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Field Performance of Selected Mowed Distichlis Clones

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Abstract

Twenty-one clonal selections of saltgrass (Distichlis spp.) were evaluated during the first full summer growing season (May - October 1999) for turf characteristics and general adaptation.
Initial percent plot cover in May ranged from 8% to 42% among clonal accessions. Accessions which produced the highest unmowed canopy heights had the greatest initial cover in May. This trend reversed itself by August and September whereby entries which exhibited less elevated foliage tended to produce turfs which had higher shoot densities, greater percent plot cover, visual estimates of density and more acceptable overall turfgrass quality under accumulated mowing pressure. The "treatment" (clonal accession) affect was significant on all dates for all field variables demonstrating clearly that differences exist for growth parameters of Distichlis screened under mowing stress.

Introduction

This second report includes turfgrass field data of twenty-one selected clones of Distichlis spp. (saltgrass) from May 6 to October 20, 1999 at the Tucson station. The turf plots were measured for overall turf appearance, which included visual estimates percent plot turf cover, percent cover (green foliage), percent cover straw foliage, color, density, and overall turf quality. Unmowed plant heights were measured in May and shoot density counts were taken in October.

Twenty-one clones labeled Arizona A(N) and seven clones selected by Colorado State University labeled as C(N) were transplanted into a replicated field trial in the summer of 1998. Arizona clones were selected for favorable growth habits from glasshouse tests which included regular mowing pressure. Three vegetative propagules/clones were incorporated into field plots which measured 4x6 feet in plywood boxes installed in situ. This was necessary to insure plot integrity which is threatened otherwise by the expansive rhizome capacity of saltgrass.

The first field station report for Tucson (May 31, 1999) included initial plant measurements, plot green-up, number of satellite plants/plot (new plants from terminal rhizomes) unmowed canopy heights and sexual expression (sex type and number of culms/plot).

Materials and Methods

From May 18 to September 15, 1999, the plots were mowed twice weekly. Mowing height was 2.75" until June 8, when it was lowered to 2.25" and remained so afterwards.

The test was fertilized throughout this test period with a total of 2.14 lbs. -N-, 0.63 lbs. -P-, and 1.23 lbs. -K- per 1000 ft^2. Fertilizer was applied on four dates (May 27, June 17, August 17 and September 26). The test area was flood irrigated on May 28, June 18, June 29 and August 18 and finally on September 27.

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Major rainfall events during the monsoon occurred on July 5, 6, 7, 14, 15, 17 and 20. Total natural rainfall was 10.25" from May to October 1.

Plots were measured on appropriate dates for percent total plot cover (0%-100%), percent plot cover comprised of green turf (0%-100%), percent plot straw turf (0%-100%), unmowed canopy heights, color, quality, density (NTEP visual scale system) and shoot density counts taken the third week in October. Counts were made as the number of shoots recorded inside and a 2.375" inside diameter ring. Field data was analyzed as a randomized complete block design using the analysis of variance technique. A single orthogonal polynomial contrast was used to compare the mean performance of Arizona versus Colorado selections. The LSD statistic was calculated for mean separation when the F value for "treatment" (clonal accessions) was significant at P = 0.05, or less.

Results and Discussion

On all dates and for all field variables, the F ratio for clonal entries (treatments) was significant at P = 0.05, or less.

In mid-May, the percent plot coverage averages for clones ranged from 8% to 42% of the plot surface (Table 1). C-66 had the greatest mean plot cover turf (42%), followed by C-12 (28%), C-92 (27%) and C-11 (25%). Five clones had less than 10% plot coverage at this time (nine months after planting in the late fall). This time period (mid-May) included realistically a three month total growing period for a warm season grass.

The mean percentage of the total existing foliage that was green (0%-100% of entire foliage) was determined in May by assigning each vegetative propagule (3 per plot), a separate score and then averaging these for the proper experimental unit analysis. Percent green foliage scores ranged from 80% to 97%. Clones C-42, C-12, C-11 and C-92 had mean percent green foliage values of 94% to 99%. Clone C-56 had only 80% of the foliage as green tissue. Clones A-138 (dwarf) had 99% of its foliage in green tissue, followed closely by A-41, A-137, A-77, A-86, A-119 and A-55, which had values of 97% green foliage.

Plots were fertilized and watered in June, at which time (third week of June) the mowing height was lowered from 2.75 to 2.25 inches to promote more mowing stress.

In July, turfgrass clones ranged from 45% to 92% turfgrass plot coverage. This estimate represents the percentage of the 4' x 6' plot that is covered by turf (Table 2). It is the same estimate as the percent plot coverage assigned to plots in May. From May to July, clones interacted tremendously in their ability to "fill in" during the first full summer season.

The clones which showed the greatest plot coverage now included A-55 (92%), C-11 (95%) C-10 (92%) and C-92 (92% plot coverage) (Table 1). Clones A-138 (62%), A-119 (50%), A-48 (65%) and A-53 (65%) ranked lowest in establishment at mid-July. These clones did however increase their amount of coverage from May by 7 to 9 times, on average (Tables 1, 2).

