FOUNDATION NEWS

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PRESIDENT'S MESSAGE

The Tri-State Makes New Strides

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

This past year has seen some exciting developments with the Tri-State Turf Research Foundation as we continue to work toward building our base of support and communicating our message to a broader audience. I would like to thank those of you who have already contributed this year to the foundation's research efforts. It's your support that allows us to continue to tackle troublesome turf issues affecting tri-state area golf courses.

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BROADENING OUR REACH

To help the foundation fortify its mission of "providing turfgrass research for better golf and a safer environment," the Tri-State board has enlisted the help of Ed Brockner, who in addition to serving as the MetGCSA executive director, has assumed the role of executive director for the Tri-State, working on our behalf to boost fundraising efforts. With Ed's help, we hope to increase the foundation's revenue by 20 percent.

Ed has already established an interesting avenue for publicizing the work of both the Tri-State Turf Research Foundation and the golf course superintendent. Working with the MGA, Ed has secured funding from one of its sponsors, Custom Golf Materials, for a "Superintendent's Spotlight." This is an article written by an area superintendent, highlighting an aspect of golf course maintenance—anything from syringing and aeration to weather-related challenges—and is designed to elevate the general golfing public's understanding of and appreciation for all that goes into our profession.

A several-line "teaser" for the spotlight appears in the MGA's bi-monthly, online E-Revision Newsletter, which publishes handicap revisions. Beneath the teaser is a link to the Tri-State Turf Research Foundation website, where readers are prompted to view the full story. The intent, of course, is to raise awareness of the foundation's ongoing efforts in turfgrass research. Please be sure to log on to tristateturf.org for a look at the Superintendent's Spotlight and all that the foundation's site has to offer.

If you have any questions about the Tri-State's work or would like to inquire about making a contribution, please contact Ed at edbrockner@hotmail.com or 917-575-3809.

A CHANGING OF THE GUARD

The Tri-State would also like to welcome Susan O'Dowd as the new executive secretary of the foundation. Susan has been an outstanding addition already

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The ABW Battle Continues

Researchers From URI and Rutgers Dig Deeper Into Viable Monitoring and Control Methods

While great strides have been made in the control of the annual bluegrass weevil (ABW) on golf course turf, researchers are still in hot pursuit of a surefire method for keeping this highly destructive pest at bay.

Technically known as *Listronotus maculicollis*, the ABW has been particularly problematic on close-cut annual bluegrass *(Poa annua)* in the northeastern United States. The trouble begins when young larvae tunnel the grass plant's stems, causing the central leaf blades to yellow and die. The older larvae feed externally on crowns, sometimes completely severing the stems from the roots.

The most severe ABW damage is normally caused by first-generation older larvae around late May/early June in the New York metropolitan area. Damage from the second-generation larvae, in early to mid-July, is usually less severe and more localized.

Invested in providing golf course superintendents with a concrete plan for managing this seemingly unstoppable pest, the Tri-State Turf Research Foundation has funded the University of Rhode Island (URI) and Rutgers University research teams in their pursuit of viable monitoring and control methods.

As URI's commitment with the Tri-State draws to a close, the team from Rutgers enters into a new phase of ABW research with the foundation's support. On the following pages, you will find URI's latest findings and recommendations, as well as Rutgers' plan-of-attack in its endeavor to uncover a reliable way to detect and then stop the ABW in its tracks.

URI Researchers Offer Promising Approach to ABW Control

With five years of Tri-State Turf Research Foundation funding behind them, University of Rhode Island's Dr. Steven Alm and his team of researchers have made considerable headway in the battle against the pyrethroid-resistant annual bluegrass weevil. Conducting trials on both golf courses and in the lab, Dr. Alm has succeeded in developing several viable alternatives to the commonly used ABW controls.

What follows are the recent developments in the team's ABW trials, as well as their most up-to-date recommendations for keeping your turf out of harm's way.

CHEMICAL TRIALS IN 2012 AND 2013

Over the course of the past two seasons, the researchers conducted trials on golf course fairways in Rhode Island and Connecticut in an attempt to determine the amounts of neonicotinoids required in *Poa annua* tissue to most effectively control larvae.

During the trials, the researchers:

» Applied Allectus (imidacloprid and bifenthrin), Aloft (clothianidin and bifenthrin), Merit (imidacloprid), and Arena (clothianidin), and bifenthrin to the golf course fairways.

» Took grass clippings and plugs weekly after treatment from April 17 to October 9, 2012 (25 weeks) and from May 20 to June 24, 2013 (5 weeks).

» Used the Enzyme-Linked Immuno-Sorbent Assay (ELISA) to determine the concentration (in ppb) of clothianidin and imidacloprid in the grass samples.

» Extracted larvae from the turf plugs by placing them in modified Berlese funnels in incubators and in saturated salt solutions.

The results from 2012 and 2013 indicated that:

» Up to 2,220 ppb clothianidin and 9,230 ppb imidacloprid were detected in *Poa annua* tissue after labeled rates of the products were applied.

