



Zoysiagrass establishment rates

Establishment rate of zoysiagrass cultivars is influenced by stolon growth and dry matter allocation.



Zoysiagrass (*Zoysia* species) is a high-quality turf that has been used on golf courses since the 1950s. It is well adapted for use in fairways, tees, roughs and bunker faces in the transition zone as well as in the warm-arid and warm-humid climatic zones of the United States. Using zoysiagrass on golf courses can help reduce maintenance budgets in the transition zone because it has excellent heat, drought, pest and wear tolerance compared to cool-season grasses.

Establishment rate

The disadvantages of zoysiagrass for golf course use are few, but its main drawback is a slow establishment rate (1,7), which increases costs and therefore limits more widespread use on golf courses. Common cultural practices used to increase bermudagrass establishment, such as increased nitrogen fertilization, have little effect on zoysiagrass establishment (2,3,10). However, cultivar selection can influence establishment rate (2,5,12). Of the most commonly used zoysiagrasses, El Toro and Palisades are two of the fastest-establishing cultivars, whereas Meyer establishes more slowly (4,5,8,9,12). Our objective was to determine differences in establishment rate of zoysiagrass cultivars.

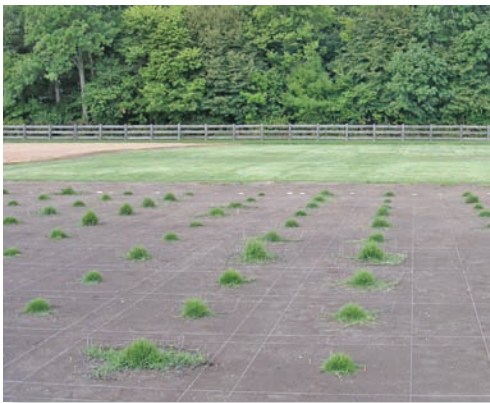
Methods

Both *Zoysia japonica* Steud. and *Z. matrella* (L.) Merr. were included in this study. Plants of commercially available cultivars and experimental cultivars of zoysiagrass (Table 1) were collected and

propagated in the greenhouse in plug trays. Vegetatively established cultivars were planted into trays as plugs or stolons, and seeded cultivars were seeded into trays at 1.0 pound/1,000 square feet (4.9 grams/square meter). After seven months, plants were transplanted into field plots at Purdue University's W.H. Daniel Turfgrass Research and Diagnostic Center, West Lafayette, Ind. One vegetative plug of zoysiagrass was transplanted into the center of each plot for both seeded and vegetative cultivars on June 7, 2004 and 2005, and irrigated to encourage establishment. The areas were fumigated with methyl bromide before establishment each year to minimize weed competition; any weeds that escaped were manually removed. Plots received 1 pound nitrogen/1,000 square feet (4.9 grams/square meter) using urea (46-0-0) on July 1 and Aug. 1 of each year.

Images of each plot were taken weekly with a digital camera mounted on a monopod to ensure a consistent height. Zoysiagrass coverage was determined using a digital image analysis technique created by turfgrass researchers at the University of Arkansas that selectively identifies green leaves in digital images (11). Using a sod staple, stolons reaching the plot border were angled back into the plot to prevent encroachment into adjacent plots and to ensure that all growth from the plug was measured using digital image analysis. Plots were not mowed because we used sod staples and because we did not want mowing height to influence cultivar establishment rate, as optimal mow-

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The research site at the W.H. Daniel Turfgrass Center at Purdue University, West Lafayette, Ind. Photo by A. Patton

ing height is different for each *Zoysia* species (13).

Stolon growth was measured by marking the growing tip of three stolons in each plot with toothpicks and measuring elongation seven days later. Stolon growth rate measurements were collected during two different intervals each summer, and a stolon growth rate (in millimeters/day) was determined for each cultivar. Rhizomes were not measured in our study to preserve plots for future measurements of coverage and winter injury.

