Selecting zoysiagrass cultivars: Turf quality and stress tolerance

Improve turf performance and environmental stress tolerance through proper cultivar selection.

Editor's note: This article is the first of a two-part series describing differences among zoysiagrass cultivars. In the June 2010 Issue of GCM, the author will present information on the pest tolerance of zoysiagrass cultivars and other selection criteria to examine when choosing the best zoysiagrass cultivar(s) for your golf course.

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Zoysiagrass (*Zoysia* spp. Willd.) has been slowly increasing in use across the U.S. since it was first introduced around 1900. Japanese lawngrass (*Zoysia japonica* Steud.) and Manilagrass (*Z. matrella* (L.) Merr.) are the most commonly used species, and in the U.S., both are commonly referred to as zoysiagrass. *Zoysia matrella* has a narrower leaf than *Z. japonica,* and *Z. matrella* typically grows more slowly and is less cold-hardy, but is more tolerant to salinity and insect pests.

Zoysiagrass in the U.S.

The first zoysiagrass cultivar in the U.S., Matrella (FC 13521), was released in Alabama in the early 1940s. Zoysiagrass was immediately popular in the southern U.S. because few well-adapted species and cultivars were available for lawns. The release of Matrella was closely followed by the release of Meyer, Sunburst and Emerald (*Z. japonica* × *Z. pacifica*) in the 1950s (Table 1). Meyer and Emerald quickly became industry standards for zoysiagrass, but many other zoysiagrass cultivars did not become commercially available until the 1980s (Table 1, Figure 1).

By 2006, approximately 16,293 acres (6,593.5 hectares) of zoysiagrass had been planted on golf courses in the U.S., with 81% in the transition zone and 18% in the southeastern U.S. (4). Although the majority of zoysiagrass is used in the transition zone, the availability of more cultivars, especially those that perform well in warmer regions, has led to increased use in the southeastern U.S. (Figure 1). Of the 38 zoysiagrass cultivars currently or previously used in the U.S., 32 were commercially available in 2009 (Table 1). Twenty-nine were released after 1980, 24 were released after 1990, and 15 were released after 2000 (Figure 1). (Table 1 includes 38 cultivars, but only 37 are included in Figure 1. Chinese common seeded zoysiagrass is missing from the count in Figure 1 because it is not clear when it was first sold in the U.S.)

A great deal of research on zoysiagrass has taken place since 1990. Various environmental stresses (cold temperature and drought tolerance, divot recovery, salinity tolerance, shade tolerance) and various biotic stresses (insect resistance, mite resistance, disease resistance, nematode resistance) have been studied for many commonly used zoysiagrass cultivars. Zoysiagrass growth characteristics have also been studied, including rooting, stolon growth, establishment and clipping yield. Additionally, zoysiagrass turf quality, color, density and texture have been documented by previous and current trials through the National Turfgrass Evaluation Program (NTEP, www.ntep.org).

On the No. 2 hole at Atlanta Athletic Club's Riverside Course, the lighter color of the Zeon zoysiagrass fairway contrasts with the Tifton-10 bermudagrass roughs. The striping of the zoysiagrass is also evident. **Photo by K. Mangum**

Despite the large body of literature on zoysiagrass, this information remains largely unavailable to superintendents. Often, cultivar selection is based solely on local availability of sod, and many well-adapted cultivars are not planted in certain environments because of their limited availability. Because many cultivars are available and information about them is difficult to obtain, I have written this two-part series to assist superintendents in selecting the right zoysiagrass cultivars.

Zoysiagrass quality

Turf quality varies by region for each turfgrass species. Specifically, zoysiagrass turf quality is influenced mostly by differences in texture and density between species: *Z. japonica* has a coarser leaf texture and less density than *Z. matrella*. Stress tolerance is the other key factor that separates the turf quality of zoysiagrass cultivars.