Imidacloprid levels were above the detection limit of 200 ppb for eight weeks in 2012 and at least five weeks in 2013. (*Poa* samples were collected for five weeks in 2013 to coincide with larval sampling.)

Clothianidin levels were above the 200 ppb detection limit for four weeks in 2012 and 2013.

This does not necessarily mean that imidacloprid is killing larvae for a longer period of time than clothianidin since the inherent toxicity of the two compounds is most likely different. *Figure 1, right,* shows the results of larval sampling in 2012.

» There were no statistically significant differences between treatment and control plots. Possible explanations for no differences in 2012:

URI Researchers Offer Promising Approach to ABW Control

1. There was resistance at the two study sites to both pyrethroids and neonicotinoids. Koppenhöfer et al. (2012) suggested that some courses appear to be exhibiting resistance to several insecticide modes of action.

2. The insect pressure at these two sites was not high enough to show any insecticide effect. Since significant insect mortality was demonstrated in 2013 *(see Table 1)*, low insect pressure in 2012 could be the primary reason for the lack of control shown in 2012.

The researchers' 2013 trials demonstrated that:

» Given the active ingredient amounts per acre *(Table 1)*, bifenthrin alone is still causing a significant level of mortality, even where pyrethroid-resistant insects are found.

» Neonicotinoids alone can be relied on for only a portion of the control needed to prevent damage on courses.

» The combination products caused greater mortality, but not statistically significantly greater mortality than bifenthrin alone at the course where the trial was conducted.

Product	Rate/Acre	Lbs. a.i. Imidacloprid/ Acre	Lbs. a.i. Clothianidin/ Acre	Lbs. a.i. Bifenthrin/ Acre	% control[1]
Allectus SC	4.5 pts.	.25	--	0.1	75c
Aloft SC	14.4 fl. ozs.	--	.25	0.123	56bc
Talstar	23.6 fl. ozs.*	--	--	--	55bc
Merit 2F	1.6 pts.	0.4	0.123*	--	24ab
Arena 50WDG	12.8 ozs.	--	0.4	--	22ab

TABLE 1
Several neonicotinoid and neonicotinoid/bifenthrin products, application rates, amounts of active ingredients, and mean percent control from field trial data 2013.
[1] Percent control followed by the same letters are not significantly different.
*This rate is higher than the label rate but was used to make a comparison with the high rate of Aloft.

SYNERGIST TRIALS IN 2012 AND 2013

The researchers have also continued experiments with the fungus *Beauveria bassiana*. Since it is quite difficult for insects to develop resistance to fungi, the researchers will continue to explore the possibility of incorporating this product into an application window for maximum control.

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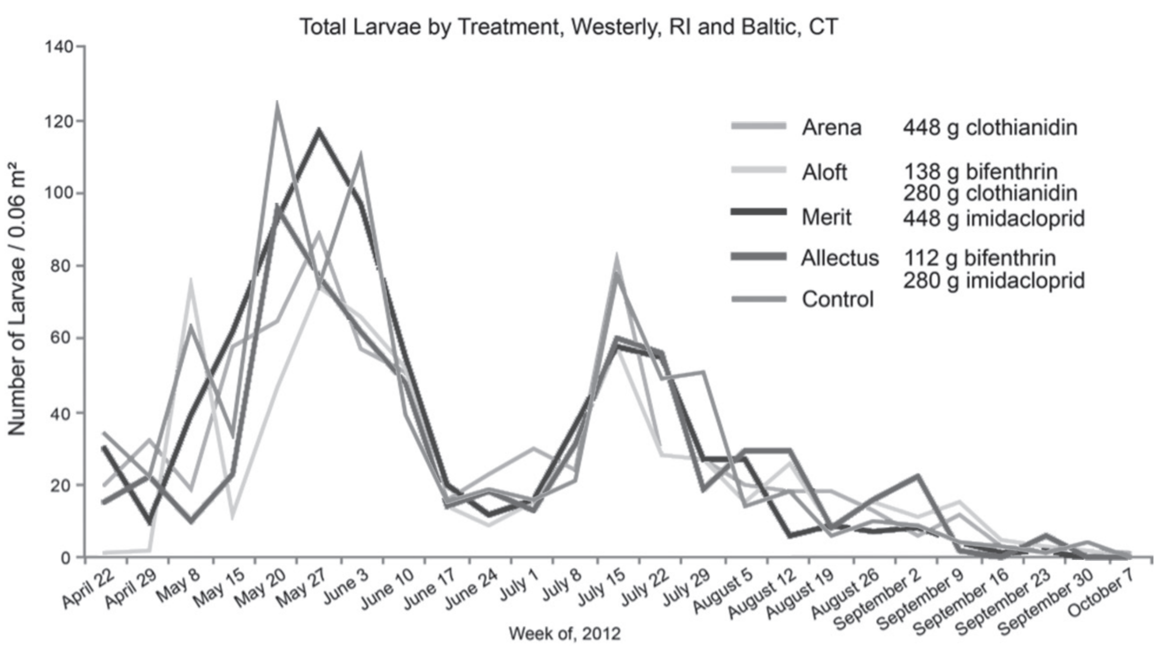

FIGURE 1
Efficacy of insecticides in ABW larval control, 2012

URI Researchers Offer Promising Approach to ABW Control

The research team did discover that:

» While labeled rates killed ABW adults in 24 hours in Petri dishes, it appears that the carrier oil (88.7 percent of the formulation) is causing most of the early mortality.

