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Evaluating St. Augustinegrass [Stenotaphrum Secundatum (Waltz.) Kuntze] Cultivar Morphological Differences

Research Article

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Abstract

Current trends toward energy conservation in home landscaping present problems in warm-season turfgrass selection since all species grow best in full sunlight. Previous research has identified several St. Augustinegrass [Stenotaphrum secundatum (Waltz.) Kuntze] selections with excellent shade and cold tolerance. To determine if germplasm samples are truly different than established cultivars, morphological traits were evaluated. The objective of this study was to determine if experimental St. Augustinegrass germplasm samples possessed different morphological differences compared to industry standards, 'Raleigh' and 'Palmetto'. Turf height measurements, visual seedhead density counts and morphological measurements were taken to quantify leaf width, leaf length, and internode distance. Measurements were taken at the third internode of each stolon. Internode distance was measured between the third and fourth internode. Significant differences between leaf width, leaf length, and internode distance occurred as did differences between turf height and seedhead density when compared to the industry standards, 'Raleigh' and 'Palmetto' St. Augustinegrasses. Findings suggest these germplasm samples have sufficient different morphological characteristics to indicate they are probably different cultivars. Differences in morphological characteristics is one tool used to determine differences between cultivars. Additional verification is justifiable if technology advances allow genetic sequencing to be definitive enough to determine if these grasses are truly different.

As homeowners trend towards greater energy efficiency, demands for better performing, more shade tolerant turfgrasses also increase. Current trends toward energy conservation in home landscaping present problems in warm-season (C4) turfgrass selection since all species grow best in full sunlight. As the use of shade for cooling homes and buildings has increased, the need for a shade and cold tolerant turfgrass by homeowners and landscapers has arrived [1-3]. To determine if germplasm samples are truly different cultivars than established ones, morphological traits are typically evaluated to justify further research such as genetic sequencing. In addition, turf height and seedhead production differences would be valuable information for those turf managers interested in cultivars not requiring as frequent mowing as others.

Genotypic sequencing, however, isn't always able to delineate between cultivars. In hybrid bermudagrasses (Cynodon dactylon (L.) Pers. x C. transvaalensis Burtt-Davy), genotyping-by-sequencing was unable to consistently distinguish triploid standard cultivars from one another [4]. Researchers also were not able to distinguish these selections from their parents due to similar origin and clonal propagation but could distinguish triploids from diploid and tetraploid samples. To the author's knowledge, molecular genotyping of St. Augustinegrasses has yet been published. Busey [5] classified 94 gentotypes based on 26 characters into five groups and developed a key based on their geography, chromosome number, and adaptation characteristics. The objective of this study was to determine if experimental St. Augustinegrass germplasm samples possessed different morphological differences compared to industry standards 'Raleigh' and 'Palmetto'.

Materials and Methods

A field trial was conducted for eight St. Augustinegrass samples - two industry standard cultivars, 'Raleigh' and 'Palmetto', and six experimental samples. Plots were located at the Clemson University Cherry Farm in Clemson, South Carolina (34°40'14" N, 82°50'15" E). To control undesirable plants preestablishment, plots were treated with glyphosate twice, three weeks apart, at 4.48 kg ai ha-1, plowed and disked, then fumigated with methyl bromide at 73kg ai ha-1 in July 2012. Plots were 3 x 4.5m with 0.5m alleys between plots. St. Augustinegrass was established by evenly plugging 7 plugs totaling 0.24m2 (2.6 ft2) per plot. Plots were fertilized with a 1-1-1 complete fertilizer after plugging and once monthly thereafter during the growing season. Plots were irrigated as needed to prevent drought stress. Plots were mowed twice weekly during the growing season with a 1.52m PTO driven finishing mower behind a John Deere 955 tractor set at 5.1cm height. Plots were treated with a postemergence herbicide, Celsius (iodosulfuron + dicamba + thiencarbozone), at 217 g ha-1 as needed to reduce weed competition. Plot edges were mechanically trimmed monthly to prevent encroachment and contamination from alleys. Plots were not treated with a fungicide or insecticide. Plots were covered with wheat straw from December 2012 through April 2013 to reduce winter damage.

After removing the wheat straw in April 2012, plots were left unmown for six weeks. Turf height measurements were taken in July 2013 (designated as year1). Five height measurements were taken from randomly selected areas within each plot and measured with a ruler. Visual seedhead density counts were also taken in year1. The lack of seedheads preventing a rating in year2. Morphological measurements were taken in year1 and July 14 (designated as year2) using five stolons from each plot to quantify leaf width, leaf length, and internode distance. Measurements were taken at the third internode of each stolon. Internode distance was measured between the third and fourth internode. Experimental design was a randomized complete block with three replications. The study was repeated in time. Data were subjected to ANOVA for evaluation of main effects. Further mean comparisons between grasses were performed using Fisher's protected LSD. Where appropriate, mean comparisons to industry standards were performed using Dunnett's test. All comparisons were based on an α = 0.05 significance level. All analyses were conducted using JMP version 10 (SAS Institute Inc., Cary, NC).

