Establishment Rates of Zoysiagrass Cultivars

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Objective

The objective to our research is to identify differences in growth among zoysiagrass cultivars. The ultimate goal of this research is to expand the use of zoysiagrass in the transition zone, thereby creating more sustainable and affordable golf courses.

Rationale

Zoysiagrass (*Zoysia* spp.) is a popular warm-season grass in the transitional and warm climatic regions of the USA including the southern $^1/_4$ to $^1/_3$ of Indiana. The primary reason for zoysia's popularity is it provides an excellent golfing surface with minimal inputs and costs. Zoysiagrass could be a key component in making transition zone golf courses more environmentally friendly and sustainable.

Zoysia japonica Steud. and *Z. matrella* (L.) Merr. are the most common Zoysia species used for turf within the United States and are both often referred to as zoysiagrass. Zoysiagrass is established by sod, sprigs, plugs, or seed. Vegetative establishment by sod, sprigs and plugs is more expensive than seeding. Recent work at Purdue University and other universities has refined methods for establishing newly-available seeded zoysiagrass cultivars.

The main roadblock to widespread zoysiagrass use is its slow establishment and growth rate. Researchers have unsuccessfully searched for methods to hasten establishment including use of N and plant growth regulators. Although researchers have found no method for expediting establishment, there are documented differences in the establishment rate of zoysiagrass cultivars. For instance, 'El Toro' establishes more quickly than 'Meyer' among the cultivars commonly used. However, there is little information comparing the establishment of the more than 40 additional commercially and experimentally available zoysiagrass cultivars. Identifying faster-growing cultivars will immediately lead to new cultivar recommendations, which golf course superintendents can use to minimize renovation or grow-in time, inconvenience, and cost.

How it was done

Plant material of commercially available and experimental cultivars (Table 1) of zoysiagrass was collected in the fall of 2003 and propagated in the greenhouse until the initiation of the experiment. Field plots were prepared by fumigating soil with methyl bromide prior to establishment to minimize weed competition. One zoysiagrass plug (8 by 8 by 8 cm) was transplanted into the center of each plot on 7 June 2004 and irrigated four times daily for the first month to encourage establishment and then irrigated as needed after the first month (Figure 1). Plots received 49 kg ha^{-1} N from urea (46-0-0) on 1 July and 1 August.

Pictures were taken weekly with a digital camera mounted on a monopod to insure shooting from a consistent height. Coverage of zoysiagrass was determined using digital image analysis (DIA) (SigmaScan Pro). To selectively identify green leaves in the images, hue range was set from 47 to 107 and the saturation was set from 0 to 100. Images were calibrated and the data was transformed from selected green pixels to zoysiagrass coverage (cm^2). Using a sod staple, stolons and rhizomes 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 DIA. Stolon measurements were collected on all stolons forty-three days after planting. Additionally, stolon growth was measured over a seven day interval by marking the growing tip of three stolons in each plot with toothpicks (Figure 2) and measuring the growth of the stolon with a Vernier caliper seven days later. Stolon growth rate was determined for 12 stolons of each cultivar on two separate occasions in August. This study will be repeated in 2005.

Figure 1. One zoysiagrass plug (8 by 8 by 8 cm) was transplanted into the center of each plot on 7 June 2004.

Results

We observed significant differences among establishment rate of 39 different zoysiagrass cultivars in our preliminary study (Table 2). As expected, El Toro zoysiagrass was among the *Z. japonica* cultivars that established quickly and Meyer and was among the slowest (Figs. 3 and 4). 'Zorro' was among the fastest *Z. matrella* cultivars and 'Diamond' was the slowest (Figs. 3 and 4). Among the *Z. japonica* cultivars El Toro coverage was 4-times that of Meyer and *Z. matrella* cultivar Zorro achieved 5-times more coverage than Diamond. These early results show that this study will immediately improve our ability to recommend zoysiagrass cultivars and as a result, could dramatically shorten the establishment period of golf course fairways resulting in reduced inconvenience and cost.

Figure 2. Stolon growth was measured over a seven day interval by marking the growing tip of three stolons in each plot with toothpicks

Table 1. Zoysiagrass cultivar and experimental names, species, type of establishment method and source of plant material.