In August, plots were assigned values for percent plot green, percent plot straw, quality and overall plot density. The sum of the percent green and percent straw would equal the total turf plot cover.

By August, the cumulative mowing pressure of bi-weekly mowings at 2.25 inches was now causing a shift in clonal performance rankings. The percent plot green mean accession scores ranged from 48% to 85%. Clone A-55 had the largest mean percent green cover (85%) followed by A-86 (82%) and A-137 (80%). The clones which were more aggressive in establishment were now declining under accumulated mowing pressure. For example, clones C-66 and C-10 now had significantly decreased ground cover. Entries C-10 (53%), C-12 (67%), C-11 (62%), C-92 (57%) all showed this trend (Table 2).

Almost all clonal selections showed a slight decrease in green ground cover with the exceptions of A-86 (82%) and A-137 (80%). As mentioned, the percent of the total plot surface which exhibited "straw" turf was measured. Distichlis appears to go through a growth period where the lower leaf sheaths become necrotic and they do not drop off the culm. This foliage, if excessive, subtracts seriously from the overall turf performances. It is unclear on what condition the shoots are (age/order) when this occurs.

Percent plot straw treatment means ranged from 2% to 25% of the total plot plant cover in August. The clones which had the greatest reduction in percent plot cover in July, to the percent plot green in August, generally had the largest

amount of straw cover within the plot. These included the clonal accessions of C-92 (15%), C-11 (18%), C-66 (25%), C-12 (20%) and C-10 (15%). Clones which had 5% or less percent plot straw included A-61 (4%), A-55 (5%), A-138 (3%), A-65 (4%), A-48 (4%), A-51 (2%), A-40 (3%), A-65 (4%), A-48 (4%), A-51 (2%), A-40 (3%), A-119 (5%) and A-77 (5%).

Color, quality and density were assigned to all plots in August 1999. Distichlis appears to have four color phenotypes which are described as a medium bright green, a medium green, a light green, and a dark blue green. NTEP visual scores ranged from 3 to 8. Treatment C-66 had a large percent of bare ground and straw remaining on the plot and this entry scored the average of 3 for color. The -C- series accessions had scores ranging from 5 to 6 (Table 5). Clones A-137, A-72, A-119, A-41 and A-53 had produced a darker color turf (means = 7.0). The darkest color Distichlis clones included A-138 dwarf, A-86, A-77, A-51 and A-40. These received mean scores of 8.0 and would either be dark green or dark blue green (Table 3).

Visual turf plot density (estimated over the entire plot area) scores in August 1999 ranged from 2 to 7, using the NTEP progressive scale. Entries C-66, A-119 and C-56 had unacceptable low density scores of 3.0, or less. Likewise, entries which had the largest numerical density scores included A-55 (7), A-65 (6), A-86 (6), A-51 (6) and A-40 (6) (Table 3).

Overall quality scores were assigned in August which ranged from 2 to 6. General acceptance of Distichlis turf as a low maintenance grass would generally require a quality score of 5.0 or greater. Clones with quality scores of 4.0 or less would not be acceptable in a golf setting but otherwise may serve as a reclamation or low input ground cover. Clones A-55 and A-86 produced overall means of 6.0. Clones with overall quality scores of 5.0 included A-137, A-51 and A-40. All other plots either lacked cover, were too stemmy or had to much vertical straw present in the canopy to warrant a quality score of 5.0 or greater at this time (Table 3).

In September 1999, the percent plot green, percent plot straw, color, quality and density were assigned again to all plots.

Percent plot green and turf density generally improved from August to September. This could be in part from the application of ammonium nitrate in August. Mean percent plot green treatment scores ranged from 18% to 95%, with four entries having 90% or more green grass cover of the plot (Table 2). These included A-55 (94%), A-65 (92%), A-86 (95%), A-137 (92%) and A-40 (92%) (Table 2). The dark slow growing dwarf A-138 had only 77% cover green turf one year after establishment. Clone C-66 continued to decline in ground cover, yielding 18% green cover in September (Table 2).

The percent straw plot cover decreased somewhat from August to September. Note, however, that the entries remained similar in rank for this variable. Entries A-138 and A-65 had the least amount of visual straw (1%-2%). A-119, A-48, A-51 and A-53 had 3% or 4% straw (Table 2). Clone C-66 had 11% straw foliage and only 18% green foliage. The remainder would be bare ground.

Mean color scores in September ranged from 4 to 8 (Table 3). The darkest color accessions included A-138, A-119 and A-86. These entries had mean color scores of 8.0. Those with mean color scores of 7 included A-72, A-137, A-48, A-40, A-53 and C-10. Those with color scores of 6.0 included A-61, A-55, C-8, A-65, C-56, C-11, A-77, A-41, A-51 and C-12.