For example, Meyer has excellent winter hardiness and thus often performs well in the transition zone and is ranked in the top half of the cultivars in each of the years tested for turf quality in areas with cold winters (Table 2). However, because Meyer has poor drought and pest tolerance, it does not perform well farther south and is ranked near the bottom in turf quality when zoysiagrasses are tested in the southern U.S. Some cultivars like Emerald, Zorro, Cavalier, Himeno, Marquis and Zeon have good turf quality in both the southern U.S. and in the southern and central areas of the transition zone. Other cultivars such

Cultivar release by decade

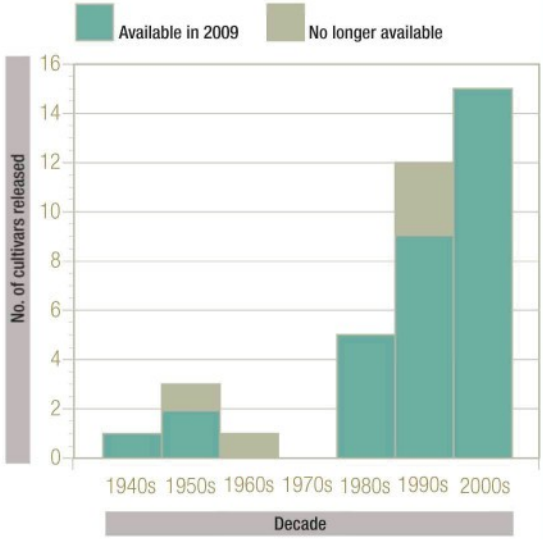

Figure 1. The number of zoysiagrass cultivars released by decade with cultivars commercially available in 2009 shaded green and cultivars no longer commercially available shaded tan. The data are from Table 1.

Zoysia cultivars

Name	Experimental no.	Type†	Species	Breeder or supplier	Year‡
Belair§	AN R52-25	veg	*Z. japonica*	USDA	1987
BK-7		veg	*Z. japonica*	Craft Turf Farms, Foley, AL	1987
Carrizo§	6136	veg	*Z. japonica*	Bladerunner Farms, Poteet, TX	2006
Cashmere§	P-1	veg	*Z. matrella*	Pursley Turf Farms, Palmetto, FL	1989
Cavalier§	DALZ 8507	veg	*Z. matrella*	Texas A&M Univ., Dallas	1996
Chinese Common		seeded	*Z. japonica*		
Compadre§	ZMB-2	seeded	*Z. japonica*	Seed Research of Oregon, Corvallis	2000
Crowne§	DALZ 8512	veg	*Z. japonica*	Texas A&M Univ., Dallas	1996
DeAnza§	Z88-8	veg	*Z. japonica*	West Coast Turf, Stevinson, CA	1995
Diamond§	DALZ 8502	veg	*Z. matrella*	Texas A&M Univ., Dallas	1996
El Toro§	UCR#1	veg	*Z. japonica*	Univ. of California, Riverside	1986
Emerald§	34-35	veg	*Z. japonica* × *Z. pacifica*//	USDA	1955
Empire§	SS-500	veg	*Z. japonica*	Sod Solutions, Mt. Pleasant, SC	1999
Empress§	SS-300	veg	*Z. japonica*	Sod Solutions, Mt. Pleasant, SC	2000
GN-Z§	ZT-11	veg	*Z. japonica*	Greg Norman Turf, Jupiter, FL	1989
Himeno§		veg	*Z. japonica*	Winrock Grass Farm, Little Rock, AR	2002
JaMur§		veg	*Z. japonica*	Bladerunner Farms, Poteet, TX	1996
Marion§		veg	*Z. japonica*	Heritage Turf, Midway, AL	2008
Marquis	TC 2033	veg	*Zoysia* species	Turf Center, Spencerville, MD	1991
Matrella	FC 13521	veg	*Z. matrella*	Alabama Agric. Experiment Station	1941
Meyer§	Z-52	veg	*Z. japonica*	USDA	1951
Midwest		veg	*Z. japonica*	Indiana Agricultural Experiment Station	1963
Omni	CD 2013	veg	*Z. matrella*	Bladerunner Farms, Poteet, TX	1991
Palisades§	DALZ 8514	veg	*Z. japonica*	Texas A&M Univ., Dallas	1996
PristineFlora§		veg	*Z. matrella*	Univ. of Florida, Belle Glade, FL	2005
Rollmaster§		veg	*Z. matrella*	Winrock Grass Farm, Little Rock, AR	2008
Royal§	DALZ 9006	veg	*Z. matrella*	Texas A&M Univ., Dallas	2001
Serene§		veg	*Z. japonica*	Heritage Turf, Midway, AL	2008
Shadowturf§		veg	*Z. matrella*	Ivey Gardens Greenhouses, Lubbock, TX	2007
Southern Gem§		veg	*Z. japonica*	Heritage Turf, Midway, AL	2008
Sunburst	Z-73	veg	*Z. japonica*	U.S. Department of Agriculture	1952
UltimateFlora§		veg	*Z. japonica*	Univ. of Florida, Belle Glade	2005
Victoria	Z88-14	veg	*Z. japonica*	West Coast Turf, Stevinson, CA	1995
Y2§		veg	*Z. japonica*	Bladerunner Farms, Poteet, TX	2006
Zenith§	ZNW-1	seeded	*Z. japonica*	Patten Seed, Lakeland, GA	2000
Zeon§		veg	*Z. matrella*	Bladerunner Farms, Poteet, TX	1996
Zorro§	DALZ 8510/9601	veg	*Z. matrella*	Texas A&M Univ., Dallas	2001
ZoyBoy§	Z-3	veg	*Z. japonica*	Quality Turfgrass, Waimanalo, Oahu, HI	1994

