

Greenhouse day/night temperatures were set for approximately 78/68 degrees Fahrenheit (F). TifEagle and Champion bermudagrass plugs, established in July 2002 and 2003, respectively, were collected from experimental greens located at the Turf Service Center in Clemson. Tifdwarf and MiniVerde bermudagrass sod was obtained from American Turf in Duluth, Ga. FloraDwarf bermudagrass sod was obtained from the University of Florida.

Sod was established in 10-centimeter (cm) pots in the greenhouse for approximately four weeks. Turf was washed free of soil and roots were cut to approximately 2.5 cm from the thatch layer. To help mimic growing conditions in the field, sod was transplanted to polyvinyl chloride lysimeters (photograph to right) with 40-cm depths and 177-square-cm surface areas, built to United States Golf Association specification (USGA Green Section Staff, 1993) with an 85:15 volume-to-volume (v/v) of sand and peat moss soil medium. Starting fertilizer, 9-18-18, was mixed into the soil at 48 kg nitrogen (N) ha¹.

After transplanting sod to lysimeters, a two-week establishment period was chosen before herbicide applications to encourage root regeneration similar to spring and early summer bermudagrass growth. Oxadiazon plus bensulide (6.6 granular [G], 1.3 percent oxadiazon plus 5.3 percent bensulide) was applied from a prepackaged combination at 1.6 kg ha¹ plus 6.8 kg ha¹ (130 kg ha¹ of product) to initiate the eight-week studies. Lysimeters were irrigated and mowed at 4 millimeters (mm) five days per week. Ammonium nitrate solution was applied weekly at 12 kg N ha¹.

Turf quality was rated weekly on a 1 to 9 scale with 9 being dark green turf and 1 completely dormant turf. Ratings below 7 were considered unacceptable. Turf injury was evaluated on a percent-scale basis, with 0 equaling no injury, 1 to 15 percent equaling minor discoloration, 16 to 30 percent equaling moderate injury, greater than 30 percent equaling unacceptable injury, and 100 percent equaling completely dead turf. Clippings were harvested four and eight weeks after treatment (WAT). Roots were sampled at the 0-cm to 15-cm and 15-cm to 30-cm depths eight WAT and were cut approximately 2.5 cm from the thatch layer. After harvestings, clippings and roots were oven-dried at 176 degrees F for 48 hours, then



Lysimeters built to USGA specifications are used for greenhouse experimental units.

weighed. Data were subjected to an analysis of variance with Statistical Analysis System (SAS) General Linear Model procedure. Mean separations were based on Fishers Protected least statistical difference (LSD) test ($P = .05$).

Results and discussion

Since herbicide interactions did not occur in either study, results were pooled over the two studies. Herbicide treatment caused no visible injury symptoms and had no effect on turf visual quality.

Oxadiazon plus bensulide did not affect root length or dry root mass after eight weeks on any of the ultradwarf bermudagrass cultivars. However, there was highly significant variation among the cultivars for final dry root mass. Therefore, results are presented among cultivars for root length and root mass.

TifEagle bermudagrass averaged 15-percent reduced root length compared with the other bermudagrass cultivars and had the least amount of root mass at both sampling depths (Figure 1). Tifdwarf, FloraDwarf, and MiniVerde had similar total root mass after eight weeks. Compared to these three cultivars, Champion and TifEagle had 36 percent and 88 percent less root mass, respectively (Figure 2). TifEagle bermudagrass, however, had 81-percent less root mass than Champion.

White (1998) observed similar results with TifEagle bermudagrass four months after sprigging the same five bermudagrass cultivars. TifEagle had 63-percent and 56-percent reduced root mass compared to Tifdwarf and

