Hosted by Clark Throssell, Ph.D. | *clarkthrossell@bresnan.net*

Super Science

// **TEN YEARS LATER**

SOIL ANALYSIS BEFORE, 10 YEARS AFTER EFFLUENT IRRIGATION

Yaling Qian, Ph.D.

To ensure sustainable and affordable water supplies, more and more golf courses are using effluent water for irrigation. It is well documented that some effluent water sources have marginal quality with relatively high levels of nutrients and salts.

Long-term and continued use of effluent water may lead to changes in soil chemical and physical properties. To determine the degree of soil property changes, we compared soil and turfgrass samples collected at the initiation of, and ten years after, effluent water irrigation at several golf courses in the Denver area.

Ten years ago, prior to the start of using effluent water for irrigation, we collected soil and plant baseline information at several golf courses. All the sampling sites were marked physically (by burying a metal rod at each sampling spot) and with GPS systems. The original soil samples were archived for measurement comparison.

Baseline data is available for both soil and turfgrass. In 2014, 10 years after the start of effluent water irrigation for these sites, we will re-sample those sites. Soil cores will be collected about one foot from the baseline soil sampling locations.

Samples will be taken at different depths at 0-7.9, 7.9-15.7, 15.7-23.6, 23.6-31.5 and 31.5-39.4 inches below soil surface. The 10-year long-term evaluations in real world conditions will be very valuable. At the same time, we will determine turfgrass and landscape plant quality and mineral composition prior to and after 10 years of irrigation with effluent water.

Yaling Qian, Ph.D., is in the Department of Horticulture at Colorado State University. Dr. Qian can be contacted at yaling.qian@colostate.edu for more information.

Golf course irrigated with effluent water

PHOTO BY: YALING QIAN

NEWS UPDATES

MATT CIMINO, CGCS, JOINS CIVITAS

The Civitas team welcomes superintendent Matt Cimino, CGCS, to their team. Cimino joined the Civitas team May 5, 2014 as Sr. Technical Services Advisor in the Southern USA, supporting the Professional Turf team.

"We're very pleased to have Matt joining our Civitas team," says Oriana Persechini, lawncare category portfolio manager, Petro-Canada Lubricants. "We feel his experience, knowledge and professionalism make him a perfect fit for our brand and we're excited to work together to help grow Civitas across the Southern US."

While in the field, Cimino has had ample experience growing and constructing championship-quality courses from Ohio and Virginia to Missouri and Texas.

"Turf maintenance is my life. As a previous superintendent, I know the issues, the hours, the schedules as well as the feeling of accomplishment of delivering high quality turf," says Cimino.

As part of his new role, Cimino will be responsible for providing technical support for the Southern states, handling golf courses and turf in the warm season region.

"PREPARING FOR WINTER INJURY SHOULD BE CONSIDERED A YEAR-LONG PROCESS THAT ENCOMPASSES A NUMBER OF DIFFERENT CULTURAL PRACTICES."

Sam Bauer

(see full story on page 30)

//MELTDOWN

Winterkill in the crosshairs

Cultural considerations for preparing greens for winter

By Sam Bauer, Brian Horgan, Ph.D. and Lindsey Hoffman, Ph.D.

***Editor's note:** This is the first of two articles by the authors on turf survival during winter.*

The 2013-2014 winter has gone down in the record books as one of the worst. Depending on your location, conditions may have included severe and prolonged freezing temperatures (aka: polar vortex), temperature fluctuations above and below freezing, excessive rainfall followed by freezing temperatures and significant snowfall events from December through March.

With this in mind, it is important to understand the multitude of factors contributing to winter injury and the cultural practices that can be implemented to minimize damage.

The term "winter injury" is a catchall term that refers to damage caused by a number of different factors including crown hydration, anoxia and gas buildup, desiccation, low temperature fungi and freezing temperatures. These factors may act alone or in concert causing damage to plants, and are collectively recognized as winterkill. Regardless of the type or number of stresses affecting the plant, the occurrence of winterkill is directly attributed to death of the turfgrass crown.

