Causes of Differential Growth Among Zoysiagrass Cultivars

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Objective

To determine the underlying factors associated with the fast growth of some zoysiagrass cultivars.

Rationale

Although there are differences in establishment (growth) rate of zoysiagrass cultivars, there are no reports on the cause of these differences. Growth analysis is a tool useful for determining the causes for different growth rates.

How it was done

Cultivars will selected based upon their differing growth in a field study (Fig. 1).

- 1 slow growing *Z. japonica* cultivar (Meyer)
- 1 slow growing *Z. matrella* cultivar (Diamond)
- 1 quick growing *Z. japonica* cultivar (El Toro)

1 quick growing *Z. matrella* cultivar (Zorro)

Cultivars were planted in sand-filled 2.5 cm diameter Ray Leach cone-tainers (Stuewe & Sons, Inc., Corvallis, OR) using a segment of stolon or rhizome containing a single node and leaf and root tissues. Plants were fertilized daily after planting with half-strength Hoagland's solution. Plants were grown in the greenhouse with temperature 23 ±5 °C for six weeks to allow time for root and shoot initiation. After six weeks of growth in the greenhouse, plants were transferred to a growth chamber maintained at 30 ±0.7 °C with 70% relative humidity and 14 h day length at 816 μmol m^{-2} s^{-1} (photosynthetically active radiation) which is 41 mol m^{-2} d^{-1}.

Eight plants of each cultivar were harvested when the plants were transferred to the growth chamber and again every week for 5 weeks. Leaf blades, roots and the remaining fraction that consisted of mainly leaf sheaths and stolons were separated. This third fraction containing leaf sheaths and stolons will be termed 'stem' throughout the reminder of the paper. At each harvest, plants were separated into fractions and the leaf area determined using digital image analysis. Plant fractions were then dried (at least 48 h at 60 °C) and weighed and the growth analysis values were calculated (Hunt et al., 2002, Table 1). This study was conducted twice.

Results:

- Crop growth rate (CGR) is consistent with field results on establishment rate (Table 2).
- RGR is similar between Meyer, El Toro and Zorro. Diamond has the highest RGR likely because of its smaller leaves which allow for a greater ULR.
- Cultivars that established quicker in the field have higher stem weight ratios than slower establishing cultivars, suggesting that they partition more dry matter into producing stems (stolons and rhizomes) than leaf or root tissues.
- Slower establishing cultivars partition more dry matter into producing leaves

Table 1. Abbreviations, meanings, units, formulae, symbols and quantities used for *Zoysia* spp growth analysis.

Abbreviation	Meaning	Units	Formulae†
CGR , C	mean crop growth rate	mg d^{-1}	$(W_2-W_1)/(T_2- T_1)$
RGR , R	mean relative growth rate	mg g^{-1} d^{-1}	$(\log_e W_2-\log_e W_1)/(T_2- T_1)$
ULR , E	mean unit leaf rate	g m^{-2} d^{-1}	$(W_2-W_1)/(T_2-T_1)*[(\log_e L_{A2}-\log_e L_{A1})/(L_{A2}- L_{A1})$
LAR, F	mean leaf area ratio	m^2 g^{-1}	$[(L_{A1}/W_1)+(L_{A2}/W_2)]/2$
SLA	specific leaf area	m^2 g^{-1}	$[(L_{A1}/L_{W1})+(L_{A2}/L_{W2})]/2$
LWR	leaf weight ratio	g g^{-1}	$[(L_{W1}/W_1)+(L_{W2}/W_2)]/2$
SWR	stem weight ratio	g g^{-1}	$[(S_{W1}/W_1)+(S_{W2}/W_2)]/2$
RWR	root weight ratio	g g^{-1}	$[(R_{W1}/W_1)+(R_{W2}/W_2)]/2$

† Formulae from Radford, 1967 and Hunt et al., 2002.

Table 2. Growth analysis mean values of zoysiagrass (*Zoysia* spp.) cultivars grown in a growth chamber maintained at 30°C with 70% relative humidity and 14-h photoperiod of 816 µmol m^{-2} s^{-1} photosynthetically active radiation. Correlation coefficients between mean relative growth rate and other growth components were calculated and their significances are given at the bottom of the table.

		Growth Analysis							
Cultivar	Species	RGR †	CGR	ULR	LAR	SLA	LWR	SWR	RWR
		mg g^{-1} d^{-1}	mg d^{-1}	g m^{-2} d^{-1}	----m^2 g^{-1}----		----------g g^{-1}---------		
Meyer	*Z. japonica*	85‡ b§	50 bc	12.6 c	7.1 a	23.8 a	0.293 a	0.586 c	0.121 c
El Toro	*Z. japonica*	85 b	90 a	17.3 bc	4.9 c	19.7 c	0.241 c	0.622 b	0.137 b
Diamond	*Z. matrella*	120 a	39 c	22.1 ab	5.8 b	21.5 b	0.267 b	0.570 c	0.163 a
Zorro	*Z. matrella*	90 b	62 b	23.6 a	4.1 d	16.7 d	0.239 c	0.644 a	0.117 c
p (correlation coefficient)			NS	NS	NS	NS	NS	NS	NS

NS, not significant.

† RGR, relative growth rate; CGR, crop growth rate; ULR, unit leaf rate: LAR, leaf area ratio; SLA, specific leaf area; LWR, leaf weight ratio; SWR, stem weight ratio; and RWR, root weight ratio.

‡ Means of 80 values (2 experimental replications and 5 harvests at 8 plants per harvest) for CGR, RGR, ULR, LAR, SLA, LWR, SWR, and RWR. Plants were harvested weekly for a total of six weeks per experimental replication.

§ Within columns, means followed by the same letter are not significantly different according Tukey's test for significant differences ($\alpha = 0.05$).

Figure 1. Cultivars selected for growth analysis.