

# Variety selection affects bermudagrass and zoysiagrass divot recovery time

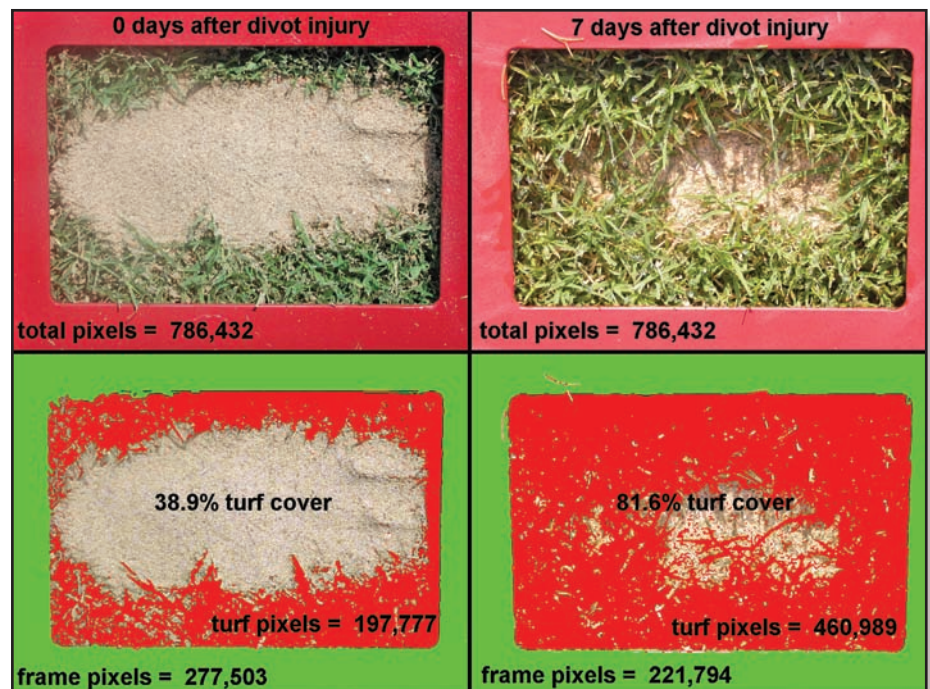
Varieties of both bermudagrass and zoysiagrass show significant differences in divot recovery time, but other characteristics should also be considered.

**Doug Karcher, Ph.D.; Mike Richardson, Ph.D.; Josh Landreth, M.S.; and John McCalla, M.S.**

Bermudagrass, the most commonly used turf species on tees and fairways throughout the southern United States, forms a dense, fine-textured turf when managed properly and tolerates moderate wear and compaction (3). However, the most desirable trait of bermudagrass for use on fairways and tees is probably its high recuperative potential (5) because these areas are consistently subjected to injury from divots, traffic or mechanical wear. It is well documented that bermudagrass has high recuperative potential, but minimal research has focused on differences in the ability of bermudagrass varieties to recover from injury.

Zoysiagrass use on tees and fairways continues to increase in the transition zone. Zoysiagrass has better cold and shade tolerance and relatively low maintenance requirements compared to bermudagrass. In addition, zoysiagrass has rigid leaves (10), which provide an excellent lie because the golf ball rests higher in the canopy compared to other species (1,4). However, zoysiagrasses are noted for a relatively slow growth rate, which translates to poor recuperative potential. Although it is commonly accepted that zoysiagrass has relatively poor recuperative potential (5), minimal research has focused on differences in recovery from injury among zoysiagrass varieties.

The National Turfgrass Evaluation Program has been the predominant means by which bermudagrass and zoysiagrass varieties are tested throughout the United States and Canada. However, NTEP evaluations normally do not measure recuperative potential (7,8). If recuperative data were available in addition to the standard evaluation data from



**Figure 1.** Digital image analysis of a bermudagrass divot to evaluate recovery at seven days after injury. This particular divot had recovered 70% [ $100 \times (81.6-38.9)/(100 - 38.9)$ ].

NTEP trials, superintendents could make better choices when selecting a bermudagrass or zoysiagrass variety for use where recovery from injury is important. The objective of the following research was to determine whether there are significant differences in recovery from divot injury among bermudagrass and zoysiagrass varieties.