» After five to seven days, *B. bassiana* does begin to cause additional mortality, indicating that, when used alone or in combination with neonicotinoids or other chemical classes, *B. bassiana* may add another mode of action to the insecticide arsenal.

» Surfactants alone may also be useful in the control of adults by essentially drowning them. This method of control has proved effective in trials with other types of pests.

BEST OPTIONS FOR ACHIEVING CONTROL

Over the course of the researchers' trials, there's one thing about ABW control that hasn't changed: the importance of timing. In his last report, Dr. Alm noted three basic "targets" you can try to hit with insecticides to control the annual bluegrass weevil. They bear repeating:

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 (Dylox).

Target #2: First, second, and third instar larvae developing inside *Poa* plants (May, July, and rarely late August to early September).
Solution: A systemic insecticide: neonicotinoid or chlorantraniliprole (Acelepryn).

The researchers point out, however, that their test results show that neonicotinoids alone are able to control only a portion of larvae. Koppenhöfer et al. (2012) analyzed 49 field trials with various rates and formulations of Arena and 56 with Merit and found that applications of clothianidin or imidacloprid between April 15 and May 3 provided an average of 54 and 48 percent control respectively, whereas applications between May 18 and June 10 provided averages of 64 and 78 percent control respectively. This coincides with the researchers' findings that levels of neonicotinoids are present at toxic levels in *Poa* for only a portion of the larval infestation period.

Target #3: Fourth and fifth instars feeding on the plant crowns.
Solution: pyrethroids, chlorpyrifos, spinosad (Conserve), indoxacarb (Provaunt), or trichlorfon (Dylox).

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

» alternating the insecticide modes-of-action to prevent resistance development, while keeping in mind that depending on the level of resistance at your course, you may not be able to rely, as you did in the past, on season-long control given the relatively short period that neonicotinoids are present in *Poa* tissue (4 to 8 weeks)

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

Another method of monitoring: Sign on to Syngenta's Weevil Trak website, http://www.greencastonline.com/weeviltrak. This will allow you to see what researchers are recommending for weevil control in your particular area. Though the season for Weevil Trak has come 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.

LOOKING AHEAD

In the coming year, the researchers plan to:

» continue to refine the rates, products, and application timings to maximize control of early instar larvae

» conduct field trials to examine the effectiveness of *B. bassiana* and surfactants in controlling adult ABW and the potential of the residual of chlorantraniliprole (Acelepryn) in controlling larval populations

» continue to evaluate new chemistries for both adult and larval control

Dr. Steven Alm is available to answer any questions concerning his research or your insect control plans. He can be reached at 401-874-5998 or stevealm@uri.edu.

Putting IPM to Work in ABW Management

Rutgers Researchers Take a New Tack in the Search for a Successful ABW Control

The annual bluegrass weevil seems determined to stay, now frequently eluding the once highly effective pyrethroid applications used to keep these destructive pests at bay. With preventive insecticides being applied up to six times a year, it is not surprising that the ABW adults now seem, in many instances, unfazed by pyrethroids—as well as less susceptible to some of the new chemistries currently in development.

With the threat of pyrethroid resistance and increasing pressure from government agencies and the public to reduce pesticide use, 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 chemical alternatives for ABW control.

Adult ABW—Photo: Ben McGraw

This spring, the researchers began work in three areas, hoping over the next three years to facilitate the development of more sustainable approaches to the management of ABW on golf courses. Here's what they have planned:

1: Develop User-friendly Sampling and Monitoring Methods. Effective and reliable monitoring is the cornerstone of integrated pest management (IPM). Yet current ABW monitoring methods are either ineffective or just too labor-intensive to execute. As a result, they're rarely used. What's more, the sampling methods and the factors that affect them are poorly understood. The researchers propose, therefore, to determine more feasible methods for turfgrass managers to use in monitoring and sampling ABW adult and larval populations.

One of their goals is to identify semio-chemical attractants (pheromones, host-plant volatiles) appropriate in both monitoring and managing the ABW. The researchers will study the behavioral and physiological responses of male and female weevils to these attractants, which appear to have several distinct advantages.

They have proved:

» damaging only to target pests

» relatively nontoxic and required in low amounts

» nonpersistent and environmentally safe

» not susceptible to developing insect resistance

2: Identify ABW-Resistant Turf Species. Seeking turfgrass species that are resistant to pests is a critical component of IPM. While *Poa annua* has long been considered a preferred host of the ABW and/or particularly susceptible to it, an increasing number of field observations are showing that the ABW is also plaguing creeping bentgrasses. With little experimental evidence for host preferences available, the researchers propose to determine the susceptibility of different bentgrass species/cultivars to ABW, as well as their suitability to ABW hosts in comparison with annual bluegrass.

