Divot Resistance of Bermudagrass and Zoysiagrass Cultivars

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The ability of a turf to resist divoting can reduce maintenance inputs.

Summary. Divots created by a golf stroke are a regular occurrence on golf course fairways and tees. Divot resistance describes how often a divot is made as well as the size of the divot and is an important factor that should be considered when selecting a species or cultivar for use on golf course fairways or tees. There are no reports comparing the divot resistance of bermudagrass and zoysiagrass cultivars. Therefore, the objective of this experiment was to quantify the divot resistance for various bermudagrass and zoysiagrass cultivars in a field experiment. In the summer of 2009, divot resistance was evaluated on two collection dates on five cultivars of bermudagrass and seven cultivars of zoysiagrass. Cavalier, Diamond, and Zorro zoysiagrass had the highest divot resistance; while those with the lowest divot resistance were Patriot, Princess 77, and Riviera bermudagrass. These results demonstrate that differences exist among bermudagrass and zoysiagrass cultivars for divot resistance, and will allow golf course superintendents to better select cultivars and species that will improve playing conditions while decreasing inputs.

Abbreviations: CD, *Cynodon dactylon*; CDT, *Cynodon dactylon* × *C. transvaalensis*; ZJ, *Zoysia japonica*; ZM, *Zoysia matrella*

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Divots created by a golf stroke are a natural occurrence on golf course fairways or tees. It has been estimated that approximately 0.5 acres of turf are removed by divoting from a bermudagrass golf course fairway each year (Patton et al., 2010). The amount, size, and length of time divots exist on a tee or fairway can be dependent on species and cultivar (Beard, 1973). Divot resistance is an important factor that should be considered when selecting a species or cultivar for use on golf course tees or fairways. Divot resistance describes the resistance of a particular turfgrass to injury such as divoting. It can determine how often a golf stroke will result in a divot as well as the size of the divot made.

Resistance to injury is a characteristic of turf that has typically only been evaluated on sports turf. Research performed by Chivers and Aldous (2003) evaluated the shear strength of a turf stand using the Turf Shear Tester. Although this apparatus was evaluated to determine if an objective measurement device could be used to compare the safety and establishment of athletic fields, it has potential for comparing the shear strength (divot resistance) of turf.

Therefore, the primary objective of this experiment was to quantify the divot resistance for various bermudagrass and zoysiagrass cultivars in a field experiment, while a secondary objective was to compare evaluation methods of divot resistance.

Materials and Methods

Five cultivars of bermudagrass (*Cynodon* spp.) and seven cultivars of zoysiagrass (*Zoysia* spp.) were established in the summer of 2007 (Table 2). Plots were maintained under golf course fairway or sports field conditions, with a mowing height of 0.5 inch and monthly applications of 1.0 lb N/1000 ft^2 for bermudagrass and 0.5 lb N/1000 ft^2 for zoysiagrass during the growing season.

Divot resistance was determined using two methods: 1) naturally divoted turf and 2) the Turf Shear Tester (Dr. Baden Clegg Pty. Ltd. Jolimont, Western Australia). Plots were divoted with both methods on 17 July and 1 September in 2009. Two golfers containing single digit handicaps each hit three golf balls on each plot using a pitching wedge. Each divot was numbered and assigned to one of the two golfers. The resulting effect of the club striking the turf was then rated for divot severity for each golf shot (Table 1).

To calculate the volume of each divot, the divot was filled with sand until the sand was level with the soil surrounding the divot. The sand used to fill the divots was sieved using a 1.5 mm sieve to remove small gravel and oven dried prior to use. Bulk density was calculated for the sand as 1.53 g/cm^3. The amount of sand needed to fill the divot was calculated by subtracting the weight of container plus sand before filling the divot and weight of container and sand after filling. The volume of each divot was determined using the calculated bulk density of the sand and the weight of sand needed to fill each divot.

Additionally, a Turf Shear Tester was used to determine lateral shear strength of each of the species and cultivars (Chivers and Aldous, 2003). The wedge of the tester was set to a 1.2-inch depth below canopy height, which approximated a 0.67-inch deep divot. A total of six measurements (subsamples) were collected on each plot using the Clegg Shear Tester.