†Type of establishment (propagation) method typically used by practitioners for each cultivar. Genotypes available by seed are typically seeded, with other genotypes typically established vegetatively (veg) by sprigs, plugs or sod.
‡Year released or made available to public.
§The cultivar was commercially available in the U.S. in 2009.
//Formerly *Zoysia japonica* Steud. × *Z. tenuifolia* Willd. ex Thiele, now *Z. japonica* × *Z. pacifica* Goudsw.

Table 1. Cultivar name, experimental designation, propagation type, species, breeder or supplier, and release date for zoysiagrass cultivars used across the U.S.

Cavalier zoysiagrass fairway at the Blessing GC in Fayetteville, Ark. Cavalier was the top-rated cultivar in the southern U.S. in the 1991 Zoysiagrass NTEP trial. **Photos by A. Patton**

as Crowne, GN-Z, Palisades, Royal and Victoria have better turf quality in the southern U.S. than in the transition zone.

A large group of commercially available cultivars has never been entered into NTEP trials, including BK-7, Carrizo, Cashmere, Empire, Empress, Marion, Matrella, Midwest, PristineFlora, Rollmaster, Serene, Southern Gem, UltimateFlora, Y2 and ZoyBoy. Information about the turf quality of these cultivars is lacking or often limited to locally available anecdotal observations. Some of these cultivars — Carrizo, Marion, PristineFlora, Rollmaster, Serene, Shadowturf, Southern Gem, Y2 and UltimateFlora — have been released since 2005, and information is lacking because of their recent release. Shadowturf, released in 2007, is included in the 2007 zoysiagrass NTEP trial along with the standards Zenith, Meyer and Zorro.

Turf color

Turf color is likely to have little influence on the selection of a zoysiagrass cultivar for golf course use because zoysiagrass color (both summer and winter) contrasts well with the color of other species such as tall fescue (*Festuca arundinacea* Schreb.) or bermudagrass (*Cynodon dactylon* [L.] Rich.), which are often used for golf course roughs in the transition zone and the southern U.S. Other factors such as pest resistance, stress tolerance and turf quality are more important and should be weighted as such. However, color could be a decisive factor in the decision between two cultivars with otherwise similar qualities.

Turf color was darkest green for Belair, Emerald, Marquis, Meyer and Royal in the 1991 NTEP trial; Meyer, Emerald and Zenith in the 1996 NTEP trial; and Emerald, Himeno and Meyer in the 2002 NTEP trial (www.ntep.org) (Table 2). Since color data are only available from NTEP trials, turf color data are lacking for a large group of cultivars.

Leaf texture

Zoysia japonica has wider leaves (>2 millimeters) than *Z. matrella* (<2 millimeters). Belair,

Quality rankings, color and texture ratings

Table 2. Turfgrass quality rankings, and genetic color and leaf texture ratings for zoysiagrass cultivars entered into NTEP trials in 1991, 1996, or 2002. Rankings are given separately for the transition zone and the Southern U.S. 1 = best ranked cultivar.

