# Shade and Traffic Tolerance of Bermudagrass and Zoysiagrass

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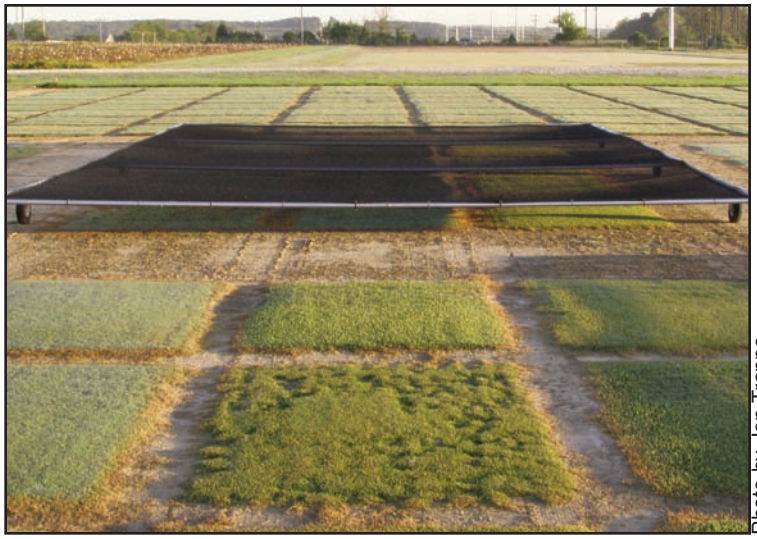

Photo by Jon Trappe

Moveable shade structure

**Additional index words:** Cady traffic simulator, *Zoysia japonica*, *Zoysia matrella*, *Cynodon dactylon*, *C. dactylon x C. transvaalensis*.

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**Summary**. Shade and traffic can reduce turfgrass coverage and playability on both golf courses and sports fields. Five cultivars of bermudagrass and seven cultivars of zoysiagrass were planted in the summer of 2007 and maintained under typical golf course fairway and sports field conditions. Plots were shaded continuously beginning spring 2008 with a 50% light reducing fabric. A second study was implemented using the same plot space to determine traffic tolerance. Digital image analysis was used to measure turfgrass coverage for evaluating shade and traffic tolerance of cultivars. The objective of this study is to evaluate cultivars and species for differences in turf coverage in response to continuous shade as well as simulated traffic. Patriot, Tifsport, and Zenith had poor shade tolerance compared to other cultivars tested in the trial. Meyer, Palisades, Patriot, and Zenith had poor traffic tolerance regardless of the shading treatment. These findings will help turfgrass managers select cultivars and improve playing conditions under conditions of high traffic and/or reduced light.

**Abbreviations:** PGR, Plant growth regulator; Avg, Average; ZJ, *Zoysia japonica*; ZM, *Zoysia matrella*; CD, *Cynodon dactylon*; CDT, *Cynodon dactylon* × C. *transvaalensis*; C, *Cynodon* spp.; Z, *Zoysia* spp

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Shade is an important factor influencing the maintenance of golf courses and sports fields. The use of shade-tolerant cultivars or species can greatly improve turf quality in shaded areas. Previous work (Baldwin, 2008; McBee and Holt, 1966; Qian and Engelke, 1997) has investigated which cultivars and species perform well under shaded conditions, but very little research has compared the most commonly used cultivars of bermudagrass and zoysiagrass in a combined trial. Bunnell et al. (2005) found that 'Meyer' zoysiagrass had better shade tolerance than 'Tifsport' and 'Tifway' bermudagrass, but comparisons of other commonly used zoysiagrass cultivars to commonly used bermudagrass cultivars are unavailable.