## Materials and methods

Varieties from the 2002 NTEP National Bermudagrass Test and 2003 NTEP National Zoysiagrass Test (Cavalier, Crowne, El Toro

and Palisades were also included) were evaluated for divot recovery (Table 1). Each variety was planted into three replicate plots (8 feet × 8 feet [2.4 meters × 2.4 meters]) in a silt loam soil at the University of Arkansas Research and Extension Center in Fayetteville. Vegetative cultivars were planted as 2-inch (5-centimeter) diameter plugs on 12-inch spacings within the plots; seeded cultivars were broadcast seeded at a rate of 1.0 pound/1,000 square feet (48.8 kilograms/hectare). Following establishment, plots were maintained under typical golf course fairway conditions,

Photo by D. Karcher

# RESEARCH

## RECOVERY RANKINGS

Bermudagrass				Zoysiagrass			
Recovery rank*	Variety	Commercially available	Propagation	Recovery rank*	Variety	Commercially available	Propagation
1.	SW1-1012		seeded	1.	Palisades	yes	vegetative
2.	SW1-1044		seeded	2.	Crowne	yes	vegetative
3.	La Paloma	yes	seeded	3.	DALZ 0102		vegetative
4.	Yukon	yes	seeded	4.	El Toro	yes	vegetative
5.	SR 9554	yes	seeded	5.	Zorro	yes	vegetative
6.	CIS-CD7		seeded	6.	Cavalier	yes	vegetative
7.	SW1-1041		seeded	7.	DALZ 9604		seeded
8.	SW1-1045		seeded	8.	Zenith	yes	vegetative
9.	PST-R68A		seeded	9.	BMZ 230		vegetative
10.	SW1-1014		seeded	10.	GN-Z	yes	vegetative
11.	Celebration	yes	vegetative	11.	6186		vegetative
12.	Arizona Common	yes	seeded	12.	Chinese Common	yes	seeded
13.	Panama	yes	seeded	13.	PZB 33		seeded
14.	NuMex Sahara	yes	seeded	14.	DALZ 0105		vegetative
15.	Princess 77	yes	seeded	15.	Himeno	yes	vegetative
16.	Sunstar	yes	seeded	16.	DALZ 104		vegetative
17.	CIS-CD6		seeded	17.	J-37		seeded
18.	Transcontinental	yes	seeded	18.	PST-R7MA		seeded
19.	Riviera	yes	seeded	19.	Companion	yes	seeded
20.	OKC 70-18		vegetative	20.	Emerald	yes	vegetative
21.	Mohawk	yes	seeded	21.	PZA 32		seeded
22.	SW1-1001		seeded	22.	PST-R7ZM		seeded
23.	B-14		seeded	23.	DALZ 0101		vegetative
24.	Sundevil	yes	seeded	24.	Meyer	yes	vegetative
25.	Tift No. 2		seeded				
26.	Southern Star	yes	seeded				
27.	FMC-6		seeded				
28.	SW1-1003		seeded				
29.	Aussie Green	yes	vegetative				
30.	GN-1	yes	vegetative				
31.	Patriot	yes	vegetative				
32.	Midlawn	yes	vegetative				
33.	Tift No. 1		seeded				
34.	Tift No. 4		vegetative				
35.	MS-Choice	yes	vegetative				
36.	Tift No. 3		vegetative				
37.	CIS-CD5		seeded				
38.	Tifway	yes	vegetative				
39.	SW1-1046		seeded				
40.	OR 2002		vegetative				
41.	Ashmore	yes	vegetative				
42.	Tifsport	yes	vegetative				

\*For each species, varieties are ranked from fastest to slowest recovery when averaging 2003 and 2004 results.

**Table 1.** Bermudagrass and zoysiagrass varieties evaluated for divot recovery in 2003 and 2004 in Fayetteville, Ark.

with a mowing height of 0.5 inch (12.7 millimeters) and monthly nitrogen applications at the rate of 1.0 pound/1,000 square feet (48.8 kilograms/hectare) for bermudagrass varieties and 0.5 pound/1,000 square feet (24.4 kilograms/hectare) for zoysiagrass varieties from mid-April through October. Phosphorous and potassium applications were made each March to correct deficiencies as recommended by soil test results. Irrigation was initially applied as needed to promote establishment and subsequently to prevent the development of wilt (0.5 inch [1.3 centimeters] applied twice weekly during periods of no rainfall).