Data	Turfgrass quality ranking†						Scale of 1-9					
Location	Transition zone			Southern U.S.			Color‡			Texture§		
Year/cultivar	1991	1996	2002	1991	1996	2002	1991	1996	2002	1991	1996	2002
Belair//	7	††		12			6.6 a			4.9 e		
Cavalier//	5			1			6.2 cd			7.5 b		
Chinese Common			7			7		6.1 c	5.8 f		4.7 f	4.8 d
Compadre//			8			6			6.3 de			4.8 d
Crowne//	10			3			6.1 de			4.5 f		
DeAnza//		8			7			5.8 d			5.8 c	
Diamond//	12			10			5.9 ef			7.9 a		
El Toro//	11	3		7	5		6.2 cd	6.3 bc		4.7 ef	5.1 e	
Emerald//	4	2	2	4	1	2	6.6 a	6.5 ab	7.0 ab	7.4 b	7.5 a	8.0 a
GN-Z//			5			3			6.2 ef			6.5 b
Himeno//			3			4			7.2 a			5.6 c
JaMur//		6			6			6.2 c			5.0 e	
Marquis	3			2			6.5 ab			6.7 c		
Meyer//	6	5	4	11	9	8	6.5 ab	6.7 a	6.8 abc	6.0 d	6.3 b	6.5 b
Omni	2			9			5.8 fg			6.9 c		
Palisades//	9			5			6.3 bc			4.9 e		
Royal//	8			6			6.5 ab			7.5 b		
Sunburst	1			8			5.6 g			5.0 e		
Victoria		9			4			5.7 d			5.7 cd	
Zenith//		7	6		8	5		6.5 ab	6.5 cde		5.5 d	5.5 c
Zeon//		4			2			6.1 c			7.4 a	
Zorro//		1	1		3	1		6.3 bc	6.7 abc		7.6 a	8.0 a

†Turf quality rankings (turf quality is based on turfgrass color, density, uniformity, texture, and susceptibility to disease or environmental stress) were compiled from the National Turfgrass Evaluation Program (NTEP). Transition zone rankings were developed after averaging values where available (http://www.ntep/org) across up to 14 states (Arkansas, Idaho, Indiana, Illinois, Kansas, Kentucky, Maryland, Missouri, Nebraska, North Carolina, Ohio, Oklahoma, South Carolina and Virginia), across 4-year NTEP cycles (1992-1995; 1997-2000; 2003-2006) and across two management regimes in 2002 (Schedules A and B, NTEP). Southern U.S. rankings were developed by averaging rankings across eight states (Alabama, Arizona, California, Florida, Georgia, New Mexico, Mississippi and Texas) for the same time periods and management regimes. For each set of data (transition zone and southern U.S.), means were sorted and a ranking was assigned to each cultivar; the highest ranking was assigned to the cultivars with the highest mean turf quality.

‡Turf color was determined as the mean of NTEP values (www.ntep/org) across 14 or more states and 17 or more locations. Turf genetic color was visually evaluated on a scale of 1 to 9, with 9 representing ideal, dark green turf and 1 representing tan or brown turf. NTEP values for genetic color reflect the inherent color of the genotype.

§Texture was determined as the mean of NTEP values (www.ntep/org) across 14 or more states and 17 or more locations. Texture was visually evaluated on a scale of 1 to 9, with 9 equaling fine texture or narrow leaf blades.

//The cultivar was commercially available in the U.S. in 2009.

††Empty table cells indicate no data were reported for this cultivar in the cited experiment.