The research will provide superintendents with:

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Seeking ABW Test Sites

As part of his search for a reliable approach to ABW control, Rutgers' Dr. Albrecht Koppenhöfer will be tackling what is probably the biggest and most pressing problem with ABW management: insecticide resistance. He and his research team are looking for at least six courses in the Long Island, New Jersey, Westchester, Connecticut, and Hudson Valley areas facing various degrees of ABW resistance.

ABW damage—Photo: Ben McGraw

WHAT DOES YOUR INVOLVEMENT MEAN?

When you volunteer your course, the team will collect at least 400 adult weevils between late October and mid-November and, as needed, in March. Sampling will be conducted without disruption to your golf course. The samples will be gathered from the ABW's overwintering sites, which are typically along the tree lines of wooded areas near fairways or around greens that have consistent problems with ABW. The weevils will then be put to the test in lab and greenhouse studies on insecticide resistance.

If you have consistent problems with ABW, believe that they are likely to be resistant to insecticides, and are willing to accept a little sampling activity in return for free ABW removal, please contact Dr. Koppenhöfer as soon as possible. You can reach him at 848-932-9324 or koppenhofer@aesop.rutgers.edu, http://www-rci.rutgers.edu/~insects/amk.htm.

Rutgers Researchers Seek Best Management Practices to Keep Anthracnose at Bay

Anthracnose remains a serious threat to annual bluegrass putting green turf throughout the Northeast. Though first observed in New Jersey in 1930, this highly destructive fungal disease did not become an epidemic on golf courses until the mid-'90s.

Determined to get to the bottom of this surge in anthracnose activity, Rutgers' Drs. James Murphy and Bruce Clarke have spent the past 13 years evaluating the role cultural practices such as nitrogen (N) fertility, sand topdressing, mowing, and rolling play in anthracnose severity on annual bluegrass turf.

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

In 2012, the foundation agreed to provide an additional three years' support to Drs. Murphy and Clarke 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

In 2012 and 2013, the researchers initiated several trials to determine the impact of a variety of factors on anthracnose development and severity. Among them:

1. N source
2. Potassium (K) fertilization
3. Sand topdressing timing
4. The effect of combining BMPs on fungicide efficacy and turf quality

Trial #1: The researchers evaluated five soluble-N sources applied at a low rate every week or biweekly. They were:

» Ammonium nitrate

» Ammonium sulfate

» Calcium nitrate

» Potassium nitrate

» Urea

The outcome: Weekly applications of potassium nitrate resulted in the least amount of disease and the best turf quality of all the treatments.

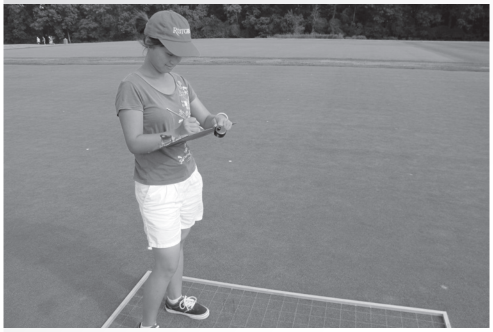
Trial #2: The researchers next initiated a trial to determine whether potassium fertilization has an effect on anthracnose disease severity.
The outcome: Initial data indicate that soil deficiencies in K can result in greater disease severity, suggesting that maintenance applications of soluble K should be used to reduce anthracnose severity.

Trial #3: The researchers continued work they had begun in 2010 to evaluate the impact of autumn, spring, and summer topdressing on anthracnose severity.
The outcome: Results clearly indicate that sand topdressing applied in the spring at 800 lbs. per 1000 sq. ft. were more effective in reducing disease severity than the autumn applications. Summer topdressing with very low rates of sand—25 to 50 lbs. per 1000 sq. ft. per application—had little to no effect on disease, which suggests that these rates were too low to have an impact on disease severity.

The researchers conducted the remaining two field trials to evaluate combinations of BMPs:

C. Schmid applying potassium treatments to research plots in North Brunswick, NJ.

Rutgers Researchers Seek Best Management Practices to Keep Anthracnose at Bay



R. Wang rating anthracnose severity on annual bluegrass putting green turf.

Trial #4: In this BMP trial, mowing height, N fertility, and sand topdressing were evaluated for their effect on anthracnose severity and playability of annual bluegrass turf.
The outcome: The research team's initial findings indicated that increasing N fertility had the greatest reduction in disease severity. Increasing mowing height and sand topdressing rate also decreased disease severity, however, not as dramatically as increased N.

As expected, mowing height had the greatest impact on green speed (Stimpmeter), while the N fertility and sand topdressing had a much smaller impact that was, most likely, imperceptible to golfers.

Trial #5: In a second BMP trial, mowing height and N fertility were evaluated for their effects on fungicide efficacy.
The outcome: Preliminary results indicate that it is possible to achieve acceptable disease control with reduced fungicide rates or fewer threshold-based applications (increased intervals between sprays) of fungicides when greater N fertility is applied.

