and Ben McGraw in 2011 offered further support for later applications. The researchers vacuum sampled adults from New York, Connecticut, and Massachusetts from early spring to summer. They dissected and examined the adults for food in the gut and reproductive maturity. Their findings: "…we did not observe fresh food in the guts of adults until the end of May…". This implies that the adulticides must actually contact the adults to control them early in the season.

» *The amounts of the neonicotinoids, clothianidin (one active ingredient in Aloft and Arena) and imidacloprid (one active ingredient in Allectus and Merit) drop*

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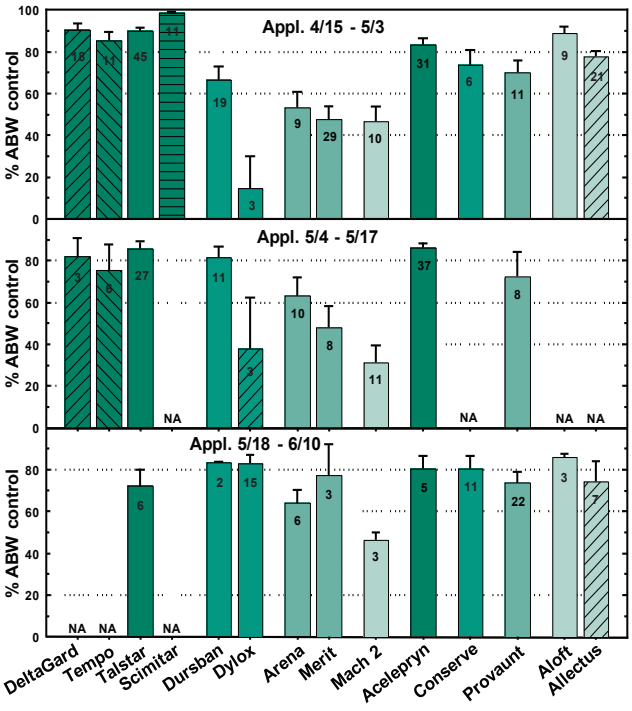
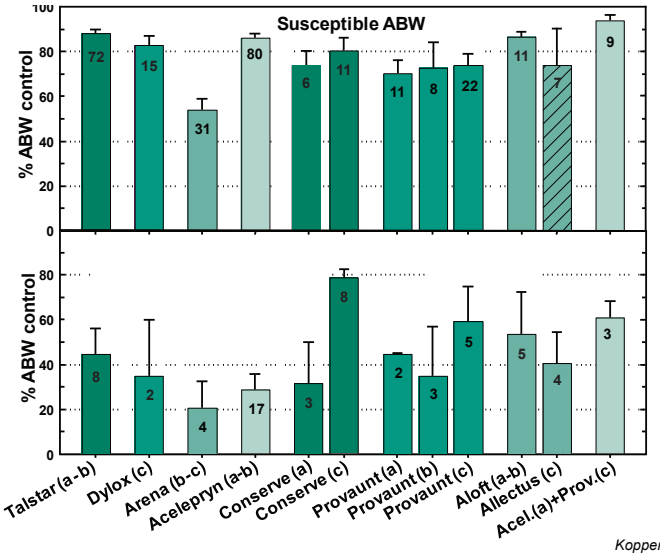


FIGURE 3
Efficacy of various chemical classes and application timings for ABW control. (The number inside a column indicates how many trials were analyzed.)



Koppenhöfer et al. 2012

FIGURE 4
Efficacy of insecticides versus susceptible and resistant annual bluegrass weevils.

Putting the Brakes on the ABW

off too quickly after the application date to provide adequate control of the adult ABW population (Figures 1 and 2). The researchers relied on the Enzyme-Linked Immuno-Sorbent Assay (ELISA) tests to make this determination and are repeating the ELISA research in 2012, taking larval samples weekly throughout the season.

» *The neonicotinoids provide better control for larvae than adults.* Interestingly, all three neonicotinoids—clothianidin, imidacloprid, and dinotefuran (Zylam)—showed very fast "knockdown" of adult weevils in Petri dishes in the laboratory, but then all recovered within 24 hours. Though neonicotinoids have clearly proved effective in controlling larvae, timing of applications is still critical.

It's essential to have the highest neonicotinoid concentration in the *Poa* when larvae are actually feeding inside the plant. In a "normal" year, that would mean you would want the greatest concentration of insecticide inside the *Poa* during the month of May to control the first generation, July for the second generation, and rarely late August to early September to control third-generation larvae. Depending on the results of the ELISA tests of concentrations of neonicotinoids inside *Poa* and larval counts, the researchers should be able to make better recommendations on timing of neonicotinoid applications and also just how high a concentration of neonicotinoids is required in *Poa annua* tissue to control larvae.