Chinese Common, Compadre, Crowne, El Toro, Empire, Himeno, JaMur, Palisades, Sunburst and Zenith are among the zoysiagrass cultivars with the coarsest texture (widest leaves) based on published reports (Table 2). Cavalier, Diamond, Emerald, Royal, Zeon and Zorro are among the narrowest-leaved cultivars (Table 2). Carrizo, DeAnza, Empress, GN-Z, Meyer, Y2 and Victoria are among a group with intermediate leaf texture (www.ntep.org). The leaf texture of other cultivars is not reported in the literature, but Cashmere, Matrella, PristineFlora, Rollmaster and Shadowturf are fine-textured; Marion, Marquis, Serene, Southern Gem and UltimateFlora have intermediate leaf texture; and Midwest and Empire have coarse texture. Among all the cultivars, Diamond, PristineFlora and Cashmere have the finest texture.

Many commercially available *Z. japonica* cultivars are not a single species as classified by their leaf texture, but instead are interspecific hybrids. Cultivars such as Victoria, El Toro and Palisades are likely crosses of *Z. japonica* and *Z. matrella*, but are classified as *Z. japonica* because of their morphology. Other cultivars such as Empress, GN-Z and DeAnza are also likely interspecific hybrids because of their intermediate leaf texture.

Environmental stress tolerance

Drought tolerance and water use are becoming increasingly important in the U.S. in light of increased urbanization, recent droughts, water shortages and water restrictions. Zoysiagrass is generally classified as being less drought resistant than bermudagrass, but zoysiagrass cultivars differ in irrigation requirement, rooting depth and leaf firing.

Irrigation requirement

Researchers in Dallas studied the amount of irrigation required to prevent water stress (wilting) (11). In addition to an average annual rainfall of 44 inches (1,118 millimeters), El Toro, Palisades and Crowne required the least supplemental irrigation (<5.9 inches [<149 millimeters]); Meyer required 11.1 inches (282 millimeters) of supplemental irrigation; and Diamond, Matrella, Emerald, Zorro, Cashmere and Cavalier required the most supplemental irrigation (>14.2 inches [>360 millimeters]) (Table 3) (11).

Rooting depth

Plants are known to tolerate drought by enhancing water uptake through increased rooting depth, which prolongs the need for supplemental irrigation. Using root tubes and controlled growing conditions, researchers documented (5) that Belair, Crowne, El Toro, Emerald, Marquis, Meyer and Palisades were among the cultivars with the highest average maximum rooting depth (>11.6 inches [>295 millimeters]), while Cavalier, Diamond, Royal and Sunburst had the lowest (<10.1 inches [<256 millimeters]) (Table 3). They also found that the average maximum rooting depth was related to survival under severe (0% ET) and moderate (35% ET) drought stress (5), indicating that zoysiagrasses tolerate drought by maintaining high tissue water potential through deep rooting.

Leaf firing

Turfgrass has a number of functional roles including evaporative cooling, air pollution mitigation and athlete safety, among others. However, drought minimizes the ability of turf to maintain these functions. One common method that is used to measure interspecific differences in response to drought is leaf firing (green turf color retention).

Meyer was found to have high leaf firing (>50%) or low green-color retention during drought in College Station, Texas; El Toro, Emerald and Matrella had low leaf firing (<10%) or high green-color retention during drought (Table 3) (3). A follow-up field study reported that Matrella and Diamond had less than 20% leaf firing when data were averaged across three dates (60, 90 and 120 days of drought stress) in College Station (1), while Belair, El Toro and Meyer had more than 40% leaf firing during the same period.

More recently, drought tolerance was evaluated in San Antonio, Texas (2). Leaf firing after 20 days of drought in 2006 was lowest among Cavalier, El Toro, Emerald, Empire, JaMur, Palisades and Zeon and highest among Y2 and Zorro. Leaf firing after 30 days of drought in 2007 was lowest among Cavalier, El Toro, Emerald, Empire, JaMur, Palisades

The difference in leaf texture among Diamond, Meyer and El Toro zoysiagrass cultivars.

Dormant Cavalier zoysiagrass green surrounds at Blessing GC in Fayetteville, Ark. The dormant color of the zoysiagrass contrasts well with the creeping bentgrass putting green. Notice the fairways green-up earlier in spring because they have a lower mowing height.

More information on zoysiagrass cultivars

Readers may want to refer to previously published *GCM* articles that describe differences in zoysiagrass cultivars.