THE TAKEAWAY

» Light, frequent applications of potassium nitrate can be used to reduce anthracnose severity. Soluble potassium can be added to other N sources, such as urea, for similar results.

» Spring topdressing provides a greater and longer-term reduction of anthracnose severity than topdressing during autumn. Topdressing at very low rates during the summer may have little to no effect on anthracnose severity.

When it comes to BMP treatments:

» N fertility has the greatest effect on reducing anthracnose severity, while mowing height has the greatest effect on playability (green speed).

» Increased N fertility reduces anthracnose severity more than increased sand topdressing or raising mowing heights.

» Increased N fertility will allow the use of reduced fungicides rates or less frequent applications to provide acceptable control of anthracnose.

PLANS FOR 2014

The Rutgers researchers will continue these assessments of best management practices (BMPs) for anthracnose control. They hope to develop recommendations that will lead to more efficient and effective use of fungicides, as well as more specific soil and tissue test recommendations for potassium fertilization.

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.

J. Hempfling applying sand topdressing treatments to anthracnose research plots in North Brunswick, NJ.

Pursuing a Reliable Formula for Improved Ball Roll

Cornell's Dr. Rossi Examines the Role of Putting Green Management Practices on Ball Roll

Some things never change. That proves true of golfer expectations. Golfers at every skill level continue to demand high-performing putting surfaces, particularly when it comes to ball roll consistency and distance.

In response, turfgrass managers have devised sophisticated management systems, integrating a variety of mechanical and chemical maintenance practices designed to maximize performance while minimizing stress and damage from disease and pests. 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 basal rot anthracnose.

Though several research projects have concluded that rolling, plant growth regulators, and fertilization have significant effects on ball roll distance while reducing stress-related problems, these studies 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 is supporting Cornell University's Dr. Frank Rossi in his search for a more reliable formula for improving ball roll without subjecting putting green turf to undue stress and disease.

Entering into the third, and last year, of foundation-funded research, Dr. Rossi began in 2012 conducting field trials to develop and validate a system for measuring the influence of management practices on turfgrass growth and, in turn, ball roll distance. The only study of its kind to date, Dr. Rossi's research is designed 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

Here's where the trials to-date have taken us.

THE METHOD

In 2012 and 2013, 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. During the course of the trials:

» Overhead irrigation was scheduled to maintain a soil moisture level of 15 percent.

» The experimental area was fertilized weekly with 0.1 lbs. N/M, primarily as ammonium sulfate or urea with mono-ammonium phosphate, potassium sulfate, and iron sulfate used to supply balanced fertility. The pH of the root zone was 8.2.

» Sand topdressing followed light, vertical mowing after each data collection period.

» Fungicides were used as necessary to prevent disease outbreaks.

» The green surface was mowed daily at 0.100" bench height with a Toro Greensmaster 1000 and then rolled with a Tru-Turf greens roller.

» Golfer traffic was simulated with a trafficking device consisting of two, 0.5m-diameter rollers fitted with SoftSpikes. The rollers created a slipping motion and resulted in traffic equivalent to 30,000 rounds of golf during a growing season.

The experiment was arranged in a completely randomized design with three treatment replicates—each plot measuring 4' by 15'.

» Treatments consisted of three plant growth regulators (PGRs)—trinexapac-ethyl, paclobutrazol, and flurprimidol—which were applied with a CO_2-powered backpack sprayer equipped with TeeJet 11010 flat fan nozzles at 40psi. The calibrated sprayer delivered a volume of 2.0 gals./M.

» Trinexapac-ethyl was applied throughout the growing season at 0.125 fl. ozs./M, paclobutrazol at 0.2 fl. ozs./M, and flurprimidol at 0.25 fl. ozs./M with the first application occurring after the first week of mowing in May of each season.

» Ball roll data was collected three times between June and August in both 2012 and 2013.

» In an effort to sustain yield suppression, trinexapac-ethyl was reapplied every 200 growing-degree-days with a base temperature of 0°C/32°F (Kreuser and Soldat, 2011). That meant trinexapac-ethyl was applied 12 times in 2012 and 9 times in 2013.

» Due to soil degradation, the activity of paclobutrazol and flurprimidol diminishes over time. The researchers used a growing-degree-day-based model to schedule applications. As a result, paclobutrazol and flurprimidol were applied six times in 2012 and four times in 2013.

» Ball roll distance was measured immediately after mowing and, again, eight hours after mowing with a PELZmeter (PelzGolf, Independent Golf Research, Inc., Spicewood, TX).

» Clipping yield was quantified during each collection period.

» Visual turfgrass quality ratings were taken regularly throughout the study.

Pursuing a Reliable Formula for Improved Ball Roll

SIGNIFICANT FINDINGS IN 2012 AND 2013

ON CLIPPING YIELD . . .