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Bayer Environmental Science

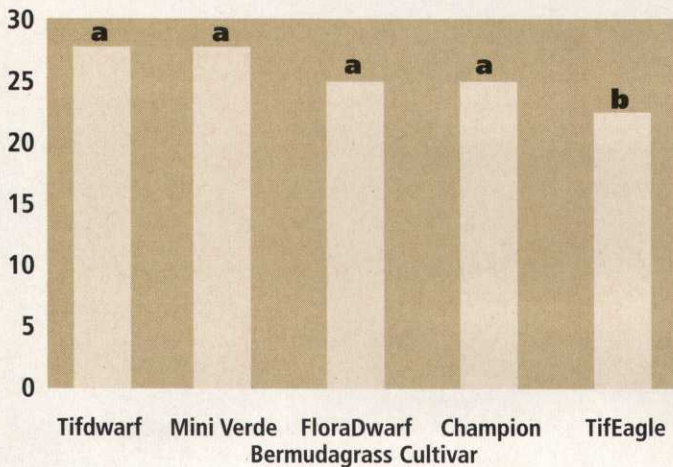
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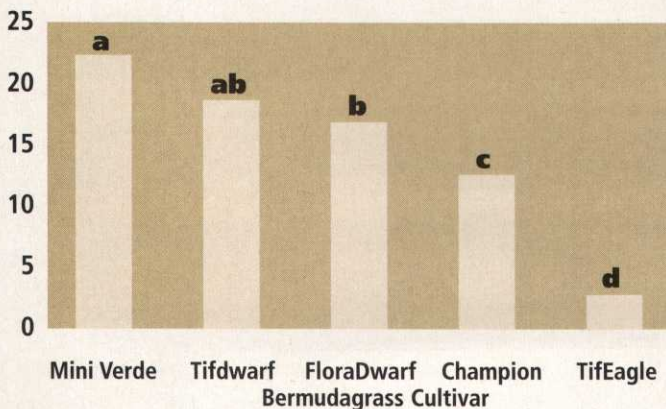
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 Champion bermudagrasses, respectively, four months after establishment.
 Genetic and morphological variations among

FIGURE 1

Root length of five dwarf-type bermudagrasses after eight weeks in combined greenhouse experiments. Different letters indicate a significant difference ($P = .05$), according to Fischer's Protected LSD test.

**FIGURE 2**

Dry root mass of five dwarf-type bermudagrasses after eight weeks in combined greenhouse experiments. Different letters indicate a significant difference ($P = .05$), according to Fischer's Protected LSD test.



dwarf-type bermudagrasses may affect root and shoot growth characteristics of these grasses. Turfgrass rooting is strongly influenced by shoot growth competition for stored root carbohydrates (Younger, 1969). In this experiment, root growth restrictions of Champion and TifEagle bermudagrass may have occurred from higher shoot growth, exemplified by higher clipping yields.

Comparing untreated turf, Champion and TifEagle had 39-percent and 52-percent higher total clipping yield, respectively, from two sampling dates compared to Tifdwarf, FloraDwarf and MiniVerde. Herbicide treatment had no effect on

Tifdwarf, Champion, and MiniVerde bermudagrass had similar clipping yield to untreated turf eight weeks after treatment.

clipping yield four weeks after treatment. However, TifEagle and FloraDwarf bermudagrass receiving oxadiazon plus bensulide had 32-percent and 25-percent reduced clipping yield eight weeks after treatment, respectively.

Reductions from the herbicide may have resulted after eight weeks from overall increased growth of untreated turf relative to samples taken four weeks later. Tifdwarf, Champion and MiniVerde bermudagrass had similar clipping yield to untreated turf eight weeks after treatment.

From this research, it appears the ultradwarf bermudagrass cultivars, FloraDwarf and MiniVerde, may have similar rooting characteristics comparable with the traditional bermudagrass putting green cultivar Tifdwarf. TifEagle bermudagrass was the only cultivar to have reduced root length and root mass relative to all other cultivars. Reduced root growth may be a major limitation to this cultivar, although, because of TifEagle's putting green quality and popularity among Southern golf courses, future research in promoting root growth of this grass will be warranted.

Oxadiazon in combination with bensulide, at 1.6 kg ha⁻¹ plus 6.8 kg ha⁻¹, appears to be safe for pre-emergent weed control on actively growing dwarf bermudagrass under consistent growing conditions. However, ultradwarfs will likely be more vulnerable to pre-emergent herbicide

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injury during root regeneration in the spring as bermudagrass breaks dormancy. Further field research is needed with different nitrogen levels, soil types and environmental conditions to which dwarf bermudagrass turf may be subjected during spring and early summer months when applying pre-emergent herbicides.

Our current research at Clemson University is evaluating the effects of six pre-emergent herbicides on seasonal root

growth of field grown TiffEagle bermudagrass. Because there are no herbicides currently labeled for the ultradwarfs, information from this research will be valuable for golf courses converting their greens to these new cultivars.

Patrick McCullough is a research associate in the department of plant biology and pathology at Rutgers University in New Brunswick, N.J. Bert McCarty, Vance Baird and Ted Whitwell are professors, and Haibo Liu is an associate professor in the department of horticulture at Clemson (S.C.) University.