### Divot recovery evaluations

Divot injury was simulated on each plot in early August 2003 and 2004. Three standardized divots, each measuring 2 inches wide × 4 inches long × 0.5 inch deep (5 × 10.2 × 1.3 centimeters) were cut within each plot using a modified edger and then completely back-filled with topdressing sand. Recovery was evaluated by computer analysis of digital pictures taken of each divot as it refilled with turf growth. Digital images were collected twice weekly for each divot, beginning on the day of injury and continuing until full recovery was reached. A red metal frame with a 4- × 6-inch (10.2- × 15.2-centimeter) opening was placed around each divot when collecting images so that for every divot, the same area of turf was measured each time an image was collected. The frame interior of each image was analyzed for percent green turf cover using SigmaScan Pro software (9) (Figure 1). Percent recovery for an individual divot was calculated from the following equation:

$$\{100 * [(\% \text{ cover}_{(x)} - \% \text{ cover}_{(0)}) / (100\% - \% \text{ cover}_{(0)})]\},$$

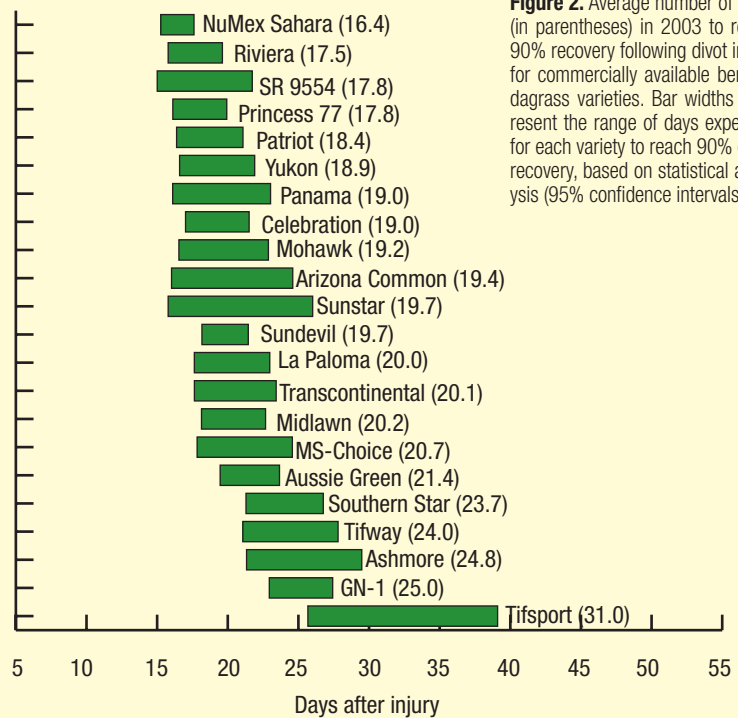
where % cover<sub>(x)</sub> is the percent green cover of the frame interior on the day the image was collected and % cover<sub>(0)</sub> is the percent green cover of the frame interior on the day of divot injury.

### Results and discussion

#### Bermudagrass

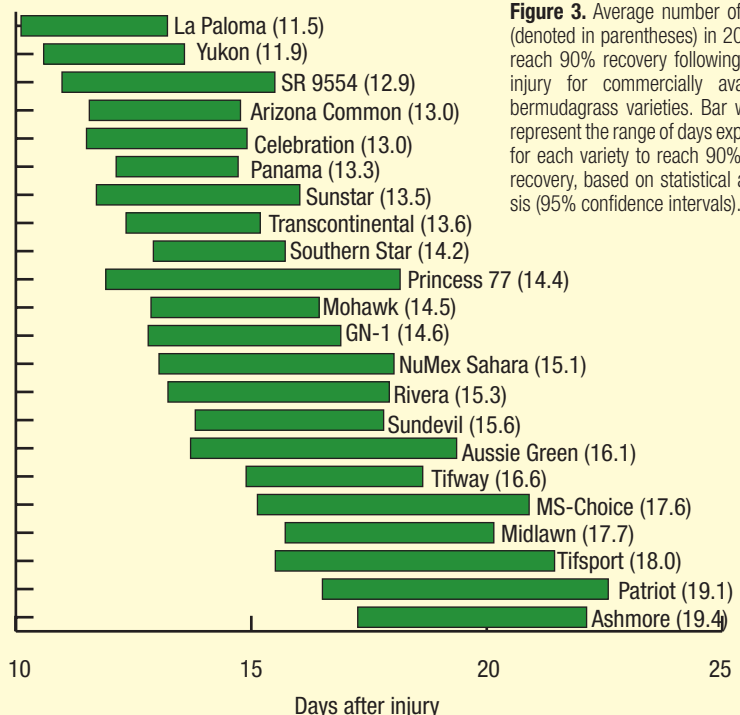
*Best and worst performing varieties.* There were significant differences among bermudagrass varieties in divot recovery time in 2003 and 2004. In 2003, NuMex Sahara had the most rapid recovery (16.4 days on average), whereas Tifsport was the slowest