Turfgrass growth, which was measured by clipping yield, was significantly suppressed in both years of the study. At no time during the study, however, was suppression greater than 15 to 20 percent of normal growth. More specifically, growth was suppressed between:

» 8 and 12 percent by trinexapac-ethyl

» 12 and 18 percent by flurprimidol

» 15 and 20 percent by paclobutrazol

These values are consistent with previously reported growth suppression levels at these rates. However, little information exists on growth suppression using the growing-degree-day application strategy. Still, it was clear from the data that little to no "rebound" effect occurred during the two years that would negate any growth suppression realized during the primary suppression phase.

In essence, we are confident by our measures that we *maintained consistent* growth regulation as defined by clipping yield for our entire study period.

ON BALL ROLL . . .

The ball roll data gathered *(Figure 1)* during the six data collections over a two-year period demonstrated little to no difference among the PGR treatments.

» In both years, ball roll ranged between 10 and 13 feet.

» During only four of the 60 data collections—i.e., less than 10 percent of the time—was there a perceptible difference in ball roll. (A golfer cannot perceive a difference in ball roll that is under 6".)

While the influence of PGRs on ball roll distance was unremarkable, there are other findings worth noting about ball roll distance. The 60 data collection events that occurred in the study revealed:

» Ball roll distance was always slower eight hours after a single cut and single roll. (We should pass this along to Johnny Miller).

» After four days of single cutting and single rolling, the test plots reached maximum ball roll distance.

» Ball roll distance seemed to be influenced more by the weather than any other factor.

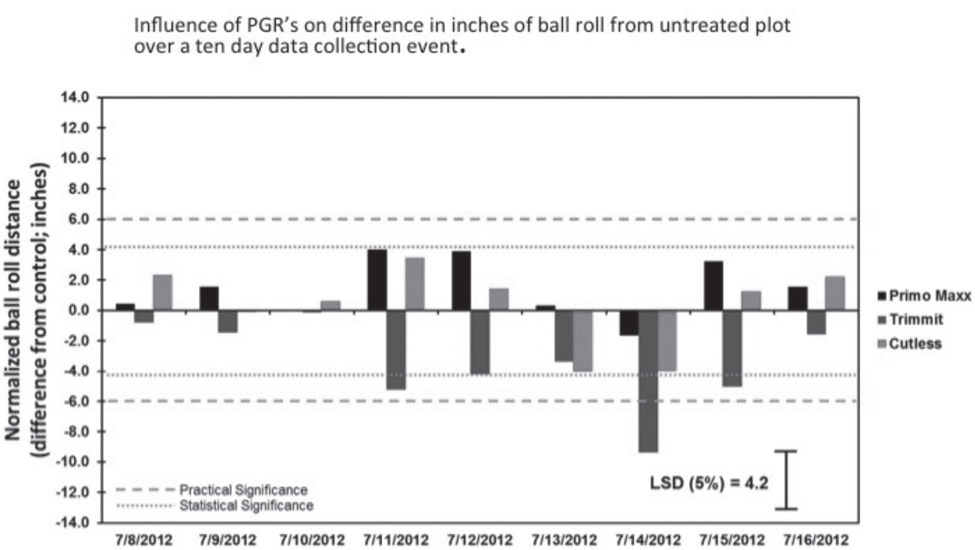


FIGURE 1
Practical significance is the detectable difference by golfers.
Statistical significance accounts only for numerical variation.

CONCLUSIONS TO-DATE

After two seasons of field trials, the researchers were able to confirm that:

» Ball roll distance is *not* correlated to turfgrass growth suppression imposed by using PGRs.

» The PGRs suppressed growth at rates that ranged from 80 to 90 percent of normal growth, but there were no significant differences among the PGRs when it came to their effect on ball roll. In fact, it does not appear that even measurable changes in growth alter ball roll.

» The conventional wisdom that "greens speed up" during the day is inconsistent with our data from this trial.

PLANS FOR 2014

During the final year of the study, Dr. Rossi will:

» continue to treat the test plots with PGRs

» alter mowing and rolling programs to assess the influence of various management programs on ball roll distance

Dr. Rossi's ultimate goal is to provide turfgrass managers with an understanding of the interaction of turfgrass growth and ball roll distance under modern putting green management programs.

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

Pitting PGRs and Biostimulants Against Summer Bentgrass Decline

Rutgers Researchers Seek Practical Measures for Alleviating SBD on Creeping Bentgrass Greens

Creeping bentgrass, *Agrostis stolonifera* L., is a cool-season grass widely used on putting greens because of its highly desirable turf characteristics. During spring and fall, this grass species grows vigorously. During summer months, however, creeping bentgrass turf frequently shows signs of stress. Commonly referred to as summer bentgrass decline (SBD), this syndrome is a major concern of superintendents growing creeping bentgrass greens across the country.

Many factors could contribute to SBD, but heat stress has proved the primary culprit in the decline in turf quality and physiological activities of creeping bentgrass.

The telltale sign of bentgrass decline is a thinning turf canopy, which typically begins as new root production slows, root dieback occurs, and shoot growth declines. Root dieback inhibits water and nutrient uptake, as well as other metabolic pathways including the synthesis of essential hormones such as cytokinins. A decline in cytokinin content may limit shoot growth and cause leaf senescence.