Cultivar	Experimental Name	Species	Type	Source
6136	6136	*Zoysia japonica* Steud.	Vegetative	Bladerunner Farms, Inc.
6186	6186	*Zoysia japonica* Steud.	Vegetative	Bladerunner Farms, Inc.
BMZ 230	BMZ 230	*Zoysia japonica* Steud.	Vegetative	Turfgrass America
Cavalier	DALZ8507	*Zoysia matrella* (L.) Merr.	Vegetative	M.C. Engelke, Texas A&M Univ.
Chinese Common		*Zoysia japonica* Steud.	Seed	Natl. Turfgrass Evaluation Program
Companion	ZMB-2	*Zoysia japonica* Steud.	Seed	Seed Research of Oregon, Inc.
Crowne	DALZ 8512	*Zoysia japonica* Steud.	Vegetative	M.C. Engelke, Texas A&M Univ.
DALZ0101	DALZ 0101	*Zoysia matrella* (L.) Merr.	Vegetative	Turfgrass America
DALZ0102	DALZ 0102	*Zoysia japonica* Steud.	Vegetative	Turfgrass America
DALZ0104	DALZ 0104	*Zoysia matrella* (L.) Merr.	Vegetative	Turfgrass America
DALZ0105	DALZ 0105	*Zoysia matrella* (L.) Merr.	Vegetative	Turfgrass America
DALZ9604	DALZ 9604	*Zoysia japonica* Steud.	Vegetative	Turfgrass America
DeAnza	Z88-8	*Zoysia japonica* Steud.	Vegetative	West Coast Turf
Diamond	DALZ 8502	*Zoysia matrella* (L.) Merr.	Vegetative	M.C. Engelke, Texas A&M Univ.
El Toro	UCR#1	*Zoysia japonica* Steud.	Vegetative	Seedland, Inc.
Emerald	34-35	*Z. japonica x. Z. pacifica* Goudsw.	Vegetative	Natl. Turfgrass Evaluation Program
Empire	SS-500	*Zoysia japonica* Steud.	Vegetative	Sod Solutions
Empress	SS-300	*Zoysia japonica* Steud.	Vegetative	Sod Solutions
GNZ	ZT-11	*Zoysia japonica* Steud.	Vegetative	Greg Norman Turf
Himeno		*Zoysia japonica* Steud.	Vegetative	Zoysian Japan Co.
J-14	J-14	*Zoysia sinica* Hance	Seed	Jacklin Seed Division J.R. Simplot
J-36	J-36	*Zoysia japonica* Steud.	Seed	Jacklin Seed Division J.R. Simplot
J-37	J-37	*Zoysia japonica* Steud.	Seed	Jacklin Seed Division J.R. Simplot
Jamur		*Zoysia japonica* Steud.	Vegetative	Bladerunner Farms, Inc.
Meyer	Z-52	*Zoysia japonica* Steud.	Vegetative	Natl. Turfgrass Evaluation Program
PST-R7LT	PST-R7LT	*Zoysia japonica* Steud.	Seed	Pure-Seed Testing, Inc.
PST-R7MA	PST-R7MA	*Zoysia japonica* Steud.	Seed	Pure-Seed Testing, Inc.
PST-R7TH	PST-R7TH	*Zoysia japonica* Steud.	Seed	Pure-Seed Testing, Inc.
PST-R7ZM	PST-R7ZM	*Zoysia japonica* Steud.	Seed	Pure-Seed Testing, Inc.
PZA 32	PZA 32	*Zoysia japonica* Steud.	Seed	Patten Seed Co.
PZB 33	PZB 33	*Zoysia japonica* Steud.	Seed	Patten Seed Co.
Palisades	DALZ 8514	*Zoysia japonica* Steud.	Vegetative	M.C. Engelke, Texas A&M Univ.
Royal	DALZ 9006	*Zoysia matrella* (L.) Merr.	Vegetative	M.C. Engelke, Texas A&M Univ.
VJ		*Zoysia japonica* Steud.	Vegetative	Bladerunner Farms, Inc.
Victoria	Z88-14	*Zoysia japonica* Steud.	Vegetative	West Coast Turf
Zen 400		*Zoysia japonica* Steud.	Seed	Turf Merchants, Inc.
Zenith	ZNW-1	*Zoysia japonica* Steud.	Seed	Patten Seed Co.
Zeon		*Zoysia matrella* (L.) Merr.	Vegetative	Bladerunner Farms, Inc.
Zorro	DALZ 9601	*Zoysia matrella* (L.) Merr.	Vegetative	Natl. Turfgrass Evaluation Program

Table 2. Zoysiagrass mean stolon length, total stolon length, stolon growth rate and coverage by cultivar.