In a recent study, Rutgers' Dr. Albrecht Koppenhofer gathered data from turfgrass entomologists in the Northeast and analyzed the products available for control *(Figure 3)*. He also analyzed the products versus resistant populations *(Figure 4)*. His findings corroborated the findings in much of URI's research. Among them:

» The best strategy is to monitor enough so that you control the greatest number of adults when they are "on the move."

» Have a systemic—neonicotinoid or chlorantraniliprole—inside the plant when early-instar larvae are feeding—usually May, July, and rarely late August to early September.

» Apply either a pyrethroid, trichlorfon (Dylox), chlorpyrifos, spinosad (Conserve), or indoxacarb (Provaunt) for late-instar larvae feeding at the crown of *Poa annua*.

Finally, Dr. Alm and his team researched combinations of insecticides with the fungus *Beauveria bassiana*. Some of these combinations were highly effective in Petri dish assays, such as Zylam, Conserve, and Arena with BotaniGard *(Figure 5)*.

Since it is quite difficult for insects to develop resistance to fungi, the researchers plan to continue to research the possibilities of incorporating this product into an application window for maximum control.

PLANS FOR 2012

This year, the researchers will be taking samples of neonicotinoids weekly throughout the summer on two golf courses and extracting larvae and measuring head capsules to determine which instars are present during each week. This will allow the research team to determine the amounts of neonicotionids required in *Poa* tissue to control larvae. The team is also testing new chemistries as they become available.

Dr. Steven Alm is available to answer any questions concerning his research or your insect control plans. He can be reached at stevealm@uri.edu.

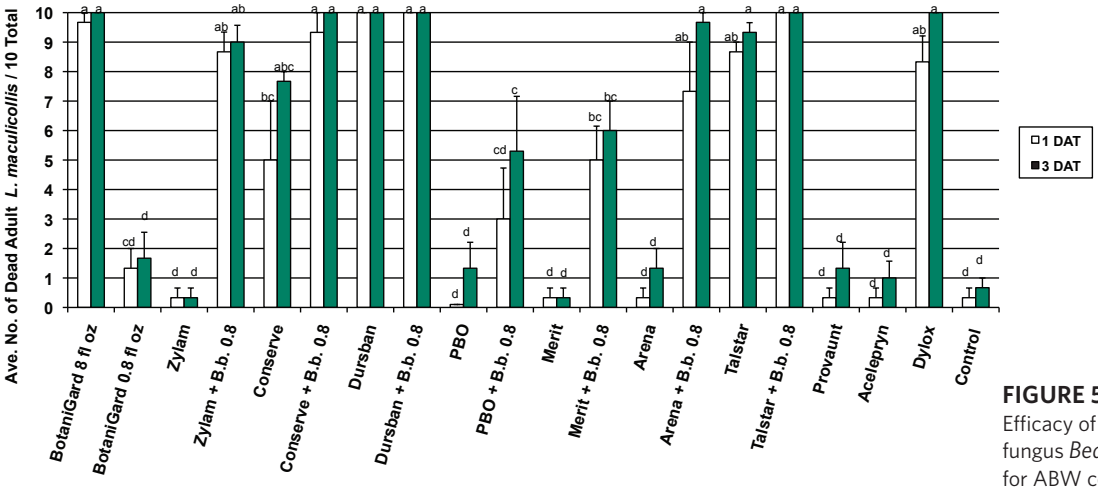


FIGURE 5
Efficacy of insecticides combined with the fungus *Beauveria bassiana* (BotaniGard) for ABW control.

Rutgers Researchers Broaden Scope of Anthracnose Trials

Anthracnose, caused by *Colletotrichum cereale,* remains a serious threat to annual bluegrass putting green turf. Hoping to provide area superintendents with a viable solution to this destructive disease, the Tri-State Turf Research Foundation has agreed to support Drs. James Murphy and Bruce Clarke in their quest to improve the best management practices for anthracnose control that the researchers had established in previous foundation-funded trials.

After three years' work, the Rutgers research team has determined, with some certainty, that sand topdressing and both granular and soluble nitrogen fertilization play a significant role in anthracnose activity. What they're hoping to learn, now, is precisely when and how to apply these—and other—cultural management practices in reducing disease severity on *Poa* putting green turf.

To do this, the researchers will be looking more closely at the impact of a variety of factors in anthracnose development and severity, including:

1. N source
2. Rate of summer N fertilization
3. Autumn and spring vs. summer fertilization
4. Mid-season cultivation, e.g., grooming, verticutting, and solid tining

In short, the researchers will evaluate the role of all common putting green management practices in the incidence of anthracnose.