Management strategies should be implemented throughout the year to promote crown survival during and following winter months. This involves minimizing or eliminating conditions that would favor the development of

PHOTO 1

PHOTO BY: ANDREW HOLLMAN

An ice melting study at the University of Minnesota's Turfgrass Research, Outreach and Education Center, conducted this last winter. These manufactured ice blocks were treated with 20 different salt and solar absorption products to evaluate ice melting potential. More detail on this study can be found at: www.turf.umn.edu.

stresses such as crown hydration and anoxia. Consequently, preparing for winter injury should be considered a year-long process that encompasses a number of different cultural practices to promote turfgrass health.

GETTING WINTER READY

Winter hardiness of turfgrasses is achieved through the process of cold acclimation, which is induced by decreases in temperature and light during the fall. During this period of time, turfgrass plants undergo physiological and metabolic changes that allow them to become more tolerant to winter stresses. The process of cold acclimation is influenced by plant genetics (such as the species or cultivar) in combination with environmental conditions (such as temperature and moisture).

Along with cold acclimation, temperature fluctuations during winter and early spring months (deacclimation) can also influence the winter injury potential of the turfgrass. Largely, cold acclimation capacity and resistance to early cold deacclimation is controlled by genetics; however, there is potential to increase both of these factors through management strategies to ultimately reduce overall winter injury.

Because of the high degree of species variability that exists on putting greens, turfgrass species becomes the major factor influencing winter injury. For example, creeping bentgrass has excellent winter hardiness compared to annual bluegrass.

Research has shown that differences in winter injury potential between these two species is associated with enhanced cold acclimation capacity of creeping bentgrass along with increased susceptibility of annual bluegrass to early cold deacclimation (Thompkins et al., 2000, 2004; Hoffman et al., 2014). Therefore, one strategy to minimize winter damage would be to promote creeping bentgrass and reduce annual bluegrass populations.

PHOTO 2

PHOTO BY: SAM BAUER

Sod cutters are useful in opening up channels for water flow off putting surfaces prior to winter. Water will often back up at the green/collar interface, therefore extending these channels through the collar and into the green can be important.

In some situations this may not be an option. In addition, creeping bentgrass may still be susceptible to winter injury, depending on both plant and environmental factors. Consequently, management of annual bluegrass/creeping bentgrass golf greens should focus on promoting healthy turfgrass plants throughout the year while minimizing conditions that favor the potential for winter injury.

So let's look at a few of the major winter stresses, along with management strategies to prepare greens for winter.

ICE, ICE, BABY

Crown hydration and damage from ice cover are two of the most devastating causes of winter injury on putting greens every year. Crown hydration occurs when temperatures increase, causing plants to absorb water, and results in winter injury if followed by subfreezing temperatures. As a consequence, cells rupture due to the formation of ice crystals and this is lethal for the plant. Damage may also be associated with ice formation outside of cells, causing water to move out of the cells and can cause severe dehydration and/or death of the turfgrass.

Ice cover can also be a contributor to crown hydration as ice melts and then refreezes. In addition, non-porous ice can cause anoxia and/or buildup of toxic gases, mainly CO_2, and has been shown to be more injurious to annual bluegrass compared to creeping bentgrass.

Tompkins et al. (2000, 2004) studied the impact of ice encasement, ice cover and snow cover on annual bluegrass in a growth chamber and in the field. Annual bluegrass plants did not survive 90 days of ice encasement in

Continued on page 32

PHOTO 3

A five-inch auger bit being drilled three feet deep by staff at Medina (Minn.) G&CC to promote water infiltration in swales on native soil greens with no drainage. Channels are back-filled with pea gravel.