Results

Establishment rate varied widely among cultivars (Figure 1). Cultivars 6186, DALZ0102, El Toro, PZB 33, Chinese Common, 6136, Companion and BMZ 230 had establishment rates significantly greater than the mean. El Toro, Chinese Common, Companion and Palisades had the highest establishment rates among commercially available *Z. japonica* cultivars. Zorro had the highest establishment rates among commercially available *Z. matrella* cultivars.

Meyer zoysiagrass has been the industry standard for zoysiagrass cultivars because it is widely used by superintendents and researchers and has been available since the 1950s. However, seven commercially available zoysiagrass cultivars established faster than Meyer, whereas Diamond and Empire were the only cultivars that established significantly more slowly than Meyer. El Toro, also widely used by superintendents and known for its quick establishment rate, had an establishment rate that was among the fastest of all cultivars.

Zoysia japonica cultivars in our study produced more coverage and had a higher establishment rate than *Z. matrella* cultivars. *Zoysia japonica* is sold commercially both as seed or vegetative propagules (sprigs, sod or plugs), but *Z. matrella* is available only as vegetative propagules. All cultivars were established by vegetative plugs for our field study. Cultivars with seed availability had

establishment rates similar to those for cultivars available only as vegetative propagules.

We identified experimental cultivars with establishment rates similar to that of El Toro, which is thought to be the fastest establishing commercially available cultivar. Palisades and Companion, which are newly released cultivars, also had establishment rates similar to that of El Toro. Furthermore, we found that the newly released *Z. matrella* cultivar Zorro has a faster

Zoysiagrass cultivars

Species/ranking/cultivar [†]	Type [‡]	Source
<i>Zoysia japonica</i> Steud.		
1. 6186	V	Bladerunner Farms
2. DALZ0102	V	TAMU- Dallas
3. El Toro [§]	V	Seedland
4. PZB 33	S	Patten Seed Co.
5. Chinese Common [§]	S	NTEP
6. 6136	V	Bladerunner Farms
7. Companion [§]	S	Seed Research of Oregon
8. BMZ 230	V	TAMU
9. Palisades [§]	V	TAMU- Dallas
10. PST-R7LT	S	Pure-Seed Testing
11. Zenith [§]	S	Patten Seed Co.
12. DeAnza [§]	V	West Coast Turf
13. J-37	S	Jacklin Seed/J.R. Simplot
14. J-36	S	Jacklin Seed/J.R. Simplot
15. GNZ [§]	V	Greg Norman Turf
16. PST-R7ZM	S	Pure-Seed Testing
18. PZA 32	S	Patten Seed Co.
21. PST-R7MA	S	Pure-Seed Testing
23. Meyer [§]	V	NTEP
24. VJ	V	Bladerunner Farms
26. Victoria [§]	V	West Coast Turf
27. PST-R7TH	S	Pure-Seed Testing
30. Empress [§]	V	Sod Solutions
31. Himeno	V	Zoysian Japan Co.
34. Empire [§]	V	Sod Solutions
<i>Z. japonica</i> x. <i>Z. pacifica</i> Goudsw.		
28. Emerald [§]	V	NTEP
<i>Z. matrella</i> (L.) Merr.		
17. Zorro [§]	V	TAMU- Dallas
20. DALZ0104	V	TAMU- Dallas
22. DALZ0101	V	TAMU- Dallas
25. Cavalier [§]	V	TAMU- Dallas
29. DALZ0105	V	TAMU- Dallas
32. Zeon [§]	V	Bladerunner Farms
33. Royal [§]	V	TAMU- Dallas
35. Diamond [§]	V	TAMU- Dallas
<i>Z. sinica</i> Hance		
19. J-14	S	Jacklin Seed/J.R. Simplot

[†]Cultivars are sorted by species. Number indicates ranking according to establishment rate, with 1 being the fastest establishing cultivar (Figure 1).

[‡]Type of establishment (propagation) method typically used by practitioners for each cultivar. S, seeded; V, vegetative. Cultivars available by seed are typically seeded, with other cultivars typically established vegetatively by sprigs, plugs or sod. All cultivars were established by vegetative plugs into field plots for this study.