Results and Discussion

Significant differences between leaf width, leaf length, and internode distance occurred [Table 1]. A grass-by-year interaction also occurred; therefore data is presented separately by year for these morphological differences. Significant differences between turf height and seedhead density also occurred in year1. A grass-by-block interaction was detected for turf height; therefore, date will be presented separately by block [Table 1]. In 2013, grasses 'A', 'E', and 'H' had significantly different leaf widths compared to 'Raleigh' but only 'F' had a significantly different leaf width compared to 'Raleigh' in year2. 'A', 'E', and 'G' had significantly different leaf lengths compared to 'Raleigh' in year1 while 'E' and 'F' had significantly different leaf lengths compared to 'Raleigh' in year2. 'E' was the only grass to show differences to 'Raleigh' both years. 'C', 'Palmetto', 'E', and 'G' had significantly different internode lengths compared to 'Raleigh' in year1, while all grasses but 'G' had significantly different internode lengths than 'Raleigh' in year2. 'E' was the only grass to have a significantly different seedhead density compared to 'Raleigh' in year1 [Table 2]. 53% of 'Raleigh' plots possessed seedheads compared to 78% of grass 'E' plots [Table 5].

Table 1: ANOVA for morphological differences of St. Augustinegrass germplasm samples over two years in Clemson, South Carolina (USA).

Source	DF	Leaf Width	Leaf Length	Internode Distance	Turf Height	Seedhead Density
Years 1 and 2 Combined						
Grass	7	*	*	*	-	-
Block	2	ns	ns	ns	-	-
Year	1	ns	*	*	-	-
Grass-by-Year	7	*	*	*	-	-
Year1						
Grass	7	*	*	*	*	*
Block	2	ns	ns	ns	*	*
Grass-by-Block	14	ns	ns	ns	*	ns
Year2						
Grass	7	*	*	*	-	-
Block	2	ns	*	ns	-	-
Grass-by-Block	14	ns	ns			

Abbreviations: DF, degrees of freedom; ns, not significant

*Significant at α = 0.05 level.

In year1, only grass 'E' had a significantly different leaf width compared to 'Palmetto' while 'A' and 'C' had significantly different leaf widths compared to 'Palmetto' in year2. Grasses 'E' and 'G' had significantly different leaf lengths compared to 'Palmetto' in year1 while 'E' and 'F' had significantly different leaf lengths in year2. 'E' was the only grass to have significantly different leaf lengths than 'Palmetto' in both years. In year1, only 'E' and 'F' had similar internode lengths compared to 'Palmetto' while 'Raleigh' and 'G' were the only grasses to have significantly different internode lengths than 'Palmetto' in year2 [Table 3]. In year1, grass 'C' was the only one to have significantly different turf height in more than one block compared to 'Raleigh'. 'A', 'F', and 'G' also had significantly different turf heights in one of the three blocks compared to 'Raleigh'. Compared to 'Palmetto', only 'C' and 'E' had significantly different turf heights in just one of the three blocks. All other grasses had similar turf heights to 'Raleigh' and 'Palmetto' [Table 4].

Table 2: DUNNETT for comparing leaf width, leaf length, internode distance, and seedhead densities of St. Augustinegrass germplasm samples to industry standard 'Raleigh' over two years in Clemson, Carolina (USA).

Grass	Industry Standard	Leaf Width	Leaf Length	Internode Distance	Seedhead Density
Year1					
A	'Raleigh'	*	*	ns	ns
C	'Raleigh'	ns	ns	*	ns
'Palmetto'	'Raleigh'	ns	ns	*	ns
E	'Raleigh'	*	*	*	*
F	'Raleigh'	ns	ns	ns	ns
G	'Raleigh'	ns	*	*	ns
H	'Raleigh'	*	ns	ns	ns
Year2					
A	'Raleigh'	ns	ns	*	-
C	'Raleigh'	ns	ns	*	-
'Palmetto'	'Raleigh'	ns	ns	*	-
E	'Raleigh'	ns	*	*	-
F	'Raleigh'	*	*	*	-
G	'Raleigh'	ns	ns	ns	-
H	'Raleigh'	ns	ns	*	-

*Significant at α = 0.05 level

Abbreviation: ns, not significant

Table 3: DUNNETT for comparing leaf width, leaf length, internode distance, and seedhead densities of St. Augustinegrass germplasm samples to industry standard 'Palmetto' over two years in Clemson, South Carolina (USA).