PHOTO BY: ERIN MCMANUS

Continued from page 31

the growth chamber, whereas creeping bentgrass survived for 150 days. In the field, death of annual bluegrass plants was observed at 75 days of ice cover with damage to creeping bentgrass detected following 90 days of ice cover. These interspecific differences in winter injury associated with crown hydration and ice cover may primarily be associated with plant genetics; however, reducing overall moisture on greens prior and during winter may help reduce the incidence of both these stresses.

Golf courses dealing with extended periods of ice cover have lessened the damage by removing or melting the ice. A current study being conducted at the University of Minnesota and Michigan State University is evaluating the ice melting potential of several standard salts, specific ice melt products and solar absorption materials. The greatest melt followed the use of black solar absorption materials (Photo 1); black substances increased surface temperatures by up to seven degrees F. Products included in the solar absorption treatments were: Milorganite (6-2-0), Sustane (5-2-10), dyed black sand, Top Cut biosolids and BioDac (paper by-product). Phytotoxicity of these products to putting greens is also being evaluated. A more detailed explanation of this study can be found on the University of Minnesota's Turfgrass Science website (www.turf.umn.edu).

LET IT DRAIN

While sometimes impossible to predict and manage, surface and subsurface drainage are important for reducing injury from crown hydration or ice cover. Surface drainage is based on the architecture of the green. Low-lying areas that hold water on the surface have the greatest potential for damage and moving water off of putting surfaces during the spring transition will have the biggest impact on survivability. As such, creating pathways and channels for water to travel is important for reducing damage (Photo 2). These areas should be established prior to winter to allow drainage as spring temperatures increase.

Swales on greens often drain poorly, which can result in excess surface moisture. Minimizing damage in these areas is much more difficult, but can be promoted by creating openings on the surface in these swales. Deep tine and core-aeration prior to winter help to alleviate damage by standing water in the spring, but the trade-off can be increased desiccation in winters that lack snow cover or in areas prone to drying.

Putting greens built on natural soils with minimal drainage will benefit from augering channels to improve water flow in these swales (Photo 3) and should be filled with pea gravel or other porous materials.

MORE TO CONSIDER

Another important component in improving winter survivability is management of thatch and organic matter. On putting greens with thatch levels exceeding 0.25 inches, crowns may be exposed to fluctuating air temperatures during winter months. In comparison, crowns deeper in the soil profile are buffered against such rapid and sometimes extreme temperature changes. Excessive thatch and organic matter also hold moisture at the surface, leading to winter injury issues associated with crown hydration, ice cover and the snow mold pathogens.

Regular, frequent topdressing of sand-based root zones is required to reduce thatch and organic matter buildup. Sand chosen for topdressing should have a consistent particle size with the existing root zone to minimize layering. For native soil putting greens, it is practical to build up a profile of sand through several years of topdressing, and from a winter injury standpoint this is almost always an improvement.

Plant growth regulators, wetting agents and other specialty turf products all have their place when preparing putting greens for winter. Generally speaking, products that promote healthy turf throughout the growing season will also be beneficial for the plants during the cold acclimation process. No one program works for every superintendent due to site specifics and climatic variation. With that in mind, be sure to use only those products you are comfortable with and have proven successful for you in the past. Test strips are useful for evaluating new products, and untreated areas for justifying current ones.

Wetting agents are more commonly being applied in the late-fall prior to irrigation blowout. The benefits of this type of application have not yet been evaluated with research, but considering that a majority of our winter injury issues are moisture related, this is a topic worth investigating. Hydrophobic sands suffering from desiccation over winter months can potentially benefit from a late season wetting agent application, as will poorly infiltrating root zones. Adequate movement of the wetting agent into the root zone through irrigation or precipitation is necessary for this application to be successful. This research is ongoing and results will be available soon.

A HOLISTIC APPROACH

A strong focus on the basics of putting green management is important for promoting survivability of both annual bluegrass and creeping bentgrass. Dr. James Beard may have said it best, "Cultural practices should ensure that the turf is healthy, disease-free, and well rooted as the winter season approaches," (Beard, 1973). We have learned a lot about the physiology of winter injury since then, but our recommendations remain the same. Balanced fertility, proper mowing heights, sharp reels and irrigation to promote rooting depth are just a handful of practices, in addition to what was already discussed, that need to become second nature in your management programs.