## 2003 BERMUDAGRASS RECOVERY



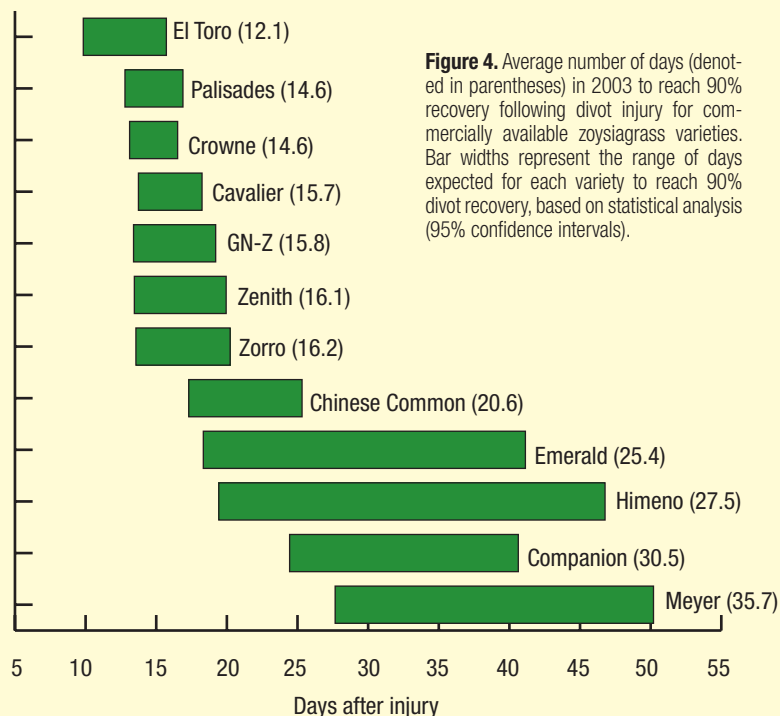
**Figure 2.** Average number of days (in parentheses) in 2003 to reach 90% recovery following divot injury for commercially available bermudagrass varieties. Bar widths represent the range of days expected for each variety to reach 90% divot recovery, based on statistical analysis (95% confidence intervals).

## 2004 BERMUDAGRASS RECOVERY



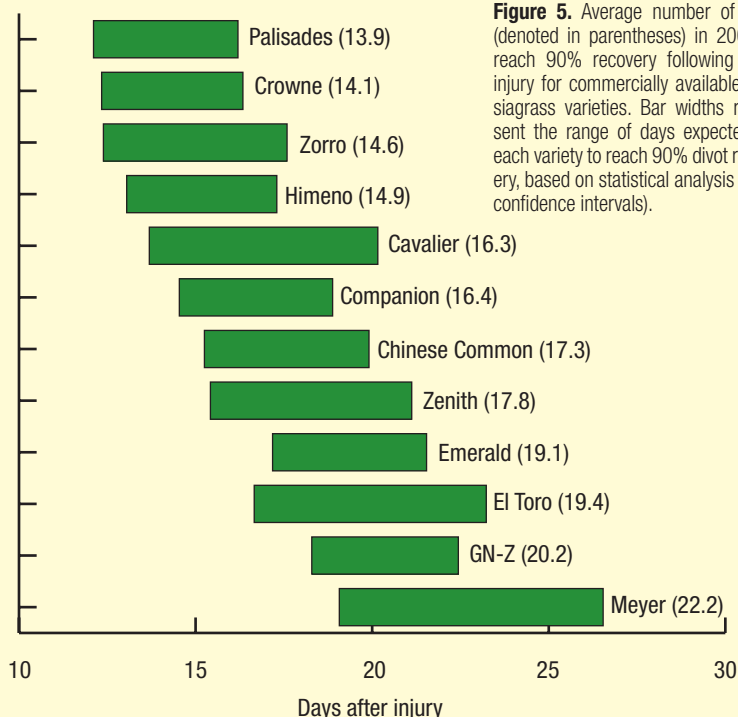
**Figure 3.** Average number of days (denoted in parentheses) in 2004 to reach 90% recovery following divot injury for commercially available bermudagrass varieties. Bar widths represent the range of days expected for each variety to reach 90% divot recovery, based on statistical analysis (95% confidence intervals).

## 2003 ZOYSIAGRASS RECOVERY



**Figure 4.** Average number of days (denoted in parentheses) in 2003 to reach 90% recovery following divot injury for commercially available zoysiagrass varieties. Bar widths represent the range of days expected for each variety to reach 90% divot recovery, based on statistical analysis (95% confidence intervals).