Regular traffic that occurs on sports fields, golf courses, and residential areas can be detrimental to bermudagrass and zoysiagrass growth. Previous research has investigated which species have superior traffic tolerance (Youngner, 1961; Shearman and Beard, 1975), but these studies investigated cultivars that are rarely used today. Trappe et al. (2008, 2009) investigated traffic tolerance of newer bermudagrass cultivars but did not investigate their traffic tolerance in a side-by-side trial with commonly used zoysiagrass cultivars. Research is needed comparing traffic tolerance of newer cultivars of bermudagrass and zoysiagrass. The objective of this study was to evaluate those cultivars and species that have the best turfgrass coverage in response to continuous shade as well as simulated traffic.

**Materials and Methods**

Five cultivars of bermudagrass and seven cultivars of zoysiagrass were established in the summer of 2007 (Table 1). 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/1000ft$^2$ for bermudagrass and 0.5 lb N/1000ft$^2$ for zoysiagrass during the growing season. For each replication, there was one shaded and one nonshaded plot. A shade fabric reducing light by 50% was installed on the plots continuously beginning April 2008. Shade tolerance was evaluated using digital image analysis to determine percent green turf cover as affected by shade (Richardson et al, 2001). Images of turf were taken monthly, and three sampling dates were used to distinguish shade tolerance among cultivars and species.

Traffic was applied weekly using the Cady traffic simulator (Henderson et al., 2005). Once each week for five consecutive weeks starting on 25 July, four passes in the forward direction were made to half of each plot in both full-sun and shaded plots. Four passes were intended to simulate two football games from within the hash marks (Henderson et al., 2005). Digital images were taken prior to each traffic application and after the final traffic application to evaluate damage. Digital image analysis was used to evaluate the amount of green turfgrass cover that was affected by the traffic simulator (Richardson et al, 2001), and a total of three evaluation dates were used to distinguish traffic tolerance among cultivars and species.

**Results and Discussion**

*Non Trafficked Plots*. Of the three sampling dates used to distinguish differences in coverage in shaded vs. full-sun plots, an interaction between shade treatment and cultivar existed for two sampling dates (11 July and 2 October) (Table 1). For both of these dates, Patriot and Zenith had less turf coverage in the shaded plots but their coverage was similar to other cultivars in full-sun plots. Additionally, Tifsport had reduced coverage in the shaded plots on 2 October compared to coverage in full sun. On 29 August, differences existed between cultivar and shade treatments, but no interaction existed between these two variables. Patriot had decreased coverage across light environments on 29 August. For all three evaluation dates, full-sun treatments had significantly more turfgrass coverage than shaded plots.

*Trafficked Plots.* Significant differences in coverage existed in trafficked plots between cultivars for two of the three collection dates; however, only on 12 August was there an interaction

between shade treatment and cultivar (Table 2). This interaction indicates that some cultivars perform better at a particular shade treatment (shade or full sun) when trafficked while others perform similar in the shade and full sun. Patriot and Zenith both had a reduction in turf coverage in shaded plots after two weeks of traffic treatment, while other cultivars had similar coverage in shade and full-sun plots indicating that Zenith and Patriot were not shade tolerant, especially under traffic stress. There were no differences in coverage between species in shaded plots on 12 August.

There were no differences in coverage between cultivars on 22 August, but there was more coverage in full-sun plots than in shaded plots indicating better traffic tolerance for turf grown in sunny areas. Across cultivars, zoysiagrass and bermudagrass had similar coverage in full-sun trafficked plots, although zoysiagrass had more coverage than bermudagrass in shaded plots indicating better resistance to traffic under shade conditions.

On 29 August, there were differences in turf coverage in shade treatments and among cultivars across both shade treatments, although no interaction existed between shade treatments and cultivar. Cavalier, El Toro, Princess-77, Riviera, Tifsport, Tifway and Zorro had the greatest turf coverage across shade treatments when evaluated on 29 August, while Meyer, Palisades, Patriot, and Zenith had the least turf coverage across shade treatment on the same date. Bermudagrass traffic tolerance of Princess-77, Riviera and Tifsport agree with previous work done be Trappe et al. (2008); however, the cultivar Patriot was relatively less traffic tolerant in this study. This may be due to the poor performance of Patriot in shaded plots. Across cultivars, bermudagrass had more coverage in full-sun trafficked plots on 29 August, and coverage was similar for each species in the shade. The results on 29 August indicate that under traffic and full sun, bermudagrass retained its coverage longer indicating that it has better traffic tolerance than zoysiagrass. Additionally, these results suggest that under shading and traffic, zoysiagrass coverage will be decreased in a similar fashion to bermudagrass.