Winter injury of turfgrass is a complex issue that should be considered with a holistic approach. This article focused heavily on the types of damage that can occur over the winter months, as the specific type of winter injury will dictate management practices that should follow. No matter what type of winter injury you are dealing with, two main points hold true: 1) healthy turf is better able to withstand the stresses of winter, and 2) mother nature rules all. Remember these points as you prepare your putting greens for winter this year.

Sam Bauer, Brain Horgan, Ph.D., and Lindsey Hoffman, Ph.D., are at the University of Minnesota where Bauer is a turfgrass extension specialist, Horgan is an associate professor of turfgrass science and Hoffman is a postdoctoral turfgrass research scientist. Bauer can be contacted at sjbauer@umn.edu for more information.

References

Beard, James B. 1973. Turfgrass Science and Culture. Englewood Cliffs, N. J.: Prentice-Hall.

Hoffman, L., M. DaCosta, and S.J. Ebdon. 2014. Examination of cold deacclimation sensitivity of annual bluegrass and creeping bentgrass. *Crop Sci.* 54(1): 413-420.

Tompkins, D.K., J.B. Ross, and D.L. Moroz. 2000. Dehardening of annual bluegrass and creeping bentgrass during late winter and early spring. *Agron. J.* 92:5-9.

Tompkins, D. K., J.B. Ross, and D.L. Moroz. 2004. Effects of ice cover on annual bluegrass and creeping bentgrass putting greens. *Crop Sci.* 44(6): 2175-2179.

//HEALTHY COMPETITION

Pursuing *Poa annua*-free cool-season fairways

Overseeding and post-seeding herbicides

By Zac Reicher, Ph.D.

All golf courses, regardless of budget, struggle to minimize *Poa annua* in fairways. Thinning or complete death of *Poa annua* in summer or winter, plus additional damage to the desired species inevitably leads to reseeding the desired turf.

However, *Poa annua* quickly germinates when favorable weather returns and it aggressively out-competes seedlings of the desired turf. Often the end result is higher populations of *Poa annua* than were originally present (Fig. 1). This cycle may repeat itself annually in areas of the country with consistently difficult summers and/or difficult winters. However, new thinking with modern herbicides may help stop this cycle.

FIGURE 1

Poa annua filling in between lines of perennial ryegrass overseeded in early September in Nebraska. The *Poa annua* will out-compete the perennial ryegrass over the winter, likely resulting in more *Poa annua* present than in the previous year.

PHOTO BY: ZAC REICHER

TIMING OF OVERSEEDING

Seeding summer-thinned areas usually starts near Labor Day with the return of cooler temperatures. Though this is an ideal time to seed cool-season grasses, the majority of *Poa annua* seed in the soil will also start to germinate in mid-September (Kaminski and Dernoeden, 2007). The desired grass and *Poa annua* will be germinating at almost the same time and *Poa annua* will always outcompete desired turf. Therefore, seeding earlier in the summer is preferred to allow germination and maximum maturity prior to *Poa annua* seed germination.

Our work at Purdue showed that seeding creeping bentgrass in mid-August resulted in 19 percent cover of annual bluegrass by the following June (with no control interventions), whereas seeding only a month later resulted in 43 percent cover of annual bluegrass. Furthermore, Henry et al. (2005) showed overseeding creeping bentgrass into an existing *Poa annua* green in July resulted in greater than 70 percent coverage of creeping bentgrass two years later, whereas August seedings resulted in 17 percent or less coverage and September seedings resulted in eight percent or less coverage of creeping bentgrass (Fig. 2).