THE PAYOFF

At the end of this three-year project, the Rutgers team hopes to provide superintendents with:

» specifics on how N fertility, sand topdressing, and cultivation affect anthracnose severity on annual bluegrass turf managed for acceptable putting green playing quality

» a comprehensive set of research-based best management practices that are designed to reduce anthracnose severity on *Poa* putting green turf while maintaining high-quality playing conditions

» the ability to reduce the number of fungicide applications required to manage this devastating disease

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.

Graduate students applying topdressing sand on anthracnose research plots.

Striving to Put a Stop to Summer Bentgrass Decline

Rutgers Researchers Put Plant Growth Regulators and Biostimulants to the Test in Alleviating SBD

Creeping bentgrass, *Agrostis palustris,* grows vigorously in cool weather during spring and fall. During summer months, new root production slows, root dieback occurs, and shoot growth declines, leading to a thin turf canopy. This problem has been called summer bentgrass decline (SBD). Many factors could contribute to SBD, including abiotic factors such as high temperature, high relative humidity, excessive soil moisture, poor air movement and soil aeration, as well as biotic factors such as diseases.

No matter what the cause, SBD has become a common problem—and growing concern—for superintendents in the tri-state area with creeping bentgrass greens. Greens suffering the effects of SBD are not only at risk during the summer months, but also going in to fall. They're often slow to recover, which affects turf quality and, in turn, playability.

Recognizing the challenges of bentgrass greens management, the Tri-State Turf Research Foundation has agreed to support Dr. Bingru Huang and her research team from Rutgers University in their work to uncover best management practices for alleviating summer decline and promoting recovery on bentgrass putting greens.

She will be looking, in particular, at the role plant growth regulators and biostimulants might play in sparing these greens from undue stress and decline.

WHAT WE KNOW—AND DON'T KNOW—ABOUT PGRS AND BIOSTIMULANTS

Since the 1980s, the use of plant growth regulators has become common practice among golf course superintendents. Though originally used solely, as the name implies, to inhibit plant growth and seedhead formation, PGRs are being used today for multiple purposes: enhancing overall turf quality, promoting a smooth and uniform playing surface, and improving stress tolerance in higher maintenance areas. A PGR inhibiting cell elongation, trinexapac-ethyl, has been used mainly for clipping reduction and enhancing general turf quality, but recently it's shown promise in improving turf performance under unfavorable environmental conditions, such as drought and heat stress.

In recent years, a number of biostimulants —natural products that work to stimulate plant growth and development—have emerged. Though these plant growth promoters contain a variety of ingredients, one of the most widely used components is seaweed extract. Seaweed extracts contain a large number of organic compounds, such as cytokinins, auxins, amino acids, vitamins, simple and complex sugars, enzymes, and proteins, as well as inorganic nutrients, such as nitrogen, phosphorous, potassium, and iron. Of those ingredients, cytokinins—plant hormones regulating cell division, leaf senescence, and stress defense—seem to show the most promise in stimulating turfgrass growth and stress tolerance.

But as with any class of products, their effectiveness hinges on the individual product's precise formulation and on myriad other factors, such as plant species, physiological conditions of the plants, and application rate and timing. The truth is, the effectiveness of different PGRs and biostimulants in alleviating SBD are not yet well documented. In addition, physiological mechanisms underlying the claimed benefits are poorly understood.

In a previous field study conducted by the researchers, they found that the combination of PGRs, gibberellins, and cytokinins, along with small amounts of nitrogen promoted rapid recovery of bentgrass from drought damages by promoting tiller production and more vigorous growth following stress. These results suggest that using PGRs and biostimulants could be a viable approach for promoting summer stress tolerance and recovery for creeping bentgrass. Time–and further trials—will tell.

THE TWO-YEAR PLAN

With funding approved for 2012 and 2013, Dr. Huang and her team will be working to develop comprehensive programs combining different PGRs and biostimulants based on their biological functions for alleviating summer bentgrass decline or promoting summer bentgrass performance, as well as promoting rapid recovery from summer damage.

Their plan:

» The study is being conducted on a 6-year-old Penncross bentgrass green built to USGA greens specifications at Rutgers University.

» The green will be managed using typical programs for irrigation, fertilization, and pesticide application and will be mowed daily at ⅛ inch.

» Turf will be rolled three times per week with a roller to simulate traffic.

» A variety of PGRs and biostimulants will be selected based on scientific and manufacturer knowledge of the biological functions of the active ingredients and the products' effectiveness in promoting plant health. *(See box, right, for PGRs and biostimulant products selected, along with their biological functions.)*

» Synergistic PGR/biostimulant products will be combined based on their biological functions and how they may affect summer stress tolerance and fall recovery from summer damages in bentgrass. They will be applied biweekly from May through October following the

Striving to Put a Stop to Summer Bentgrass Decline

manufacturer-recommended rates and application methods, and each treatment will be replicated three times in three plots (3' x 5'). The research team plans to make the following applications:

1. Prior to summer heat stress (May–June): Gibberellic acid (GA) inhibitors to control vertical growth and build turf density.