Zoysiagrass had significantly more turfgrass coverage in shaded plots than bermudagrass for two of the six sampling dates in both the trafficked and nontrafficked plots (Tables 1 and 2). This agrees with previous research that determined Meyer zoysiagrass has superior shade tolerance than Tifway, Celebration or Tifsport bermudagrass (Bunnell et al., 2005).

The ultimate goal of this study is to help golf course and sports field managers select cultivars and species that have excellent shade and traffic tolerance. Selecting the best cultivar adapted for a particular location will ultimately help to reduce maintenance inputs and reduce costs. This research will be completed again in the summer of 2009.

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**Table 1. Percent green coverage of various bermudagrass and zoysiagrass cultivars grown in two environments (shade or full sun) without traffic stress.**

| | | 7/11/2008 | | | 8/29/2008 | | | 10/2/2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cultivar | Species | Sun | Shade | Avg. | Sun | Shade | Avg. | Sun | Shade | Avg. |
| | | ----------%---------- | | | | | | | | |
| Cavalier | ZM[z] | 100.0 A[y] | 100.0 A | 100.0 | 99.0 | 99.6 | 99.3 a[x] | 97.8 AB | 98.6 A | 98.2 |
| Diamond | ZM | 99.7 A | 99.5 A | 99.6 | 99.8 | 99.8 | 99.6 a | 100.0 A | 99.5 A | 99.7 |
| El Toro | ZJ | 99.9 A | 97.5 A | 98.7 | 98.1 | 97.6 | 97.6 a | 98.9 A | 98.5 A | 98.8 |
| Meyer | ZJ | 99.8 A | 98.6 A | 99.2 | 97.1 | 98.3 | 97.7 a | 98.6 A | 90.2 B | 94.4 |
| Palisades | ZJ | 99.9 A | 99.6 A | 99.8 | 98.8 | 98.0 | 98.4 a | 98.9 A | 98.8 A | 98.8 |
| Patriot | CDT | 99.7 A | 82.2 B | 91.0 | 86.7 | 70.2 | 78.4 b | 95.9 AB | 54.1 D | 75.0 |
| Princess-77 | CDT | 99.9 A | 99.1 A | 99.0 | 97.8 | 96.8 | 97.6 a | 99.7 A | 99.5 A | 99.6 |
| Riviera | CD | 99.8 A | 95.9 A | 97.9 | 99.0 | 94.6 | 96.8 a | 99.9 A | 98.2 AB | 99.0 |
| Tifsport | CDT | 100.0 A | 96.1 A | 98.0 | 99.3 | 88.2 | 93.8 a | 99.8 A | 53.3 D | 76.5 |
| Tifway | CDT | 99.9 A | 98.6 A | 99.3 | 99.1 | 85.7 | 92.4 a | 97.7 AB | 97.3 AB | 97.5 |
| Zenith | ZM | 98.7 A | 53.5 C | 76.1 | 98.9 | 96.4 | 97.7 a | 97.7 AB | 80.9 C | 89.3 |
| Zorro | | 100.0 A | 100.0 A | 100.0 | 98.5 | 99.6 | 99.1 a | 99.9 A | 97.3 AB | 98.6 |
| Average | | 99.8 | 93.4 | | 97.7 A | 93.7 B | | 98.7 | 88.9 | |
| *Species* | | | | | | | | | | |
| Bermuda | C | 99.9 | 94.2 | | 96.4 | 87.1 b | | 98.6 | 80.5 | |
| Zoysia | Z | 99.7 | 92.8 | | 98.5 | 98.5 a | | 98.8 | 94.8 | |