Our current work at the University of Nebraska is also evaluating seeding in mid-summer, almost as a preventative seeding in areas that perennially thin during the summer stress. This three-year study will wrap up soon, but early results indicate early summer seeding is more effective than late summer seeding for long-term success, especially when overseeding with creeping bentgrass. More important, our work is showing that following up seeding with herbicides for *Poa annua* control limits competition and further improves successful establishment of desired seedlings.

In other studies, we are evaluating ratios of Kentucky bluegrass/perennial ryegrass, for short-term cover (golfer satisfaction) as well as aiming to maximize Kentucky bluegrass in the stand. This study also includes aggressive use of post-seeding herbicides to minimize *Poa annua*. Early results suggest that regardless of the Kentucky bluegrass/perennial ryegrass ratio used in seeding, the most important aspect is aggressive use of post-seeding *Poa annua* control herbicides (Fig. 3).

HERBICIDES FOR *POA ANNUA* CONTROL

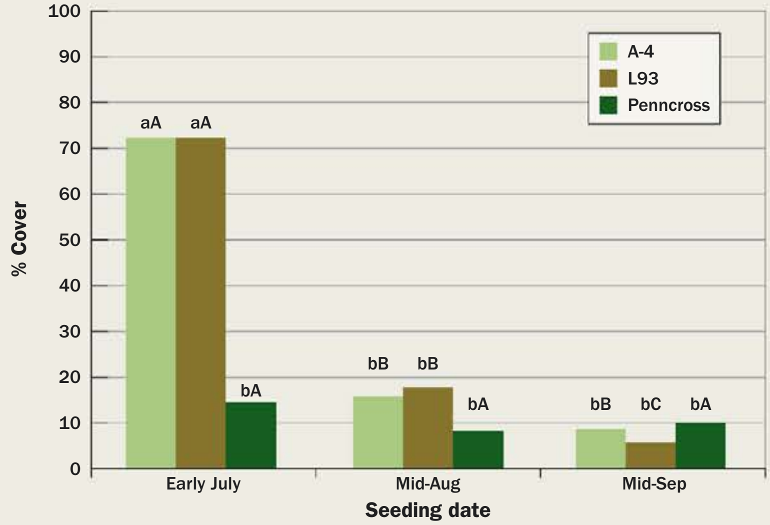
Controlling established annual bluegrass is difficult and a task that the industry has struggled with for generations. However, control is much easier on annual bluegrass that is thinning due to summer stress or when it is a newly-germinated seedling. Even though there is some risk that seedling damage may occur with aggressive herbicide use, it can be quickly compensated for with reduced competition from annual bluegrass.

Herbicide choice depends on the overseeded turf species. Velocity (byspiribac-sodium) can be used as early as two weeks after emergence of creeping bentgrass or perennial ryegrass according to the label. Tenacity (mesotrione) is highly effective when used

Continued on page 36

FIGURE 2

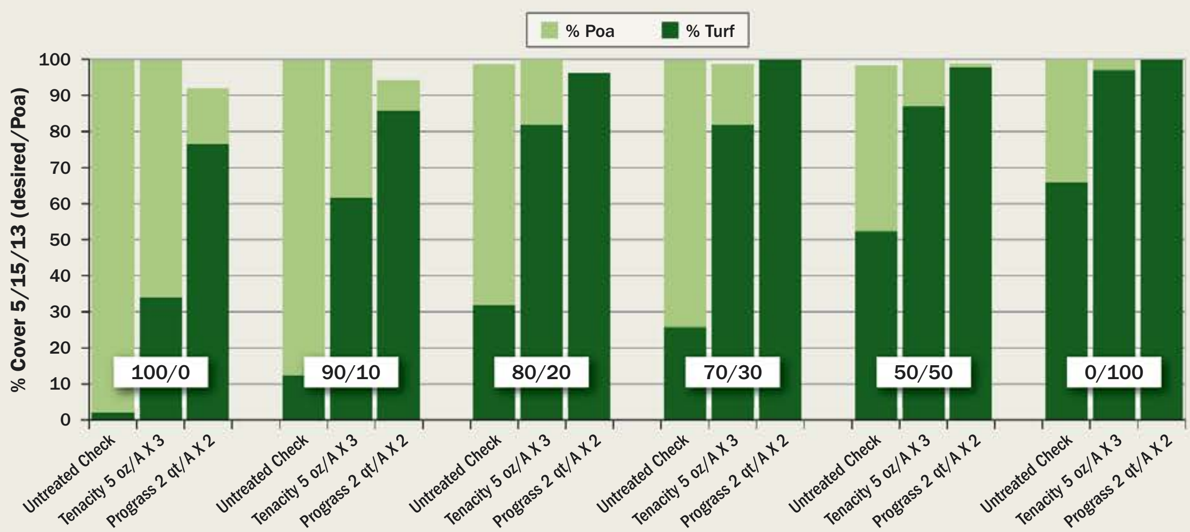
Effect of seeding date on creeping bentgrass overseeding into Petersons creeping bluegrass (*Poa annua* L. spp. *reptans*) green rated in July, two years after seeding.