Hoping to help superintendents avoid the ill effects of summer bentgrass decline, the Tri-State Turf Research Foundation has supported Dr. Bingru Huang and her research team from Rugers University in their work to identify best management practices for alleviating SBD on bentgrass putting greens.

In their second and final year of foundation-funded work, the researchers continued to examine the role plant growth regulators (PGRs) and biostimulants could play in sparing these greens from undue stress and decline.

PGRS AND BIOSTIMULANTS IN PLANT GROWTH HEALTH

Since the 1980s, the use of PGRs has become a standard practice in turfgrass management on golf courses, particularly with a number of chemicals showing improved efficacy and reduced phytotoxicity. Once used solely to suppress plant growth and seed-head formation, PGRs are now being widely used by turfgrass managers to enhance overall turf quality, promote a smooth and uniform playing surface, and improve stress tolerance in higher maintenance areas.

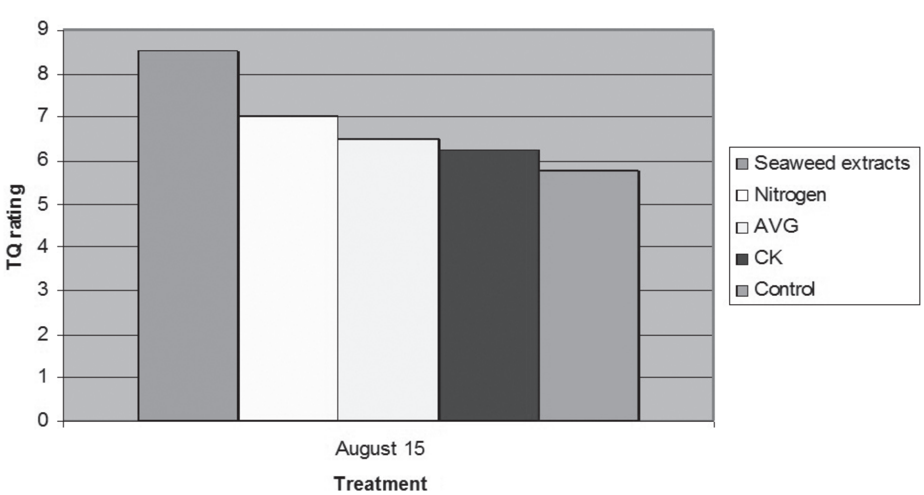
A PGR inhibiting cell elongation, trinexapac-ethyl (TE, Syngenta Crop Protection, Greensboro, NC), has been used mainly for clipping reduction and improving general turf quality. Recently, however, TE has proved effective in improving turf performance under unfavorable environmental conditions, such as shade, freezing, and drought and heat stress.

Also showing promise in aiding creeping bentgrass stress tolerance and recovery are biostimulants. Classified collectively as plant growth promoters, these natural products contain a variety of components, including carbon sources, humates, microbial suspensions or powders, and hormone-containing products such as seaweed extracts. Seaweed extracts are among the most widely used ingredients in biostimulant product formulations and 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—have shown the most promise in stimulating turfgrass growth and stress tolerance.

As with any class of products, however, their effectiveness varies greatly with the individual product's precise formulation and with such factors as plant species, physiological conditions of the plants, and application rate and timing. Myriad environmental factors can also influence the effectiveness of biostimulants, leading to inconsistent and unreliable outcomes.

While the primary ingredients in biostimulant products have proved

Effects of Biostimulants on Turf Quality in August 2013



Pitting PGRs and Biostimulants Against Summer Bentgrass Decline

beneficial to plant growth in controlled laboratory and/or greenhouse experiments, there is still a lack of season-long, field experiments to confirm manufacturer claims or controlled-environment studies.

The effectiveness of both PGRs and biostimulants in alleviating SBD are not yet well documented. With the increasing use of these products on creeping bentgrass putting greens, the goal is to help turfgrass managers determine precisely how PGRs and biostimulants can be applied in promoting summer stress tolerance and recovery for creeping bentgrass.

THE STUDY AT WORK

From May through October 2012, Dr. Huang and her team evaluated treatments combining different PGRs and biostimulants based on their biological functions for alleviating summer bentgrass decline or promoting summer bentgrass performance.

Their methodology:

» Studies were conducted on a 6-year-old Putter bentgrass green built to USGA greens specifications at Rutgers University's Horticultural Farm II.

» The green was managed using typical irrigation, fertilization, and pesticide application programs, and it was mowed daily at ⅛ inch.

» Several commercial products and experimental materials containing seaweed extracts, amino acids, hormones, hormone-inhibitors, and humid acids were put to the test. All were applied biweekly, unless otherwise noted:

1. *Ocean Organics Experimental seaweed extracts:* Spring applications: Experimental seaweed extract at 6 fl. ozs./1,000 ft^2 and experimental granular 12-4-4 (once/month) at 4.2 lbs./1,000 ft^2. Summer applications: Experimental seaweed extract 5-0-1 at 4 fl. ozs./1,000 ft^2 and experimental seaweed extract 6-0-3 at 6 fl. ozs./1,000 ft^2.