- **Establishment.** Patton, A.J., and Z.J. Reicher. 2007. Zoysiagrass establishment rate. *Golf Course Management* 75(3):124-127.
- **Winter hardiness.** Patton, A.J., and Z.J. Reicher. 2007. Zoysiagrass winter hardiness. *Golf Course Management* 75(4):119-123.
- **Divot recovery.** Karcher, D., M. Richardson, J. Landreth and J. McCalla. 2006. Variety selection affects bermudagrass and zoysiagrass divot recovery time. *Golf Course Management* 74(12):83-87.

Environmental stress tolerance

Cultivar	Irrigation needed (mm)†	Avg. max. root depth (mm)‡	Drought response (leaf firing)				Salinity response (% leaf firing)			Cumulative TPI under 90% shade///	Shade tolerance rating	
			%		Scale of 1-9							
			1985§	1988//	2006††	2007††	Study A‡‡	Study 1§§	Study 2§§		90%†††	50%‡‡‡
Belair §§§	////	296 abc	med.	54			46.4 abc			16		
Carrizo §§§												
Cashmere §§§	390 ab											
Cavalier §§§	360 ab	255 b-e			4.5 abc	5.8 abc	37.9 cd	48.3 a	40.7 a	28		G
Crowne §§§	93 d	355 a					39.3 cd	22.0 ef	12.0 cde	31		
DeAnza §§§								30.0 de	38.0 a			
Diamond §§§	488 a	246 cde		19			20.0 e	2.2 g	2.5 de	34	G	G
El Toro §§§	148 cd	356 a	low	44	4.5 abc	6.7 abc	32.9 d	19.8 f	14.5 cd	25		G
Emerald §§§	437 ab	330 ab	low	33	6.5 a	8.0 a	37.9 cd	33.6 cd	40.1 a	31	P	
Empire §§§					5.3 ab	6.8 abc						
JaMur §§§					4.5 abc	7.0 abc		30.3 de	16.0 cd			
Marquis		300 abc					33.6 d			31		
Matrella §§§	457 a		low	16								
Meyer §§§	282 bc	333 ab	high	42			54.3 a	45.1 ab	22.5 b	16	P	F
Omni							45.7 abc					
Palisades §§§	132 cd	318 abc			5.0 abc	7.8 a	40.0 bcd	39.3 bc	9.0 de	31		G
Royal §§§		177 e					33.6 d			31		
Shadowturf §§§											G	
Sunburst		203 de					50.0 ab			22		
Victoria								27.3 def	20.4 bc			
Y2 §§§					3.0 cd	5.8 abc						
Zenith §§§												P
Zeon §§§					5.0 abc	5.5 bc		45.4 ab	38.0 a			
Zorro §§§	390 ab				3.3 bcd	5.3 c				33	P	G

†From White et al. (11). Supplemental irrigation requirement to prevent wilting. Mean of three years (1989-1991) in Dallas, Texas, with an average annual rainfall of 44.0 inches (1,118 millimeters).
‡From Marcum et al. (5).
§From Kim et al. (3). Leaf firing after 35 days of drought in 1985 in College Station, Texas. High, >50% leaf firing; medium (med.), 10% to 50% leaf firing; low, <10% leaf firing.
//Adapted from Beard and Sifers, Table 2 (1). Mean of leaf firing after 60 days, 90 days, and 120 days drought in College Station, TX. 100% = complete leaf firing or brown turf.
††From Chalmers et al. (2). Leaf firing after 20 days of drought in 2006 and 30 days of drought in 2007 in San Antonio, Texas. High values indicate drought tolerance; 9 = no leaf firing.
‡‡From Marcum et al. (6). Low values indicate salinity tolerance.
§§From Qian et al. (7). Low values indicate salinity tolerance.
///Adapted from Riffell et al., Table 6. (8). Cultivars were assigned a turf performance index (TPI) value of 1 each time they appeared in the top statistical grouping when rated for coverage, quality, color, and density and a value of 0 when not in the top statistical group. There were a total of 38 evaluations in this study with a maximum TPI of 38.
†††Adapted from Sladek et al. (9). Greatest shade tolerance (G), poorest shade tolerance (P).
‡‡‡Arkansas. Adapted from Trappe et al. (10). Good shade tolerance (G), fair shade tolerance (F), poor shade tolerance (P).
§§§Indicates that the cultivar was commercially available in the United States in 2009.
////Empty table cells indicate no data were reported for this cultivar in the cited experiment.

