as chlorine, soda ash and cement. "At that time, most plant protection products were in the chlorinated hydrocarbon family," Kozsey points out.

Although agriculture was the big market for plant materials, golf was in Daconil fungicide's DNA from the get-go. The lab where Kozsey and Batershell worked was in Concord, Ohio, across from Quail Hollow Country Club. Some of the basic field testing was done with Al Brotzman at the Erie Shores Golf Course in Madison, Ohio. The first approval for the product's use was for turf, not agriculture.

In 1963, in Lab 13, a six-person team, including Kozsey (whose formal turf education is based mainly on short courses at Purdue, Ohio State and Florida) was trying to make the material in large quantities. They used a one-foot-long capillary tube and figured how to make the basic material. They graduated to a two-foot reactor to produce material for a worldwide screening of Daconil. Soon they graduated to a 10-foot reactor.

Daconil was produced at the research site until after it had produced 100,000 pounds of material. By 1973, production moved to Greens Bayou, Texas, where it is still made today.

Kozsey moved out to the Research Farm in Ohio in 1967 and in 1984 was transferred to Naples, Florida, to manage the research farm there. He moved up to Pennsylvania in 1988 when the farm was sold and eventually went into sales. As the product was sold from firm to firm, it eventually found a home with Zeneca. "They had Heritage fungicide — Heritage and Daconil were complementary to one another," he notes. "I was fortunate enough to make the cut when Syngenta was formed," he says.

Looking forward

Kozsey says he "absolutely" would encourage any young person to get into the Green Industry. "Improving plant health, yields on crops, turf… these needs will be here forever. We need green. Without scientists helping develop things to make life better in the plant world, we could be lost."

When he plays Canterbury Golf Club in Cleveland with his grandsons, he points out the *Poa*, the bentgrass, and other things. "It is important to know what's going on below your feet," he says.

Kozsey says, "Whether a youth goes into the turf business as a scientist or marketer, it is important to deliver the best product you can. Do something that will improve the situation," he adds.

"You have to think ahead. We have problems out there," Kozsey continues. For example, he notes that people used to think *Poa* died because it is an annual grass. But after years of research, it was discovered that it in fact gets a disease called summer patch. "You have to get out there, get involved a little deeper in things to correct them. The challenge to young people is to get into things and to research them more," he urges.

"We're continually trying to improve the product line to suppress or control dollar spot and other diseases a bit more so they do not take out the turf," he says. "We're always trying to drop a new engine under the old hood," Kozsey chuckles.

The average superintendent is 37 years old and was not working prior to 1996. They don't know a world before Daconil Ultrex and Daconil Weather Stik. "If you asked most of them, they would think that those were the original formulations," Goglia says.

"The challenge to young people is to get into things and research more."

— Lee Kozsey

The latest performance boost for golf turf is Daconil Action fungicide — a combination of Daconil with plant activator Acibenzolar-S-methyl (also known as acibenzolar). The result is a product that gives turf an extra protein boost to help defend itself against diseases.

"Lee was specifically put on the launch team for Daconil Action because of his history and knowledge base," Goglia notes. "He was critical in helping the development of the product positioning and how we launched it."

Kozsey's wife, Lucille, has been supportive of his long career. She says it makes him happy and proud. It's not all work, though. Kozsey is a solid golfer and competes in an amateur tournament every year in Pennsylvania.

"The turfgrass industry is a great industry. People enjoy turf. It is necessary. God gave turf to us and we have to be good stewards," Kozsey says. Superintendents used to be called greenskeepers, Kozsey says. Now, he says they are environmental managers who produce a good product while managing inputs and water usage along with course membership needs and members' expectations.

And, for a half-century, Lee Kozsey has been a key part of that progress.

Curt Harler is a freelance writer.

WHY DACONIL-2787?

For 40-plus years, superintendents have applied Daconil fungicide to their turf. But we're willing to bet that you don't know why the compound is called Daconil-2787.

The DAC part comes from the original developing company's name: Diamond Alkali Co. The ONIL is from the end of the technical name of the product: chlorothalonil. The 2787 simply means it was the 2787th molecule the lab made.

PHOTOS COURTESY: LEE KOZSEY

Let it Rain

Focusing on irrigation in the golf course and sports turf arenas, Rain Bird's Intelligent Use of Water Summit makes a splash with supers and students.

By Beth Geraci

Dave Johnson, Rain Bird's director of corporate marketing, took the stage on the Michigan State University campus to launch the Intelligent Use of Water Summit XIII.