2. *Floratine commercial biostimulants and plant growth regulators:* All products applied weekly. Spring applications: Astron at 2 fl. ozs./1,000 ft^2 and Knife Plus at 3 fl. ozs./1,000 ft^2. Summer applications: Perk Up at 3 fl. ozs./1,000 ft^2, Renaissance at 1.5 fl. ozs./1,000 ft^2, and Protesyn at 6 fl. ozs./1,000 ft^2.

3. *Sequential application of Primo (trinexapac-ethyl) and aminoethoxyvinylglycine (AVG, an ethylene inhibitor):* Spring applications: Primo at 0.125 fl. ozs. (containing 0.001 lbs. ai)/1,000 ft^2. Summer applications: AVG at 25 µm.

4. *Sequential application of Primo and cytokinins (CK, kinetin):* Spring applications: Primo at 0.125 fl. ozs./1,000 ft^2. Summer applications: Kinetin at 25 µm.

5. *Sequential application of Primo and nitrogen:* Spring applications: Primo at 0.125 fl. ozs./1,000 ft^2. Summer applications: Urea at 0.1 lbs. nitrogen/1,000 ft^2.

6. *The control treatment:* Water-only was used in the same amount as each product application.

NOTABLE RESULTS

» Most of the treatments had beneficial effects on turf performance during summer stress, with the commercial treatments provided by Ocean Organics having the most significant impact, followed by Floratine.

» The application of the experimental seaweed extracts from Ocean Organics and Floratine products promoted significantly higher turf quality, green leaf biomass, and plant density compared to the control during most of the experimental periods.

» The combined treatments of Primo with CK, AVG, or nitrogen had some beneficial effects in promoting turf density (turf quality and plant density) and green color (chlorophyll content), but the effects were not statistically different from the control treatments on some sampling days due to the variations between replicates in the field conditions.

» Spring product applications seemed to have the most pronounced effect on turf quality and stress tolerance. Though the positive effects of all the treatments were still evident in the summer, they were not as significant as in the spring.

It is worth noting that the results reported here are preliminary. Some of the treatments were repeated in the 2013 growing season to confirm the 2012 results. Though the data for this past season's trials have not yet been fully analyzed, the outcomes appear similar:

» Ocean Organics' seaweed extract treatments clearly offered the most notable results during both the spring and summer.

» The other treatments—CK, AVG, nitrogen, and the combined treatment—in general seem to have beneficial effects compared to the control, with the combined and nitrogen treatments showing the most significant improvement.

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

Putting IPM to Work in ABW Management

» a better understanding of the threat that ABW poses to their various existing turf areas

» essential knowledge for selecting more sustainable turfgrass species/cultivars to replace annual bluegrass

3: Pinpoint Alternatives to Chemical Insecticides in Managing ABW Larvae. In view of the threat of resistance development and the lack of effective synthetic insecticides to manage resistant ABW populations, Dr. Koppenhöfer and his team are seeking alternatives for the control of ABW larvae. Entomopathogenic nematodes showed some potential for ABW larvae control, but their performance was variable and declined at high ABW densities.

Nematodes and the neonicotinoid imidacloprid interact synergistically on white grub mortality with no negative effects on the nematodes. This combination also seems quite feasible against ABW larvae since imidacloprid is already widely used for white grub management and combinations could be applied at the appropriate time to control both ABW larvae and white grubs.

For further information on the research and future progress, you can reach Dr. Albrecht Koppenhöfer at koppenhofer@aesop.rutgers.edu.

The Tri-State Makes New Strides

and can be reached at 914-909-4843 or sodowd@mgagolf.org. She has replaced Ineke Pierpoint, who was an invaluable resource to our organization, along with the entire golf community for nearly 20 years.

Please join our entire board in congratulating Ineke on her retirement and on a job well done in her many years of service to our organization and its members.

RESEARCH UNDERWAY

As you read through this issue, you will see that we are continuing our commitment to ongoing research by supporting four projects this year. Three of those projects have been underway since 2012. At Rutgers, Drs. Bruce Clarke and James Murphy have been working to develop best management practices for anthracnose control on annual bluegrass putting greens. And Dr. Bingru Huang is exploring the use of plant growth regulators and biostimulants in both alleviating summer decline and promoting the recovery of creeping bentgrass greens. At Cornell, Dr. Frank Rossi is continuing work to determine the effect of chemical and mechanical putting green management programs on ball roll.

New this year is Dr. Albrecht Koppenhöfer's work at Rutgers to investigate the use of several IPM practices—including parasitic nematodes—in establishing more effective and sustainable controls for insecticide-resistant annual bluegrass weevil populations.

I would like to thank everyone for your support of the Tri-State. We look forward to putting your contributions to work in funding these and future research endeavors that will provide us with important insight into turfgrass issues that affect each and every one of us.

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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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