[§]Commercially available cultivar as of 2006.

Table 1. Zoysiagrass cultivar, species, typical establishment method and source of plant material.



Some zoysiagrass cultivars establish faster than others (bottom left vs. center), as evident in this NTEP trial. Photo by Z. Reicher

establishment rate than the older Emerald (*Z. japonica* × *Z. pacifica* Goudsw.), which is similar in color, texture and density to *Z. matrella* (7). These results indicate that newer cultivars exist or are being developed with rapid establishment rates. Planting newer cultivars with improved establishment rates could dramatically reduce the time, inconvenience and cost of establishing zoysiagrass on golf courses.

Why the differences in establishment rate?

Mechanisms that influence establishment rates among zoysiagrasses are not understood. Growth analysis is a useful tool for determining causes of differential growth rates. In general, growth analysis uses plant weights and leaf area in formulas to interpret plant performance. The objective of this study was to determine the underlying factors associated with differential growth rates among zoysiagrass cultivars.

Methods

Based on preliminary results from the field study, one slow-growing and one fast-growing cultivar of both *Z. japonica* and *Z. matrella* were selected for further growth analysis. *Zoysia japonica* cultivars El Toro (fast-growing) and Meyer (slow-growing) and *Z. matrella* cultivars Zorro (fast-growing) and Diamond (slow-growing) were selected for these experiments.

Individual plants of each cultivar were established in the greenhouse for six weeks and then transferred to a growth chamber maintained at 86 F (30 C) and 14-hour day length. Eight whole plants of each cultivar were harvested when plants were transferred to the growth chamber and once per week for the next five weeks, for a total of six harvests. Leaf blades, roots and the remaining fraction that consisted of mainly leaf sheaths, rhizomes and stolons were separated. This third fraction containing leaf sheaths, rhizomes and stolons was termed stem. All tissue fractions were dried separately in an oven and weighed. This experiment was conducted in 2004 and repeated in 2005.

Results

One key finding was that dry weight was allocated differently among cultivars. On a relative basis, Diamond allocated 2.8% more dry weight to leaves and 4.6% more dry weight to roots than did Zorro. By comparison, Zorro allocated 7.4% more of its dry weight into stolon and rhizome mass than did Diamond.

This difference in dry matter allocation helps explain why Zorro established more quickly in the field than Diamond. El Toro and Meyer also allocated dry weight differently. El Toro allocated 1.6% more dry weight to produce leaves and 3.6% more dry weight to produce stolons and rhizomes than did Meyer. Meyer, however, allocated 5.2% more dry weight to leaves than did El Toro.

Overall, growth analysis data suggest cultivars that establish quickly devote more energy to stems (stolons and rhizomes) than to leaves, whereas slow-establishing cultivars devote more energy to leaves than to stems. This is consistent with our