With the theme "Play on: Playability in water-sensitive environments," this year's agenda was geared toward the golf course and athletic turf industries. And several superintendents and Michigan State University turf students gathered for the occasion.

"The Intelligent Use of Water is a company philosophy that we came up with about a dozen years ago that really describes the principles the company was founded on — using water wisely and intelligently and efficiently," Johnson said in his opening remarks.

This year's summit assembled some of the country's top researchers to talk about the scientific side of water management, as well as superintendents to discuss the practical side.

A group of superintendents and Michigan State turf students represented the target audience of the Intelligent Use of Water Summit XIII.

Getting practical

Speaker Shawn Emerson, director of agronomy at Desert Mountain Club, Scottsdale, Ariz., relies heavily on the newest water management technologies at Desert Mountain. In such an arid climate, he has no choice.

But at a time when pressure is mounting in the U.S. to conserve water and irrigate responsibly, Emerson told the audience that conserving water doesn't have to mean brown turf.

"If there's one thing I cannot stand and that I can't get my hands around it's the statement 'Brown is the new green.' Where

(Above): Attendees are engaged as speakers such as Dr. Ali Harivandi (top right) and Mike Boekholder (lower right) share their expertise. The day's discussions touched on reclaimed water use, utilizing water technology, and irrigating sports turf.

PHOTOS BY: BETH GERACI / ISTOCKPHOTO

did they get that from?" he said. "That's not what I'm about. I'm about green grass. What I want to do is be more efficient at it. What I want to do is be more practical with it. And what I want to do is be educated on it.

"If I'm going to relent and turn back the clock and say, 'Brown is the new green,' then we might as well go back to 1963 when my father was a golf course superintendent," he added.

Ken Mangum, CGCS, director of golf courses and grounds at the Atlanta Athletic Club, explained how irrigation design upgrades at AAC enhanced roughs and fairways, bringing a "wow factor" to the complex that members appreciated.

Kevin Peck hadn't heard of some of the technologies the day's speakers discussed, so the assistant superintendent at Country Club of Detroit was inspired by what he learned. "It's a good perspective on how to manage water, and it's helpful to hear how courses in different regions are using the technology that's available," he said.

And superintendents weren't the only turf managers taking the podium. Mike Boekholder, head groundskeeper for the Philadelphia Phillies and a part-time consultant, told the audience he is amazed by how many times clients complain of problems on their fields yet don't have irrigation.

"The first question out of my mouth is, 'Do you have irrigation?' and they say, 'No, we don't have that. It's expensive to put in.' You have no grass!" he exclaimed.

Boekholder said simply "praying for water" doesn't help anything. What does help is having a well-designed water system and knowing your water window.

"If you're looking to build (a watering system) from ground up, you better think water window on day one," he said. "Because it's great that you have a well-designed irrigation system, but if it takes 10 hours to water everything out there, you may not have the opportunity to actually do that every night. That water window really should, in my mind, drive the entire design of the system."

The science side

Summit attendees also got a huge lesson in alternative irrigation techniques from some of the country's top scientists.

Dr. Ali Harivandi, regional specialist in turf soils and water at the University of California, talked about the small amount of quality water readily available for use throughout the world, due to a global population now numbering 7 billion. And you can expect that number to rise to 8.5 billion by 2025, he said.

"Drought has become part of our life," he warned the audience. "For that very reason we have to look into other sources of water if we want to survive as an industry."

That message may abound with doom and gloom, but courses in metro areas are using it as motivation, increasingly turning to recycled water to irrigate their courses. About 12 to 15 percent of golf courses are using reclaimed water, and that number jumps to 37 percent in the Southwest, Harivandi said.

Assistant superintendent Andrew Harrell, Peck's coworker at the Country Club of Detroit, said Harivandi's message made an impact. "I've dealt with reclaimed water before, and it's something that everybody in this industry is going to have to deal with sooner or later," he said. "It's going to be a necessary step that you're going to have to address."

Speaker Carol Colein, executive director of the American Society of Irrigation Consultants (ASIC), said in her position she is "seeing irrigation through a larger lens" than she ever has before. "This water shortage," she stressed, "is something that we have to put our hands around and embrace."

The ASIC will devise a plan to do just that at its 2013 national conference, where water reuse strategies will constitute 25 percent of the program.

Colein also drove home her point that in places like the Great Lakes region, so abundant with water, it's a challenge to convince golf course decision makers to invest in efficient water systems.

Too bad, she said, because "if you've got more uniform water application, if you've got the proper water management tools, you're going to be able to provide more consistent and better playing conditions. Now that rings a bell with golfers."