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TURFGRASS TRENDS

SECTION STAFF

Managing Editor

Curt Harler
440-238-4556; 440-238-4116 (fax)
curt@curtharler.com

Golfdom Staff Contact

Thomas P. Skernivitz
440-891-2613; 440-891-2675 (fax)
tskernivitz@advanstar.com

Online Editor

Lynne Brakeman
440-826-2869; 440-891-2675 (fax)
lbrakeman@advanstar.com

Chief Science Editor

Dr. Karl Danneberger
614-292-8491; 614-292-3505 (fax)
danneberger.1@osu.edu

Production Manager

Jill Hood
218-723-9129; 218-723-9223 (fax)
jhood@advanstar.com

Art Director

Lisa Lehman
440-891-2785; 440-891-2675 (fax)
llehman@advanstar.com

Publisher

Patrick Jones
440-891-2786; 440-891-2675 (fax)
pjones@advanstar.com

Group Publisher

Tony D'Avino
440-891-2640; 440-891-2675 (fax)
tdavino@advanstar.com

Corporate & Editorial Office

7500 Old Oak Blvd.
Cleveland, OH 44130-3369

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Agronomist

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CONTACT US:

Editorial: 440-238-4556

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Everything you always wanted to know about transition management*

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Bayer Environmental Science's summit draws top turf experts

By Larry Aylward, Editor

What do you get when you put 20 turf professors in a room to talk about transition management? The answer, of course, is obvious: You get a lot of scientific discussion — some intense and passionate — about turf. But what's not so obvious is you also get a lot of laughs. These well-educated turf doctors from the warm-season turfgrass zones definitely don't lack a sense of humor. (Betcha didn't know that Dave Kopec from the University of Arizona is a big Little Rascals' fan?)

The turf experts, including Kopec, Fred Yelverton from North Carolina State, Shawn Askew and Erik Ervin from Virginia Tech University, Tim Murphy from the University of Georgia, Bert McCarty from Clemson University and others, comprised the main course of the recent Transition Management Summit held in San Francisco, sponsored by Bayer Environmental Science. The two-day conference featured nearly 40 people, including several turf experts from Bayer, such as Don Myers and Bruce Monke.

Of course, the event was dominated with discussion about transition of bermudagrass to ryegrass and back to bermudagrass. Topics included new bermudagrass cultivars and the influence of fungicides on transition of bermudagrass greens.

The turf professors also shared results of two-year transition studies on Bayer's latest sulfonylurea herbicide, Revolver, which eradicates ryegrass during overseeding.

Leading off ...

Who better to give a presentation on the history of overseeding than Stanley Zontek, director of the USGA Green Section's Mid-Atlantic region. Nobody knows where overseeding originated, but Zontek likens it to having its own eras.

"The first era was the natural era," Zontek said, noting that it probably began sometime in the 1950s. "That's when Mother Nature did the overseeding for us."

Winter weeds took their place in the dormant bermudagrass. It wasn't pretty, but nobody said it had to be. "That was your winter color — take it or leave it," Zontek said.

The late '60s brought the era of winter maintenance, Zontek noted. That's when the early, basic herbicides were used to kill weeds. The adolescent era occurred in the early '70s. "That's when a lot of people tried a lot of different things," Zontek said.

Zontek joined the USGA as an agronomist in 1971, which was also the era of the great debate between the pros and cons of using domestic ryegrass vs. annual ryegrass in overseeding, he said.

Zontek remembers Augusta National spending \$100,000 on overseeding. He recalls bermudagrass greens being overseeded with rates of annual ryegrass at 30 pounds per square 1,000 feet. He remembers superintendents trying aerators and slicers in accordance with overseeding for the first times. "There was a lot of testing and people trying different things to figure out the best way of doing this," Zontek said.

The '80s and early '90s signified the adult era. Overseeding came into its own and was universally accepted as Southern golf courses spent more money to keep their courses green in the winter. All of this was made possible by improved varieties of perennial ryegrass, Zontek noted.

Zontek says the turf industry is currently in the next era — or the maturity era. The name speaks for itself. Zontek also noted that there's a sub era in the maturity era called "the perfect course." Zontek said golfers want perfect courses in the spring, summer, fall and winter.

The last era is called managed care, Zontek said. "We're entering a new era of managed care where we're using chemicals to manage the transition of these overseeded grasses."