Seeding earlier in the summer results in improved establishment of creeping bentgrass in the short term, which continues to spread in future years. This is especially true with the newer, more aggressive creeping bentgrasses. Bars with a different lower case letter within a seeding date are different at P≤0.05 and bars with a different uppercase letter within a cultivar are different at P≤0.05 (Henry et al, 2005).

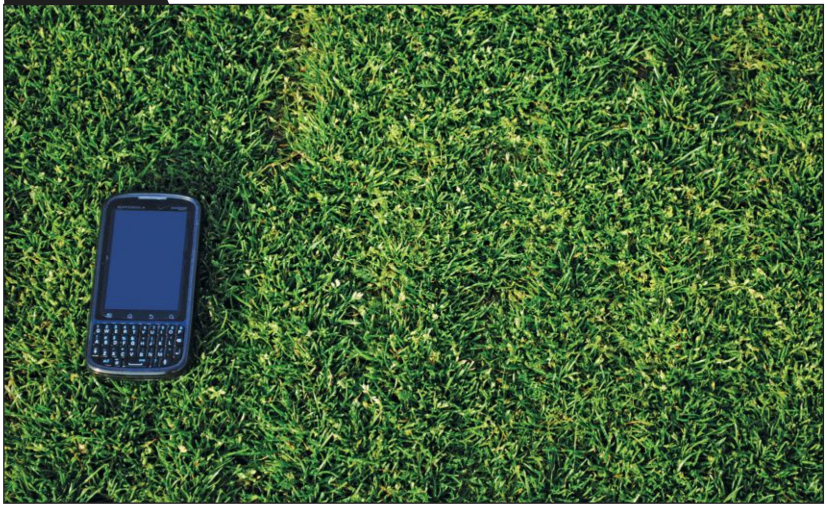
FIGURE 3

Effect of seeding ratio of Kentucky bluegrass/perennial ryegrass (in white box in each set of bars) and post-seeding herbicides on percent cover of desired turf or *Poa annua* rated in May following seeding.



Areas were killed with glyphosate, power raked in two directions, seeded in September 2012, herbicide applications began in mid-October 2012 and were made on two week intervals. Regardless of seeding ratio, this preliminary data suggests following-up seeding with aggressive *Poa annua* control herbicides will reduce *Poa annua* and increase desired turf.

FIGURE 4



A fall seeding of perennial ryegrass with no follow-up *Poa annua* control herbicide application results in turf that is over 50 percent *Poa annua* the following spring.

FIGURE 5

A fall seeding of perennial ryegrass with aggressive Tenacity use following seeding. *Poa annua* cover is essentially zero percent the following spring and ryegrass can fill in with no competition.