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SPORTS TURF SHOW COMES OUT SWINGING

The first major trade show of the year adds more education and sees an immediate uptick in attendees, optimism and buying interest.

BY SETH JONES

DAYTONA BEACH, Fla. — A town best known for rowdy spring breakers and race cars temporarily became sports turf managers central, as turf pros from around the country flocked to the annual STMA show.

As the Sports Turf Managers Association's 24th Annual Conference and Exhibition in Daytona Beach, Fla., wrapped up, the news was all good. The 1,600 people in attendance made the conference trade show one of the most well attended in STMA history, and with nearly every booth filled, attendees had no problem browsing products from the 168 exhibitors on hand. Most important: They all seemed ready to do business.

Peter Moeller, director of marketing, The Toro Co., noticed an uptick in attendees as well as in overall optimism. Toro was showing off its new Tier 4-compliant engine, as well as new rotors on the irrigation side.

"I've felt a renewed buying interest from the customers who are here," Moeller said. "I've talked to many in the municipal sector who have seen their buying budgets come back a little bit. In general I feel like there's some optimism. It feels like attendance is up, and a better mood than in some of the recessionary times."

Chris Vernon, vice president of marketing and product management for Jacobsen, echoed Moeller's thoughts. He said he was "thrilled" with the crowd they saw on Thursday, the first day of the show. Jacobsen was unveiling its new 5-gang fairway mower, the LF510, and that

Continued on page 36

PHOTOGRAPHY BY: SETH JONES

Jacobsen did its big reveal at the STMA show, pulling the sheet off of this piece of equipment: the LF510, a 5-gang fairway mower.

Business was brisk at the Toro booth. "I've felt a renewed buying interest from the customers who are here," said Toro's Peter Moeller.

HOME SCHOOLED

Interested in checking out some of the STMA's educational sessions? These seminars are available online for $10 to $20 each:

- **"Making Plant Growth Regulators Work for You"** – Thomas Serensits
- **"The Reality of LEED Certified Landscape and Site Management"** – Larry DiVito
- **"3 Keys to Providing High Quality, High Traffic Athletic Fields"** – Jerad Minnick
- **"Back To Basics: Getting the Most from Your Granular Fertilizers"** – Brad Jakubowski and Dr. Tom Samples

Click on http://stma.peachnewmedia.com/store/provider/provider09.php to access the seminars.

Continued from page 35

event "brought a lot of people" to the Jacobsen booth, Vernon said.

"I think last year wasn't quite as good," Vernon told *Golfdom*. "I think last year's show wasn't as well attended, so I think they're recovering and getting more attendees."

This year's conference offered more educational opportunities, and that may have helped numbers. More than 90 hours of education were available, including two new tracks. Tracey Hawkins, market development manager, sports, for Profile Products, heard good things about the increase in education.

"They're really pushing the new educational speakers they're having," she said. "I think (the STMA is) learning from the GCSAA and local chapters that education is important, and it's been well received."

Kimberly Heck, CEO of the STMA, was pleased with the results. "The attendance level at this year's STMA conference — both for the increasing number of educational sessions offered and our trade show — underscores the continuing strength of the association and the industry," she said.

Zach Holm, head groundskeeper for the York (Pa.) Revolution, was attending his sixth STMA conference and said the show was going in the right direction.

"It seems like there's a few more (people), but not terribly bigger, but bigger than my first year, when it was in Phoenix. And there seems to be more and more students," Holm said.

Will Wolverton, general manager, North America for Wiedenmann, said his booth had a huge influx of people when the show's doors opened. One of his products was discussed at a seminar that day, and he said that may have boosted his traffic.

"We got two new products for synthetic turf. The Terra Clean 100 is a pull-behind, it sweeps debris up, separates the rubber crumb and collects the debris and puts the rubber crumb back on the ground," Wolverton said. "It was mentioned during one of the seminars.

"The STMA is a really good organization, they've always been fair to the vendors," Wolverton concluded.

Blair Elliot, who works for the City of Aspen, Colorado's Parks and Recreation department, serves on the STMA's environmental committee, and says education is definitely the biggest draw to the STMA conference.

Elliot, who was attending the conference for the 15th time, said he was most intrigued by Netherlands-based company Campey and its verticutters.

"They get a lot of people, from NFL and Major League parks to local ball fields, they get everyone here," Elliot observed. "Is it growing? No, I don't think so, but I think it is stable. I would say that this year's show is bigger than last year's."