Table 3. Environmental stress tolerance of zoysiagrass cultivars commonly grown in the U.S. Only cultivars tested in research trials are included in this table.

and Y2. As illustrated by these reports, choosing a drought-tolerant cultivar will help reduce water use while simultaneously improving turfgrass performance and aesthetic quality.

Salinity tolerance

With freshwater sources for turfgrass irrigation becoming more limited, the use of low-quality recycled water sources is becoming more common. Zoysiagrass is classified as moderately tolerant to salinity stress, but there are significant differences among cultivars. Similar to drought tolerance, leaf-firing measurements (green turf color retention) are often used as a measurement of salinity tolerance. Researchers have reported that *Z. matrella* cultivars were more tolerant to salinity than *Z. japonica* cultivars (6). Among cultivars, Diamond is the most tolerant to salinity; Crowne, DeAnza, El Toro, Emerald, JaMur, Marquis, Palisades, Royal and Victoria have intermediate salinity tolerance; and Belair, Cavalier, Meyer, Omni, Sunburst and Zeon are the least tolerant to salinity (6,7) (Table 3).

Shade tolerance

Another common environmental stress of turfgrass is shade. Zoysiagrasses are generally considered to have good shade tolerance. The most com-

prehensive study to date on the shade tolerance of zoysiagrass was completed in Dallas under 90% shade from southern live-oak trees (*Quercus virginiana* Mill.) (8). Cultivars were assigned a turf performance index (TPI) value of 1 each time they appeared in the top statistical grouping when rated for coverage, quality, color and density and a value of 0 when not in the top statistical group. There were a total of 38 evaluations in this study over a three-year period, and the maximum TPI was 38. Diamond had the highest rating (TPI = 34); followed by Zorro (TPI = 33); Crowne, Palisades, Royal, Emerald and Marquis (TPI = 31); Cavalier (TPI = 28); El Toro (TPI = 25); and Sunburst (TPI = 22) (8) (Table 3). Belair and Meyer had the poorest shade tolerance (TPI = 16) and were in the top statistical category in less than 43% of all evaluations (8).

Others have also looked at the shade tolerance of zoysiagrass. A greenhouse study evaluated five zoysiagrass cultivars under 90% simulated shade and found that Diamond and Shadowturf had good tolerance to shade, but Emerald, Meyer and Zorro performed poorly in shade (9). In a separate study (10), Cavalier, Diamond, El Toro, Palisades and Zorro all performed well in 50% shade; Meyer's performance was fair; and Zenith performed poorly. All zoysiagrasses do not grow equally well in shade. Selecting shade-tolerant cultivars will improve playing conditions and also decrease reestablishment costs.

Overview

Each region or site-specific location has different requirements, and the preferences of superintendents vary. However, some cultivars in each region perform well because of their quality and tolerance to one or more abiotic stresses. Select a well-adapted cultivar that is also regionally or locally available.

This two-part series is intended to help superintendents assemble information to select the best zoysiagrass cultivars for their particular location. As new data become available, use them in conjunction with this publication to aid in cultivar selection. Before purchasing and planting a cultivar, superintendents, regardless of their location, should vet that cultivar by interviewing and visiting others currently growing the cultivar in their region.

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Drought symptoms on a Cavalier zoysiagrass fairway at the Bear Den Course at Chenal CC, Little Rock, Ark.

The research says

→ In 2009, 32 zoysiagrass cultivars were commercially available and more than 16,293 acres of zoysiagrass were planted on U.S. golf courses.

→ Although the majority of zoysiagrass is used in the transition zone, its use is increasing in the southeastern U.S. with the increased availability of cultivars, especially those that perform well in warmer regions.

→ Zoysiagrasses vary in their turf quality, adaptability, and shade, drought and salinity tolerance.

→ Before purchasing and planting a cultivar, superintendents should vet zoysiagrass cultivars by interviewing and visiting others who are currently growing the same cultivar in their region.