Cultivar	Species[a]	Est. method	43 DAP[b] Mean stolon length	43 DAP Total stolon length	Stolon growth rate[c]	29 DAP coverage	63 DAP coverage	91 DAP coverage
			cm	cm	mm day^{-1}	cm^2	cm^2	cm^2
6136	j	Vegetative	9.7	245	9.1[d]	132	801	2808
6186	j	Vegetative	18.4	383	14.0	173	1217	4554
BMZ 230	j	Vegetative	16.9	253	15.5	122	958	4302
Cavalier	m	Vegetative	4.6	65	7.0	102	345	1233
Chinese Common	j	Seed	13.5	232	12.7	151	820	2752
Companion	j	Seed	12.4	178	11.3	121	820	3113
Crowne	j	Vegetative	10.8	151	10.1	131	850	3308
DALZ0101	m	Vegetative	8.0	138	6.9	116	486	1716
DALZ0102	j	Vegetative	10.2	274	9.1	189	1050	3864
DALZ0104	m	Vegetative	5.9	88	3.8	112	392	1567
DALZ0105	m	Vegetative	7.2	153	7.2	123	564	2258
DALZ9604	j	Vegetative	11.1	234	8.7	150	1032	3800
DeAnza	j	Vegetative	7.3	224	4.3	145	752	2434
Diamond	m	Vegetative	1.8	10	1.7	102	167	368
El Toro	j	Vegetative	15.2	307	13.8	189	1450	4908
Emerald	jp	Vegetative	3.7	46	3.9	106	273	809
Empire	j	Vegetative	7.0	77	9.3	159	633	2509
Empress	j	Vegetative	4.9	58	3.3	121	357	1181
GNZ	j	Vegetative	8.9	156	7.3	121	612	2188
Himeno	j	Vegetative	9.8	208	9.1	103	420	1588
J-14	s	Seed	9.9	156	10.8	137	612	2227
J-36	j	Seed	10.1	174	11.6	132	740	2684
J-37	j	Seed	9.3	171	11.6	115	631	2833
Jamur	j	Vegetative	6.1	41	7.3	97	355	1077
Meyer	j	Vegetative	5.7	72	4.9	118	383	1196
PST-R7LT	j	Seed	10.9	147	9.0	122	742	2707
PST-R7MA	j	Seed	5.4	74	8.1	96	436	1535
PST-R7TH	j	Seed	8.2	86	6.9	122	442	1464
PST-R7ZM	j	Seed	8.0	145	9.1	105	581	2111
PZA 32	j	Seed	12.1	130	12.0	123	748	2749
PZB 33	j	Seed	13.0	312	10.5	160	1041	3301
Palisades	j	Vegetative	10.4	153	13.1	146	835	3672
Royal	m	Vegetative	8.1	166	8.3	115	415	1432
VJ	j	Vegetative	4.6	31	8.6	120	369	1370
Victoria	j	Vegetative	4.6	79	6.4	118	359	1295
Zen 400	j	Seed	13.0	166	13.9	127	735	2517
Zenith	j	Seed	8.2	93	7.5	141	588	1690
Zeon	m	Vegetative	6.2	89	7.7	107	361	1407
Zorro	m	Vegetative	7.0	181	8.2	117	502	1913
Mean			8.9	152	8.8	128	638	2319
$LSD_{0.05}$			3.2	90	3.2	25	204	686

[a] j = *Zoysia japonica*, m = *Zoysia matrella*, s = *Zoysia sinica*, jp = *Z. japonica x. Z. pacifica*
[b] Days after plugging (DAP)
[c] Stolon growth rate was determined by dividing the growth (length) from 57 DAP to 64 DAP and 64 DAP to 71 DAP of each stolon by 7 d.
[d] Mean of 24 stolons (three samples per plot with four replications on two sampling intervals).