Establishment rates

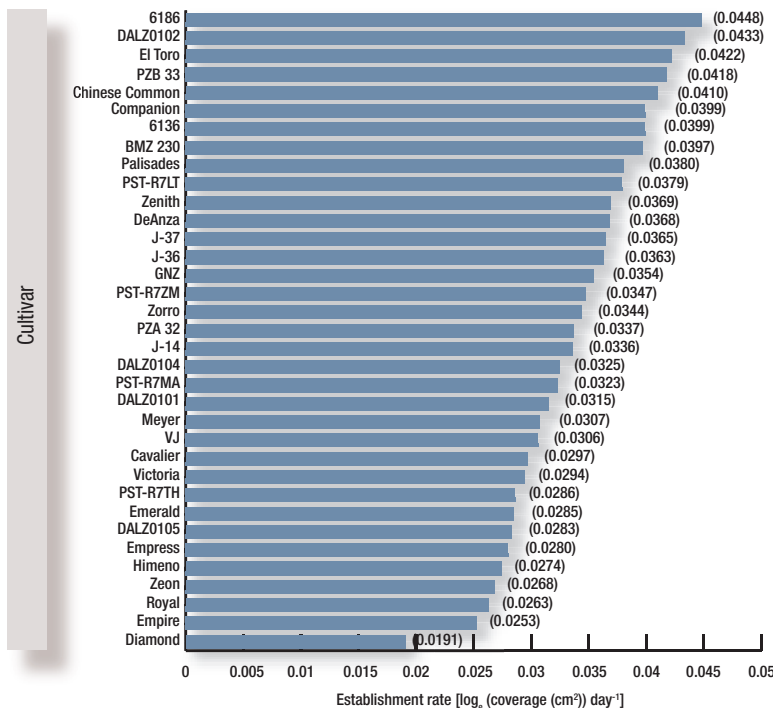


Figure 1. Zoysiagrass establishment rate by cultivar. Data were averaged over 2004 and 2005.



field data, where cultivars with high establishment rates had longer stolons. For instance, Meyer and Diamond allocated more dry matter to leaves than to stems, which is probably why they are slow to establish and spread in the field.

Summary

There are considerable differences in zoysiagrass growth and establishment rates between species and cultivars. *Zoysia japonica* cultivars generally have higher establishment rates than *Z. matrella* cultivars. Cultivars capable of producing long stolons with high growth rates establish quickly. Quick-establishing cultivars have a high stolon growth rate because a higher proportion of their dry weight is allocated to stems instead of leaves. Many experimental cultivars we tested established as fast as or faster than the best-establishing commercially available cultivars.

In addition to this work on zoysiagrass establishment rate, researchers at the University of Arkansas recently evaluated zoysiagrass cultivars for divot recovery (6). Combined, these research projects will help golf course superintendents choose fast-establishing cultivars with good recovery rates. Bermudagrass is known to have a faster establishment and recovery rate than zoysiagrass, which sometimes prevents zoysiagrass from being used on golf courses. However, identification of newer cultivars with quicker establishment and recovery than Meyer, the industry standard, may make zoysiagrass a more acceptable option than bermudagrass.

Although rapid growth is desirable during establishment, a more moderate growth rate may be desirable when managing an established turf. The slower growth of some zoysiagrass cultivars can sometimes be advantageous. A slower growth rate can reduce maintenance costs by reducing mowing and by reducing bunker, greens and car path encroachment. Cultivars with slower establishment and recovery rates may be well-suited for bunker and green surrounds where they are less likely to be damaged, and cultivars with faster establishment and recovery rates may be better suited for tees and areas with more traffic. Selecting fast-growing zoysiagrass cultivars will help reduce establishment time, increase revenue and improve course conditions. However, superintendents can also choose certain slow-growing cultivars to help reduce maintenance costs and fulfill site-specific needs.

Funding

We gratefully acknowledge the Midwest Regional Turfgrass Foundation and the Tri-State Superintendents Association for partial support of this project.

Acknowledgments

Special thanks to Daniel Weisenberger for his help harvesting zoysiagrass plants.

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The test plots for the zoysiagrass establishment rate research after final data collection was completed in September. Photo by A. Patton



The research says

→ Establishment rates in the field were faster for *Zoysia japonica* than *Z. matrella* cultivars.

→ Seeded and vegetative cultivars of *Z. japonica* have similar establishment rates.

→ El Toro, Chinese Common, Companion and Palisades were among the *Z. japonica* cultivars that had the fastest establishment rates; Meyer had an establishment rate similar to the mean. Zorro was among the fastest establishing *Z. matrella* cultivars.

→ El Toro and Zorro, which establish faster than Meyer and Diamond, allocate more dry matter to stolons and rhizomes than leaves. Zoysiagrass cultivars that allocate more dry matter to rhizomes and stolons instead of leaves are quicker to reach establishment.

→ Cultivars with faster establishment rates are ideal during establishment, but other slower establishing cultivars may be better suited for bunkers and green surrounds.