Results and Discussion

Differences existed among cultivars for divot resistance using both a pitching wedge and the Turf Shear Tester (Table 2). The cultivars having the most severe injury from divoting across the two dates of the study were Patriot, Princess 77, Riviera, and Tifsport bermudagrass, as well as Meyer, Palisades, and Zenith zoysiagrass. Zorro zoysiagrass had the lowest mean divot severity and was less than Palisades zoysiagrass, Princess 77, Riviera, and Tifsport bermudagrass. The cultivar with the largest volume divots was Riviera bermudagrass (Table 2). The cultivars with the smallest volume divots were Cavalier, Diamond, El Toro, Meyer, Zenith, and Zorro zoysiagrass.

Differences existed in the amount of force required to make a divot for cultivars and species using the Turf Shear Tester (Table 2). The cultivars requiring the highest amount of force to remove a divot (most divot resistance) were Cavalier, Dia-

mond, Palisades, and Zorro zoysiagrass, as well as Tifsport, and Tifway bermudagrass (Table 2). The cultivars requiring the lowest amount of force to make a divot (least divot resistance) were Patriot, Riviera, and Princess 77 bermudagrass, as well as El Toro, Meyer, and Zenith zoysiagrass.

There is little published work comparing the divot resistance of bermudagrass or zoysiagrass cultivars. Beard (1973) suggested that wear tolerance is similar to a turfgrass' ability to withstand injury. Wear tolerance has been evaluated extensively in selecting turfgrass species and cultivars with higher resistance to foot and vehicle stresses (Youngner, 1961; Shearman and Beard, 1975; Trenholm et al., 2000). Youngner (1961) simulated wear (scuffing) on different turfgrass species and reported that 'Meyer' *Z. japonica* and a *Z. matrella* cultivar tolerated more simulated wear than two different common bermudagrass cultivars. Although no statistical analysis was reported in Youngner (1961), for discussion purposes, some similarities to the reports of this research could be stated. *Zoysia matrella* has been reported as having a high shoot density (Riffell et al., 1995), which has been reported as an important factor in a turfgrass' ability to withstand injury (Serensits, 2008). This may explain why *Z. matrella* was found to have a higher divot resistance in this study.

Conclusion

Across the three evaluation methods for divot resistance, the cultivars having the highest divot resistance were Cavalier, Diamond, and Zorro zoysiagrass. The cultivars having the lowest divot resistance were Patriot, Princess 77, and Riviera bermudagrass. These results demonstrate that differences exist among bermudagrass and zoysiagrass cultivars' divot resistance. Golf course superintendents should select a species or cultivar having a high divot resistance for use on fairways or tees anticipating heavy amounts of divoting, especially Par 3 or driving range tees.

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Table 1. Visual rating scale used to describe divot severity of various bermudagrass and zoysiagrass cultivars in Fayetteville, Ark.

Divot severity
1 = none to very small divot or turf surface disruption
2 = small divot or turf surface disruption
3 = moderate divot size or turf surface disruption
4 = large divot or turf surface disruption
5 = very large divot or turf surface disruption

Table 2. Divot severity, divot volume, and force required to make a divot with the Turf Shear Tester on various bermudagrass and zoysiagrass cultivars in Fayetteville, Ark.

Cultivar	Species	Severity[z]	Volume[x]	Shear strength[y]
		(1-5)	cm^3	N/m
Cavalier	ZM[v]	2.3 bcd	19 e	72 ab
Diamond	ZM	2.1 cd	21 de	73 a
El Toro	ZJ	2.3 bcd	27 b-e	61 cde
Meyer	ZJ	2.4 a-d	22 cde	59 de
Palisades	ZJ	2.8 ab	35 b	68 abc
Patriot	CDCT	2.5 a-d	31 bc	57 e
Princess	CD	2.8 ab	33 b	59 de
Riviera	CD	3.0 a	45 a	64 b-e
Tifsport	CDCT	2.7 abc	31 bc	67 a-d
Tifway	CDCT	2.3 bcd	30 bcd	67 a-d
Zenith	ZJ	2.5 a-d	25 b-e	58 e
Zorro	ZM	2.0 d	18 e	70 ab

[z] Visual rating of divot severity (1-5). See Table 1.
[x] Average volume of sand (cm^3) required to fill divot.
[y] Force ($N\ m^{-1}$) required to make a divot using the Turf Shear Tester.
[v] ZJ = *Zoysia japonica*; ZM = *Zoysia matrella*; CD = *Cynodon dactylon*; CDCT = *Cynodon dactylon* × *C. transvaalensis*.