[z] ZJ = *Zoysia japonica*; ZM = *Zoysia matrella*; CD = *Cynodon dactylon*; CDT = *Cynodon dactylon* × *C. transvaalensis*; C = *Cynodon* spp.; Z = *Zoysia* spp.
[y] When comparing coverage means on an evaluation date, within columns and across rows, means followed by the same uppercase letter are not significantly different according to Fisher's protected LSD (α= 0.05).
[x] Within columns, means followed by the same letter are not significantly different according to Fisher's protected LSD (α= 0.05).

**Table 2. Percent green coverage of various bermudagrass and zoysiagrass cultivars grown in two environments (shade or full sun) with traffic stress.**

| | | 8/12/2008 | | | 8/22/2008 | | | 8/29/2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cultivar | Species | Sun | Shade | Avg. | Sun | Shade | Avg. | Sun | Shade | Avg. |
| Cavalier | ZM[z] | 96.3 A[y] | 97.3 A | 96.8 | 40.7 | 16.1 | 28.4 | 70.2 | 38.4 | 54.3 abc[x] |
| El Toro | ZM | 95.8 A | 92.3 A | 94.0 | 71.6 | 20.8 | 46.2 | 73.6 | 20.6 | 47.1 abc |
| Meyer | ZJ | 91.3 A | 91.2 A | 91.2 | 39.0 | 23.7 | 31.4 | 72.6 | 15.2 | 43.9 bcd |
| Palisade | ZJ | 96.4 A | 90.9 A | 93.6 | 49.6 | 43.1 | 46.4 | 71.6 | 17.9 | 44.8 bcd |
| Patriot | ZJ | 99.9 A | 60.1 B | 80.0 | 78.3 | 15.0 | 46.7 | 62.4 | 4.9 | 33.7 d |
| Princess-77 | CDT | 99.9 A | 93.1 A | 96.5 | 87.4 | 12.0 | 49.7 | 81.1 | 16.1 | 48.6 abc |
| Riviera | CDT | 99.9 A | 89.5 A | 94.7 | 60.9 | 10.5 | 35.7 | 85.5 | 24.5 | 55.0 ab |
| Tifsport | CD | 99.8 A | 87.2 A | 93.5 | 85.0 | 30.1 | 57.6 | 89.2 | 24.8 | 57.0 a |
| Tifway | CDT | 99.8 A | 90.7 A | 95.2 | 54.4 | 23.8 | 39.1 | 90.4 | 20.5 | 55.5 ab |
| Zenith | CDT | 91.0 A | 53.3 B | 72.1 | 28.6 | 17.3 | 45.9 | 71.5 | 14.0 | 42.8 cd |
| Zorro | ZM | 96.8 A | 96.2 A | 96.5 | 59.3 | 52.4 | 55.9 | 78.5 | 30.2 | 54.4 abc |
| Average | | 97.0 | 85.6 | | 59.5 A | 24.4 B | | 77.0 A | 20.6 B | |
| | | | | | | | | | | |
| Species | | | | | | | | | | |
| Bermuda | C | 99.8 | 84.1 | | 74.5 | 18.5 b | | 81.7 a | 18.2 | |
| Zoysia | Z | 94.6 | 86.9 | | 47.9 | 28.9 a | | 73.0 b | 22.7 | |

[z] ZJ = *Zoysia japonica*; ZM = *Zoysia matrella*; CD = *Cynodon dactylon*; CDT = *Cynodon dactylon* × *C. transvaalensis*; C = *Cynodon* spp.; Z = *Zoysia* spp.
[y] When comparing coverage means on an evaluation date, within columns and across rows, means followed by the same uppercase letter are not significantly different according to Fisher's protected LSD (α= 0.05).
[x] Within columns, means followed by the same letter are not significantly different according to Fisher's protected LSD (α= 0.05).