Continued from page 35

in the seedbed of Kentucky bluegrass or perennial ryegrass to control *Poa annua* before it germinates. Tenacity can also be used postemergence within four weeks after seedling emergence (Fig. 4 and Fig. 5). Tenacity applied as recommended on the label at 8 oz./A in the seedbed followed by 8 oz./A at four weeks after seedling emergence is highly effective, as are three 5.3 oz./A applications with the first application applied to the seedbed and the second and third applications made four and six weeks after seedling emergence. Though Tenacity is safe on seedlings of Kentucky bluegrass and perennial ryegrass and on established Kentucky bluegrass, damage is occasionally seen when applied to established perennial ryegrass.

Though not as commonly used, Prograss (ethofumesate) is also labeled and effective for *Poa annua* control when applied to seedlings of perennial ryegrass (Fig. 3). Dimension or Dithiopyr (dithiopyr) has the most flexible label among the preemergence herbicides for use over seedlings. Dithiopyr can be applied shortly after the second mowing of the seedlings to help limit *Poa annua* germinating later in the fall and/or early spring. However, this herbicide cannot be used on fairways mowed below 0.5 inch.

Regardless of the situation on each golf course, it is crucial to follow up seeding with aggressive control of *Poa annua*. Furthermore, if seeding in the spring following winterkill, additional controls will likely be needed for crabgrass and broadleaf weeds. Tenacity, Tupersan (siduron), Drive and other quinclorac-containing products, Quicksilver (carfentrazone) and SquareOne (carfentrazone plus quinclorac) have some of the most flexible labels for use in seedling cool-season grasses for controlling crabgrass and/or broadleaf weeds.

REGRASSING WITHOUT CLOSING FAIRWAYS?

The expense and inconvenience of closing fairways often raises questions about successful regrassing from annual bluegrass without closing. Historical research suggests it is virtually impossible when converting to Kentucky bluegrass (Kraft et al., 2004) since it is not aggressive as a seedling.

Converting fairways to perennial ryegrass may be more successful since it is more aggressive as a seedling. Most success is seen with regular overseeding with creeping bentgrass to convert the fairways (Reicher and Hardebeck, 2002). However, most success is currently seen when overseeding at high rates over many years and when combined with scalping, growth regulators and/or other strategies that favor the overseeded grass (Figure 4). Our previously mentioned research is re-evaluating some of these strategies using newer herbicides after seeding.

FIGURE 6

Converting fairways to a new species is difficult without an application of glyphosate and closing. However, three years of seeding creeping bentgrass at high rates is starting to have an effect in this study on an Indiana golf course.

TAKE HOME MESSAGE

Unfortunately, many golf courses are faced with repairing summer- or winter-damaged areas of *Poa annua*. The easiest and quickest fix is to overseed a fast-germinating species plus allow the *Poa annua* to germinate and fill back in.

However, this is only a short-term fix and damage will likely reoccur with the next harsh summer or winter. Rethinking the situation, fixing the cultural issues, choosing to overseed a better-performing species at a potentially better time than used in the past and following up with *Poa annua* controls should help limit future problems.

Zac Reicher, Ph.D., is a professor of turfgrass science at the University of Nebraska-Lincoln. Reicher can be contacted at zreicher2@unl.edu for more information.

References

Henry, G. M., S. E. Hart, and J. A. Murphy. 2005. Overseeding bentgrass species into existing stands of annual bluegrass. *HortScience.* 40(2):p. 468-470.

Kaminski, J. E., and P. H. Dernoeden. 2007. Seasonal *Poa annua* L. seedling emergence patterns in Maryland. *Crop Sci.* 47(2):p. 775-781.

Kraft, R. W., S. J. Keeley, and K. Su. 2004. Conversion of fairway-height perennial ryegrass turf to Kentucky bluegrass without nonselective herbicides. *Agron. J.* 96(2):p. 576-579.

Reicher, Z. J., and G. A. Hardebeck. 2002. Overseeding strategies for converting golf course fairways to creeping bentgrass. *HortScience.* 37(3):p. 508-510.

Ad Index

Companies featured in this issue