Grass	Industry Standard	Leaf Width	Leaf Length	Internode Distance	Seedhead Density
Year1					
A	Palmetto	ns	ns	*	ns
'Raleigh'	Palmetto	ns	ns	*	ns
C	Palmetto	ns	ns	*	ns
E	Palmetto	*	*	ns	ns
F	Palmetto	ns	ns	ns	ns
G	Palmetto	ns	*	*	ns
H	Palmetto	ns	ns	*	ns
Year2					
A	Palmetto	*	ns	ns	-
'Raleigh'	Palmetto	ns	ns	*	-
C	Palmetto	*	ns	ns	-
E	Palmetto	ns	*	ns	-
F	Palmetto	ns	*	ns	-
G	Palmetto	ns	ns	*	-
H	Palmetto	ns	ns	ns	-

*Significant at α = 0.05 level

Abbreviation: ns, not significant

Table 4: DUNNETT for turf height measurements of St. Augustinegrass germplasm samples compared to industry standard 'Raleigh' in July in Clemson, South Carolina (USA).

Grass	Industry Standard	Turf Height		
		Block 1	Block 2	Block 3
A	Raleigh	*	ns	ns
'Raleigh'	Raleigh	ns	ns	ns
C	Raleigh	*	*	ns
E	Raleigh	ns	ns	ns
F	Raleigh	ns	*	ns
G	Raleigh	ns	*	ns
H	Raleigh	ns	ns	ns
A	Palmetto	ns	ns	ns
'Raleigh'	Palmetto	ns	ns	ns
C	Palmetto	ns	ns	*
E	Palmetto	ns	*	ns
F	Palmetto	ns	ns	ns
G	Palmetto	ns	ns	ns
H	Palmetto	ns	ns	ns

*Significant at α = 0.05 level

Abbreviation: ns, not significant

Table 5: Leaf width, leaf length, internode distance, and seedhead densities of St. Augustinegrass germplasm samples over two years.

Grass	Leaf Width (mm)	Leaf Length (cm)	Internode Distance (cm)	Seedhead Density (%)
Year1				
A	6.2	2.3	5.5	80
'Raleigh'	7	2.87	5.18	53
C	6.6	2.5	4.25	53
'Palmetto'	6.8	2.75	6.39	61
E	5.9	1.99	6.2	78
F	6.36	3.23	5.86	76
G	6.43	4.31	2.88	50
H	6.26	2.58	5.13	71
$LSD_{0.05}$	0.51	0.39	0.51	17.8
Year2				
A	7.03	2.74	5.25	-
'Raleigh'	6.6	2.58	3.77	-
C	7.1	2.65	5.24	-
'Palmetto'	6.17	2.6	5.44	-
E	6	2.08	5.19	-
F	5.67	1.92	5.6	-
G	6.17	2.39	3.22	-
H	6.23	2.54	5.32	-
$LSD_{0.05}$	0.49	0.35	0.6	-

Table 6: Turf height measurements of St. Augustinegrass germplasm samples in July in Clemson, South Carolina (USA).

Grass Selection	Turf Height (cm)		
July			
	Block 1	Block 2	Block 3
A	14.22	19.81	24.89
'Raleigh'	22.86	19.81	19.81
C	12.19	12.7	13.72
'Palmetto'	17.27	13.72	22.35
E	24.38	20.32	22.86
F	18.29	12.19	10.6
G	16.76	12.7	16.76
H	21.34	19.81	18.29
$LSD_{0.05}$	5.97	4.7	5.69

Conclusions

'A' was different than 'Raleigh' in four morphological traits at least once throughout the study and different than 'Palmetto' in two morphological traits at least once throughout the study. 'C' was different than 'Raleigh' in two morphological traits at least once throughout the study and different than 'Palmetto' in three morphological traits at least once throughout the study. [Table 6] 'E' was different than 'Raleigh' in four morphological traits at least once throughout the study and different than 'Palmetto' in three morphological traits at least once throughout the study. 'F' was different than 'Raleigh' in one morphological traits at least once throughout the study and different than 'Palmetto' in one morphological traits at least once throughout the study. 'G' was different than 'Raleigh' in three morphological traits at least once throughout the study and different than 'Palmetto' in two morphological traits at least once throughout the study. 'H' was different than 'Raleigh' in two morphological traits at least once throughout the study and different than 'Palmetto' in one morphological traits at least once throughout the study. These findings support preliminary work suggesting these germplasm samples have sufficient different morphological characteristics to indicate they are probably different than the two standard cultivars. Differences in morphological characteristics is one tool used to determine differences between cultivars. If genetic sequencing becomes reliable, further categorizing St. Augustinegrass selections using this technology would be an additional tool

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