2. In the thick of summer stress (July–August): Products containing cytokinins, humic acids, amino acids, organic acids, and sugars alone or in combination to promote turf color, density, and root growth.

3. During periods of recovery from summer stress (September–October): Products containing GA to promote shoot vertical growth, cytokinins to promote tiller formation, and nitrogen to promote greener turf.

» During each year of the study, the researchers will evaluate bentgrass summer performance during July and August and recovery from summer damage in September and October. To do this, they will examine weekly or biweekly turf quality (overall turf performance), leaf photochemical efficiency (indicator of photosynthesis and leaf senescence), leaf area index growth, green leaf biomass, and ball roll speed.

» On a monthly basis, root growth data will be collected by measuring total root length present in three soil cores (20 cm deep, 7.8 cm^3 soil volume/core) taken from random locations within each subplot.

EXPECTED OUTCOME

In addition to developing effective programs using PGRs and biostimulants, the researchers are looking forward to providing scientific explanations of how these products affect heat tolerance and recovery in creeping bentgrass greens.

For further information on the researchers' trials, you can contact Dr. Huang at Huang@aesop.rutgers.edu

PGRs and Biostimulant Products Selected for Study

1. *PGRs:* Inhibit gibberellic acid (GA) synthesis and vertical shoot growth to reduce water consumption / Primo MAXX (Syngenta).

2. *Cytokinins:* Promote tiller formation and chlorophyll synthesis to promote greener turf and higher turf density / Analytic products with pure cytokinins (25 micro mole) at 3 ozs./1,000 ft^2.

3. Combination of *Humic Acids*: Have hormone-like functions to stimulate root growth and increase carbohydrate production.

4. *Amino Acids*: Provide organic nitrogen for protein synthesis

5. *Organic Acids and Sugars:* Provide source of energy for plant growth / Seaweed extracts (Ocean Organics) and Floratine products (Astron, Knife Plus, Perk Up, Protesyn, and Renaissance) at manufacturer-recommended rates.

6. *Gibberellic Acids:* Promote shoot elongation for rapid recovery from stress / Analytic products with pure GA (50 mol) at 3 ozs./1,000 ft^2.

7. *Control:* Water only in the same amount as in the product application. Fertilize at half-strength using Hoagland's solution.

Cornell's Dr. Rossi Pursues Practical Measures for Maximizing Ball Roll

Golf course putting green surfaces comprise the smallest area of a golf course, yet they command more than two-thirds of the shots in a typical round of golf! It's no wonder, then, that golfers demand high-performing putting surfaces, particularly when it comes to ball roll consistency and distance.

To rise to the challenge, turfgrass managers have devised sophisticated management systems integrating a variety of chemical and mechanical maintenance practices in an attempt to maximize performance and minimize stress and damage from pests. Often, however, these practices backfire, leading to significant increases in pesticide use to prevent turf loss from stress-induced disease, not the least of which is basal rot anthracnose.

Though there are studies out there that claim to have pinpointed the precise practices for better ball roll and reduced stress, these studies lack the intensive and precise measurements, as well as the consistent implementation of management systems required to deem their findings reliable.

As a result, the Tri-State Turf Research Foundation has agreed to support Cornell University's Dr. Frank Rossi in his pursuit of a tried-and-true formula for improving ball roll without subjecting putting surfaces to undue stress and, in turn, disease and pest problems.

Dr. Rossi's first step is to develop and validate a system for measuring the influence of management practices on turfgrass growth and, in turn, ball roll distance. To do this, he will evaluate the effect of:

» plant growth regulator use on clipping yield, turfgrass quality, putting surface friction, and ball roll distance

» mowing and rolling programs with and without plant growth regulators on clipping yield, turfgrass quality, putting surface friction, and ball roll distance

This project will be the first to intensively measure the influence of management practices on turfgrass growth and ball roll. Measurements will be made three times per day for 40 days during three growing seasons.

WHAT TO EXPECT

At the study's end, Dr. Rossi's goal is to provide turfgrass managers with:

» definitive information on the optimal use of plant growth regulators and various management practices on ball roll distance

» an efficient, low-stress management program that substantially influences putting surface performance

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

PRESIDENT'S MESSAGE (CONTINUED FROM PAGE 1)

Our Work Is Never Done

invoice, if needed.) When you contribute to the Tri-State Turf Research Foundation, you contribute to your future success as a turfgrass manager. And for that, $200 is truly a small price to pay!

Finally, I would like to personally thank all of the contributors for 2012 who are listed in this issue. It takes everyone working together to be successful, and this year looks like it will be one of our best ever—with your support!

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