## 2004 ZOYSIAGRASS RECOVERY



**Figure 5.** Average number of days (denoted in parentheses) in 2004 to reach 90% recovery following divot injury for commercially available zoysiagrass varieties. Bar widths represent the range of days expected for each variety to reach 90% divot recovery, based on statistical analysis (95% confidence intervals).

to recover (31.0 days), taking approximately 15 days longer than NuMex Sahara to reach 90% cover (Figure 2). In 2004, La Paloma recovered most quickly from injury, reaching 90% cover in 11.4 days, eight days before Ashmore, the slowest recovering variety (19.4 days) (Figure 3). The commercially available varieties that were in the top-performing group in both years of the study were NuMex Sahara, SR 9554, Princess 77, Yukon, Panama, Celebration, Mohawk, Arizona Common and Sunstar (Figures 2,3). (Although La Paloma was a top performer in 2004, it did not perform consistently in both years of the study.) In contrast, TifSport, Ashmore and Tifway were among the slowest recovering commercially available varieties in both 2003 and 2004 (Figures 2,3).

**Propagation effects.** When averaged across 2003 and 2004, 26 of the 28 fastest recovering varieties were seeded bermudagrasses (Table 1). In general, seeded bermudagrasses are coarser-textured than vegetative varieties. An exception is Celebration, a vegetative variety with a coarse texture (6). Celebration recovered more quickly on average than many seeded varieties (Table 1). Leaf texture and density in bermudagrass is dictated primarily by stolon and rhizome internode length and as internode length decreases, the growth rate of lateral stems also decreases (2). This seems to have a significant impact on recovery from divot injury, as recovery is primarily a function of lateral growth. It is noteworthy that Ashmore, which was among the slowest varieties to recover, is a very fine-textured *Cynodon transvaalensis* species.

### Zoysiagrass

**Best and worst performing varieties.** As with bermudagrass, there were significant differences in divot recovery among the zoysiagrass varieties in both years of the study. In 2003, El Toro was quickest to recover (12.1 days), while Meyer had the slowest recovery time, reaching 90% more than 23 days after El Toro (35.7 days) (Figure 4). In 2004, Palisades recovered quickest from injury (13.9 days), reaching 90% cover eight days before Meyer, which was again the slowest recovering variety (22.2 days) (Figure 3). The commercially available varieties that were in the top-performing group in both years of the study were Palisades, Crowne, Zorro, Cavalier and Zenith (Figures 4,5). (Although El Toro was a top performer in 2003, it did not

perform consistently in both years of the study.) In contrast, Meyer and Emerald were the only two commercially available varieties that were among the slowest to recover in both 2003 and 2004 (Figures 4, 5).

**Propagation effects.** In contrast to bermudagrasses, vegetatively propagated zoysiagrasses recovered from injury faster than seeded varieties, especially in 2003 (Table 1, Figure 4). In fact, when averaged across years, 10 of the 11 quickest recovering varieties were vegetatively propagated. However, in 2004 the difference in recovery time between seeded and vegetative varieties was not significant. Since the varieties, which were established in summer 2002, only had one year of growth in 2003, the seeded varieties probably did not have well-developed lateral stems from which to recover into areas with divots. An increase in lateral stem development in 2004 among seeded varieties probably resulted in more rapid recovery from injury. From these results, the relationship between propagation type and recuperative potential in zoysiagrass is less clear than in bermudagrass.

## Conclusion

Injury recovery times differ significantly among bermudagrass and zoysiagrass varieties. Therefore, the performance of intensively used turf areas such as driving ranges, par-3 tees and fairways that have limited landing areas will be improved with varieties with faster recovery times. However, turf characteristics such as cold tolerance, disease resistance, genetic color, density, leaf texture and overall quality are also important and should be considered in relation to the local environment, management intensity and user expectations.

## Funding

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## THE RESEARCH

says . . .

- **Injury recovery times** differed significantly among bermudagrass and among zoysiagrass varieties, and recovery times differed from year to year.
- **The best commercially** available bermudagrass performers in both years were NuMex Sahara, SR 9554, Princess 77, Yukon, Panama, Celebration, Mohawk, Arizona Common and Sunstar; Tifsport, Ashmore and Tifway were the slowest to recover in 2003 and 2004.
- **The best commercially** available zoysiagrass performers in both years were Palisades, Crowne, Zorro, Cavalier and Zenith; Meyer and Emerald were the slowest to recover in both years.
- **Seeded bermudagrasses and** vegetative zoysiagrasses were the quickest to recover, but the differences were not as clear-cut for zoysiagrasses.
- **Characteristics other than** recovery time are important and should be considered when selecting a variety.

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