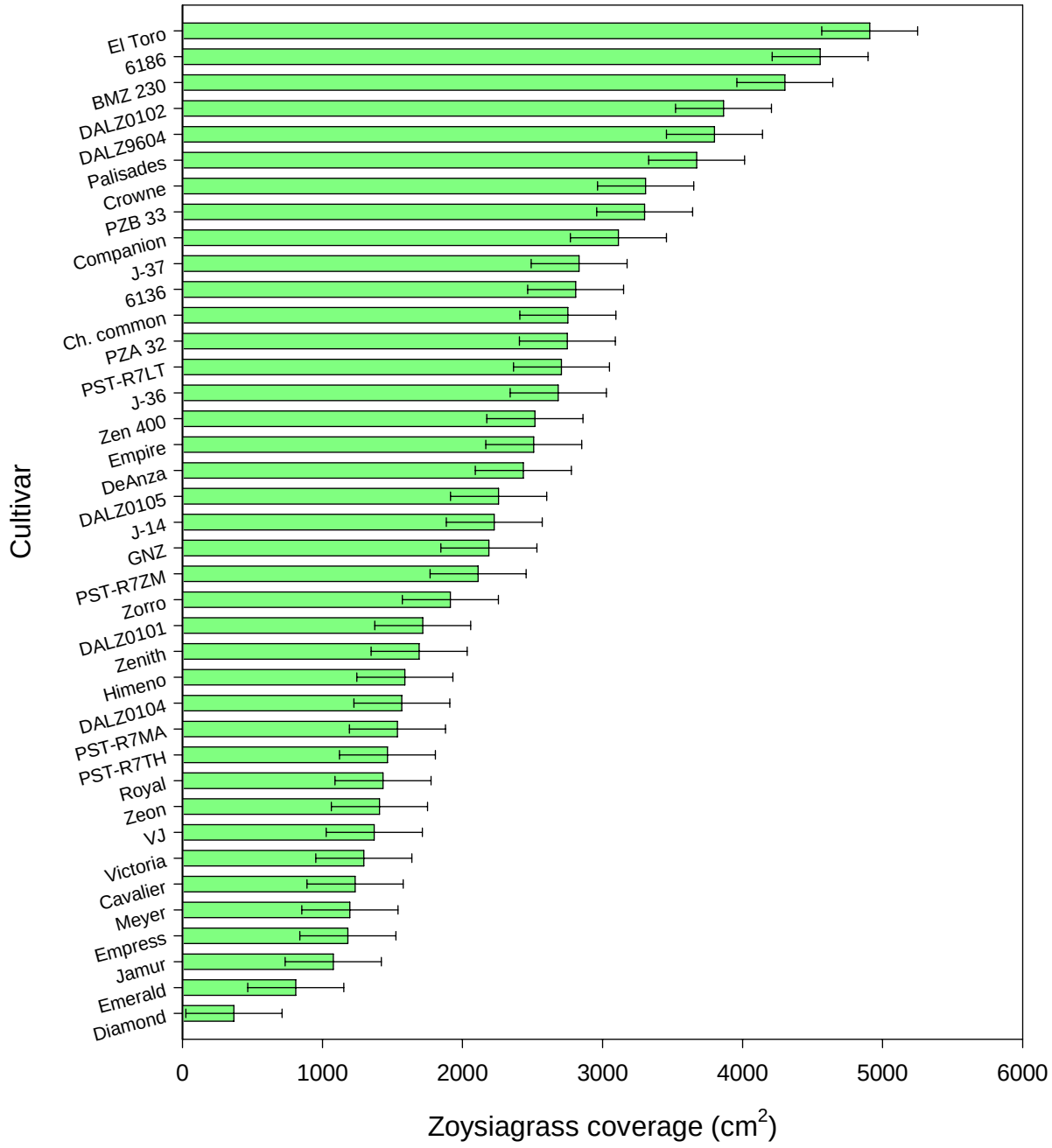

Figure 3. Relative ranking of zoysiagrass establishment rate 91 days after planting. Error bar represents an $LSD_{0.05}$ of 686.