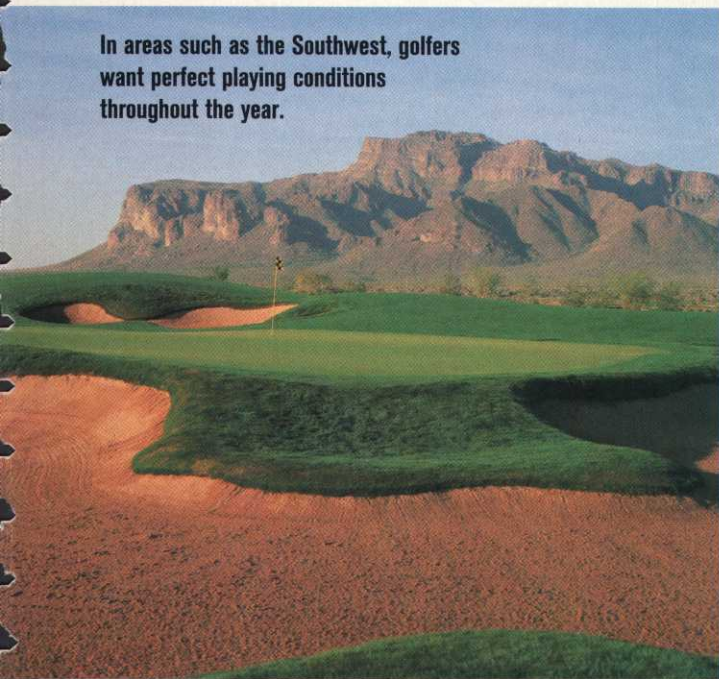
Misery loves ...

Shawn Emerson, director of agronomy for the Golf Club at Desert Mountain in Scottsdale, Ariz., was the only superintendent at the Transition Management Summit. However, he was the perfect superintendent to have on hand. The 41-year-old Emerson has participated in more than 50 golf course overseedings in his career. "I can't think of anyone who has put himself through more misery than I have," he said, only half-jokingly.

You could say Emerson has a stressful job, especially when

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Transition Management

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it comes to overseeding at Desert Mountain, which consists of six Jack Nicklaus-designed courses each with maintenance budgets of \$1.9 million. Golfers expect near perfection at Desert Mountain, and overseeding is not always perfect or pretty for that matter.

"The agronomic framework [for overseeding] starts with revenue," Emerson says. "The more money I make, the more money I can spend on my golf course."

Desert Mountain gains 90 percent of its rounds and revenue from Oct. 15 through June 15. The problem Emerson faced during that time was that bermudagrass would begin to green in April but ryegrass wouldn't die until July. "That means I only had July through September to grow in the bermudagrass, which wasn't enough time," Emerson said, noting that bermudagrass doesn't grow well when it has competition from another variety.

Three years ago Emerson began "spraying out" — or using herbicides to eradicate the ryegrass — with the goal of getting the bermudagrass to fully establish by mid-July. It took



"The first era was the natural era. That's when Mother Nature did the overseeding for us."

STANLEY ZONTEK, DIRECTOR OF THE USGA GREEN'S SECTION MID-ATLANTIC REGION

a few years for that to happen — the turf had to adjust to the process and the course wasn't always aesthetically pleasing — but Emerson is satisfied with the results. He says other superintendents should consider using herbicides such as Revolver to eradicate ryegrass because it makes transition so much easier.

Speaking of transition, Emerson asked the turf professors if the word was the proper term to describe the action. He pointed out that "transition" is usually associated with being seamless.

"I don't know if this is seamless," Emerson said of overseeding. "I think 'convergence' is a better word for it."

Who needs it?

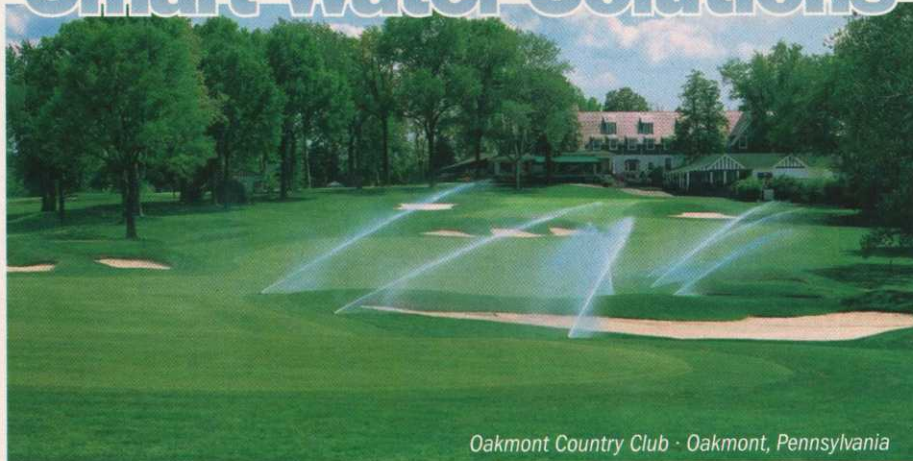
While everybody was talking about the challenges of transition, Pat O'Brien, director of the USGA Green Section's Southeast Region,

offered a solution: don't overseed.

"I've seen superintendents go through the pain and agony of overseeding in the Southeast," he said, noting that some superintendents have scrapped the process.

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