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

Super Science

//IN THE FIELD

POACURE HERBICIDE TESTED ON GREENS IN AZ

By Clark Throssell, Ph.D.

PoaCure (methiozoline) is an experimental use permit herbicide that has high activity against annual bluegrass (*Poa annua*) on greens. Several tests are being conducted on creeping bentgrass greens at both low and high elevation locations in Arizona. The research objective is to determine if repeat fall applications differ from repeat spring applications for the elimination of annual bluegrass. Initial testing shows good creeping bentgrass tolerance and that perhaps a fall application program is more effective in annual bluegrass removal than a spring program. Contact David Kopec, Ph.D., of the University of Arizona at dkopec@ag.arizona.edu for more information.

Untreated creeping bentgrass putting green turf can be seen above the tape measure; methiozoline-treated turf can be seen below it.

PHOTO BY: CLARK THROSSELL

Golfdom suggests...

- **Feb. 26-27** — Idaho GCSA Spring Meeting and Trade Show, Boise. idahogcsaa.org
- **Feb. 27-28** — MGCSA Mega Seminar, St. Paul, Minn. mgcsa.org
- **March 4-7** — New England Regional Turfgrass Conference and Show, Providence, R.I. nertf.org/show/

ON THE GREEN

DORMANT GREENS

I had the good fortune of playing 18 great dormant bermudagrass greens recently. The ball rolled great, tracked well and the greens were plenty fast. The hole locations had been changed regularly to reduce wear, and rolled/mowed frequently enough that the putting surfaces were smooth.

The bermudagrass greens I played were still dormant, with maybe a hint of green low in the canopy. No painting (dyeing to be technically correct) on the greens I played. My round of golf on dormant bermudagrass greens illustrates that golf can be played under all sorts of conditions with many different playing surfaces and still be fun.

When deciding which winter playing surface is right for your course start by determining the amount of play you expect during the winter and the revenue associated with that play. If you are expecting a high volume and winter golf is a large portion of your yearly revenue, overseeding is probably the best option. One of the limitations of dormant bermudagrass greens, painted or not, is their susceptibility to traffic damage if the volume of play is high. If the number of rounds is expected to be modest, playing on dormant bermudagrass greens, painted or not, is a great option.

— *C.T.*

"GLYPHOSATE-RESISTANT ANNUAL BLUEGRASS IS OF CONCERN GIVEN THIS SPECIES' PROLIFIC SEED PRODUCTION AND LONG-TERM SEED VIABILITY."

James Brosnan, Ph.D.

(see full story on page 38)

//HERBICIDE RESISTANCE

Glyphosate resistance in turf: A problem on the horizon

By James T. Brosnan, Ph.D., and Gregory K. Breeden

The prevalence of herbicide-resistant weed biotypes is an issue challenging all agricultural producers. Currently, there are 396 biotypes across 210 weed species that exhibit some degree of herbicide resistance (Heap 2013) and the rate at which herbicide-resistant biotypes are emerging is increasing. To date, 19 different species with glyphosate resistance have been identified, all resulting from widespread use of glyphosate for broad-spectrum weed control (Heap 2013).

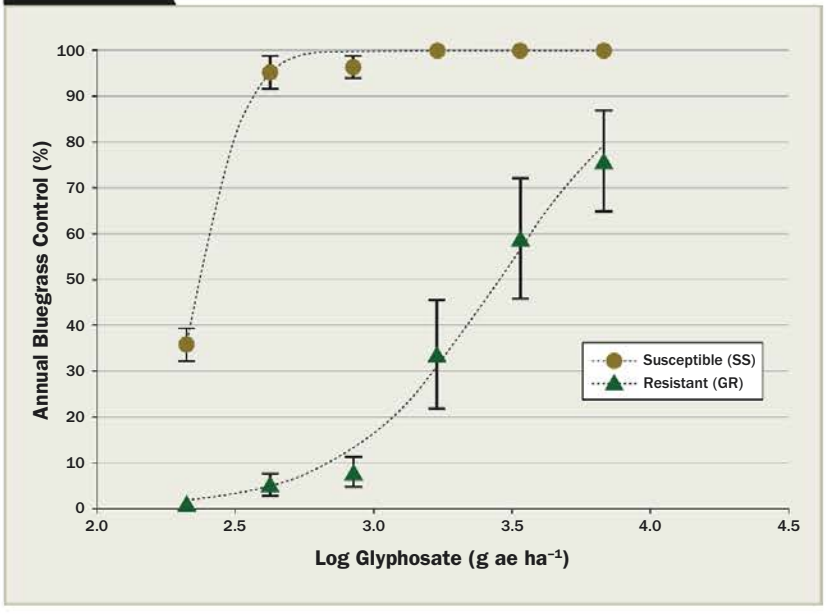
Glyphosate is labeled for broadleaf and grassy weed control in dormant bermudagrass turf at rates of 5 to 44 fl. oz. /A (Anonymous 2010). Glyphosate is commonly used to control annual bluegrass in dormant bermudagrass fairways and roughs, as efficacy with other herbicides, particularly those inhibiting acetolactate synthase (ALS) such as foramsulfuron (Revolver) and bispyribac-sodium (Velocity), can be negatively affected by cold temperature conditions in winter and early spring (Lycan and Hart 2006; Hutto et al. 2008; Willis 2008).