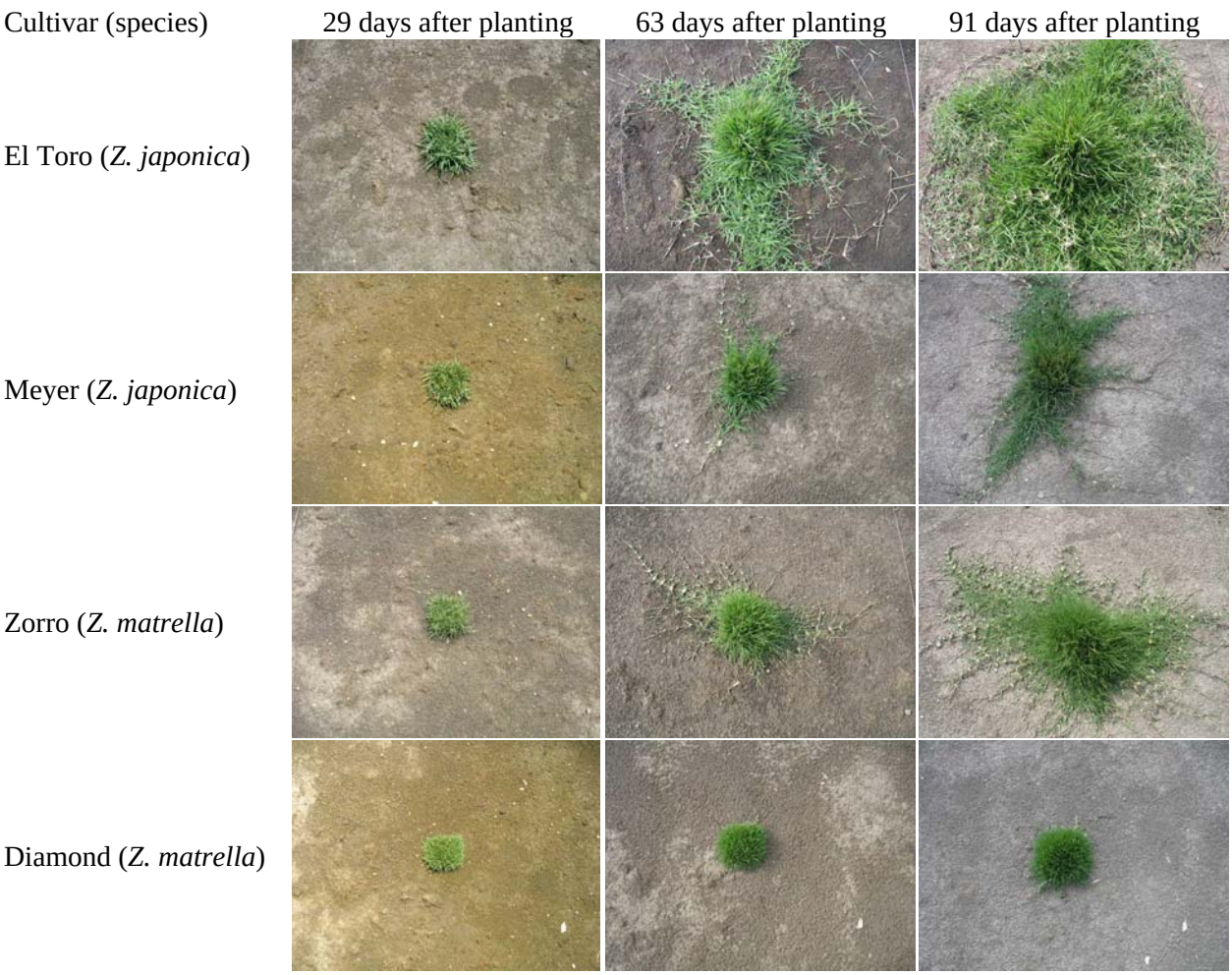

Figure 4. Twenty-nine days after planting (DAP), 63 DAP and 91 DAP images of zoysiagrass (*Zoysia* spp.) cultivars established from plugs on 7 July 2004 in West Lafayette, Ind. 'El Toro' is a fast-growing *Z. japonica* and 'Meyer' a slow-growing *Z. japonica*. 'Zorro' is a fast-growing *Z. matrella* and 'Diamond' a slow-growing *Z. matrella*.