Additionally, glyphosate applications provide turf managers with a more economical option for broad-spectrum winter weed control than the aforementioned ALS inhibitors. Thus, many annual bluegrass populations on golf courses are under yearly glyphosate selection pressure, and superintendents have limited the diversity of herbicides used for control; both of these phenomena have been identified as principal factors in the development of glyphosate-resistant weeds (Duke and Powles 2009). That being said, only a single biotype of annual bluegrass found in golf course turf has shown resistance to glyphosate applications (Binkholder et al. 2011). Glyphosate-resistant annual bluegrass is of concern given this species' prolific seed production and long-term seed viability (Roberts and Feast 1973). Moreover, annual bluegrass biotypes resistant to atrazine, prodiamine, simazine and diuron have also been reported (Heap 2013). A biotype of annual bluegrass at Humboldt Golf and Country Club (Humboldt, Tenn.) was not controlled following treatment with glyphosate at 32 fl. oz. /A during bermudagrass dormancy.

The golf course superintendent made

Only a single biotype of annual bluegrass found in golf course turf has shown resistance to glyphosate applications.

FIGURE 1



Effect of herbicide treatment on control of glyphosate-resistant (GR) and glyphosate-susceptible (SS) annual bluegrass 14 days after treatment. Points represent treatment means, and lines represent the predicted response as determined by log-logistic regression analysis. Log-transformed rates correspond to 8, 16, 32, 64, 128, and 256 fl. oz. /A.

Alternative modes of action need to be used in regular rotation to guard against resistance development.

a single application of glyphosate at 32 fl. oz. /A every year from 1990 to 2009 to control weeds during bermudagrass dormancy (David Green, personal communication). The objective of this research was to determine the sensitivity of a potentially glyphosate-resistant annual bluegrass biotype collected from this location.

MATERIALS AND METHODS

Three standard golf course cup cores were removed from the third fairway at Humboldt Golf and Country Club on February 17, 2010, using a cup cutter. Each core contained mature annual bluegrass plants suspected to be glyphosate resistant.

These glyphosate-resistant plants had not been treated with any herbicide after emerging in the fall of 2009. A biotype known to be susceptible to glyphosate was harvested in the same manner from the East Tennessee Research and Education Center (Knoxville, Tenn.)

Considering that annual bluegrass is a self-pollinated species (Ellis 1973) and seed was limited, individual tillers of the glyphosate-resistant and glyphosate-susceptible biotypes were used in greenhouse experiments. Individual glyphosate-resistant and glyphosate-susceptible tillers were removed from cores harvested in the field and transplanted into containers filled with a peat moss growing medium.

Tillers of the glyphosate-resistant and glyphosate-susceptible biotypes were maintained under controlled greenhouse conditions for five weeks prior to initiating research. During the five-week acclimation period, plants were irrigated to prevent the onset of wilt and clipped daily at a height of ~2 in. Plants were fertilized with a complete fertilizer to promote active growth.

GREENHOUSE EXPERIMENTS

Both glyphosate-resistant and glyphosate-susceptible plants were treated with glyphosate (Roundup ProMax., Monsanto) at 0, 8, 16, 32, 64, 128 and 256 fl. oz. /A using a CO2-powered backpack boom sprayer containing flat-fan nozzles calibrated to deliver 30 gpa of spray volume. Annual bluegrass control was evaluated visually on a 0 (no injury) to 100 percent (complete kill) scale at 7 and 14 days after treatment. Measurements of photochemical efficiency were made on each evaluation date to provide a quantitative assessment of plant response to glyphosate treatment.

Experimental design was a randomized complete block with four replications that was repeated in time. I50 values were calculated for each biotype to determine the rate of glyphosate giving a 50 percent response (i.e., 50 percent annual bluegrass control).

RESULTS AND DISCUSSION

Responses of the glyphosate-resistant and glyphosate-susceptible biotypes to increasing rates of glyphosate varied (Figure 1, pg. 38.) At 14 days after treatment, glyphosate controlled the susceptible biotype >95 percent at rates greater than 16 fl. oz. /A. Comparatively, the resistant biotype was only controlled 76 percent with glyphosate at 256 fl. oz. /A. I50 values for resistant and susceptible biotypes were 107 and 9 g a.e. ha-1, resulting in a resistance factor (RF) of 12.

Moreover, photochemical efficiency values on resistant plants were not significantly different from the untreated control with glyphosate rates ≤ 32 fl. oz.

Continued on page 40

TABLE 2

Herbicidal modes of action with activity against annual bluegrass in golf course turf

Timing	Mode action	Active ingredient†
PRE	Mitotic inhibition	Benefin (Balan)
		Dithiopyr (Dimension)
		Oryzalin (Surflan)
		Pendimethalin (Pendulum)
		Prodiamine (Barricade)
		Trifluralin (Treflan)
	Lipid biosynthesis inhibition	Bensulide (Bensumec)
	Protoporphyrinogen oxidase (PPO) inhibition	Oxadiazon (Ronstar)
PRE/POST	Mitotic inhibition	Dimethenamid (Tower)
		Pronamide (Kerb)
	Photosystem II inhibition	Amicarbazone (Xonerate)
		Atrazine (Aatrex)
		Metribuzin (Sencor)
		Simazine (Princep)
	Cellulose biosynthesis inhibition	Indaziflam (Specticle)
	Lipid biosynthesis inhibition	Ethofumesate (Prograss)
	Carotenoid biosynthesis inhibition	Mesotrione (Tenacity)
POST	Acetolactate synthase (ALS) inhibition	Bispyrabic-sodium (Velocity)
		Chlorsulfuron (Corsair)
		Flazasulfuron (Katana)
		Foramsulfuron (Revolver)
		Imazaquin (Image)
		Imazapic (Plateau)
		Metsulfuron (Manor)
		Rimsulfuron (TranXit)
		Sulfosulfuron (Certainty)
		Trifloxysulfuron (Monument)
	Enolpyruvyl Shikimate-3 Phosphate (EPSP) synthase inhibition	Glyphosate (Roundup)
	Glutamine synthetase inhibition	Glufosinate (Finale)
	Photosystem I inhibition	Diquat (Reward)
		Paraquat (Gramoxone)

† Active ingredients may be available under multiple trade names. Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the University of Tennessee Institute of Agriculture. The omission of a particular trade name is not intended to reflect adversely, or to show bias against, any product or trade name not mentioned. Always refer to the product label for specific information on proper use, tank-mixing compatibility and turfgrass tolerance.

Continued from page 39

/A by 14 days after treatment, suggesting that photosynthesis was not affected by glyphosate at these rates. Susceptible plants treated with glyphosate at > 8 fl. oz. /A yielded photochemical efficiency values of 0.000 by 14 days after treatment, indicating that plants had been killed (i.e., no photosynthesis was occurring).

MOVING FORWARD

This research represents the first instance of a weed species having glyphosate resistance in bermudagrass turf. While not compared directly, the level of resistance in the glyphosate-resistant biotype from Tennessee is greater than that reported for a glyphosate-resistant annual bluegrass biotype infesting zoysiagrass turf in Missouri (Binkholder, 2011) and higher than what has been reported for many other grassy weeds in non-turf settings.

Transfer of resistance traits through pollen dispersal or seed movement is not likely in self-pollinated species such as annual bluegrass, where gene flow in managed turfgrass settings is limited (Ellis 1973; Ng et al. 2004; Sweeney and Danneberger 1995).

Rather, glyphosate-resistant biotypes may emerge at specific locations after repeated use of glyphosate for weed control in dormant bermudagrass turf. Such was the case at Humboldt Golf and Country Club, where the golf course superintendent regularly applied glyphosate at 32 fl. oz./A for nearly 20 years. Superintendents should rotate herbicidal modes of action used to control winter annual weed species in dormant bermudagrass turf.

The golf course superintendent at Humboldt Golf and Country Club was able to control this glyphosate-resistant biotype of annual bluegrass with the use of a photosystem II inhibitor (simazine) the following season. It should be noted, though, that continued use of simazine alone would just increase selection pressure for simazine-resistant annual