Mean density scores for treatments ranged from 4 to 8. As plots continued to grow into September (dry weather, hot days, somewhat cooler nights), plot appearance generally improved over that of July and August. Cones A-138, A-119, A-137, A-41 and A-53 increased their mean density scores by 2.0 units from August into September (6 weeks actual). Accessions which had density scores of 7.0 now included A-55, A-86, A-137 and A-51. The entry A-65 scored a mean value of 8.0 for density. Entry C-66 had the lowest density score of 3.0 as did C-56. Entries C-11 and C-13 scored mean density values of 5.0.

September quality scores for accessions ranged from 3 to 7. A-55, A-65 and A-86 had mean quality scores of 7.0. Entries A-137, A-48, A-51, A-40 and A-53 all yielded a mean September quality score of 6.0. Entries C-10, C-11 and C-8 scored means of 5.0 for September quality. These ratings were essentially 13 months after the initial establishment (Table 3).

Unmowed plant heights (7 days growth in May) were determined by measuring the canopy height (cm) at which 90% of the unmowed foliage reached above the ground. Measurements were taken to determine if relative differences in elongation rates, internode lengths, or both may exist among entries. Canopy heights were highly variable between

clones and ranged from 5 to 21 cm at the beginning of the growth season in May. Entry C-66 had the largest vertical elongation (21 cm), followed by C-92 (17 cm) and C-12 (13 cm) (Table 4). These three entries had the greatest percent plot cover scores in May 1999, but would decrease dramatically in plant cover by August.

Likewise, entries A-65, A-86 and A-55 which were slow to establish ground cover (as percent of the total plot area) eventually covered the plots with 90% or more green turf. These accessions also had high August quality scores of 7.0. These three entries had lower unmowed mean canopy heights in May than the "C" entries mentioned above. C-56 had a low elongation rate of 4 cm and also had very low plot cover values throughout the history of the test (Tables 3, 4).

Lastly, shoot density counts were made the third week in October 1999. A 2.375" diameter ring was dropped on two representative areas of the plot and the average of the two counts were used in the analysis.

Mean shoot counts ranged from 41 to 107 shoots/ring (Table 4). A-138 had the highest shoot density (107/ring). Those with 80 or more shoots/ring included A-138, A-86, A-65 and A-137 (Table 4). These plots generally had the best quality scores in August and September (Table 3). Note the inverse relationship between unmowed plant heights and the number of shoots per ring. This indicates a general trend that clones with lower plant canopy heights (unmowed) generally produced a greater shoot density. This is most common in other turfgrass species and defines turf type selection under mowing stress as the key selection pressure in germplasms screening.

Conclusion

1. For all variables measured or assigned to plots, the "treatment affect" (clonal accession) was significant at P = 0.05, or less.

2. In May 1999 (10 months after establishment including a five month winter dormancy period) clones C-66, C-92, C-12 and C-11 had established the greatest amount of percent plot ground cover to turf.

3. By July 1999, other entries had now produced equal amounts of ground cover which included A-55 and A-40.

4. At a new and lower mowing height of 2.25" (formerly 2.75"), lower growing entries increased in all aspects of turf performance as evident in August and September plot ratings. The entries A-55, A-86, A-65 generally

   increased turf performance under accumulated mowing stress. Enhanced responses for percent plot green cover, density and overall quality occurred for these entries.

5. Clones C-92, C-11, C-12 and C-10 declined under the accumulated mowing stress and yielded poor quality turf under the 2.25" mowing regime.

6. Conclusions 2-5 show a biological interaction among Distichlis accessions for adaptation to mowing stress within 16 months after establishment.

7. Clones which had the lowest unmowed canopy heights in May tended to have greater shoot densities at the close of the first full season of growth (October 1999).

8. Clonal variation exists among Distichlis germplasm for growth and turf parameters while under mowing stress.

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Table 1. Mean percent green foliage and percent plot cover of mowed Distichlis clones at spring green up. University of Arizona, 1999.

TRT	NAME	% PLOT COVER[2]	% FOLIAGE GREEN[1]
1	A61	10	96
2	A55	16	97
3	C8	13	92
4	C92	27	96
5	A138	8	99
6	A65	9	94
7	C56	4	80
8	C11	25	94
9	A72	14	96
10	A119	8	97
11	A86	17	97
12	A77	11	96
13	A137	12	97
14	A41	11	97
15	C66	42	97
16	A48	10	92
17	A51	12	91
18	C12	28	99
19	C10	18	95
20	A40	13	88
21	A53	9	93
TEST MEAN[3]	- -	15	94
LSD VALUE[4]	- -	8	7

[1]Percent of the existing foliage that is fully green (0%-100%). Values are the mean of three replications/plot and three plots within the test.
[2]Percent plot coverage equals percent of plot surface covered with turf (0%-100%). Values are the mean of three replications.
[3]Test Mean = value of all twenty-one accessions.
[4]LSD Value = mean separation statistic. The absolute difference between two treatments, if larger than the LSD value, indicates those treatments are different from each other, statistically.

Table 2. Mean percent plot cover, percent plot cover green foliage and percent straw turf of mowed Distichlis clones. University of Arizona, 1999.

TRT	NAME	% PLOT COVER [1]	% PLOT GREEN [2]	% PLOT STRAW [3]	% PLOT GREEN [2]	% PLOT STRAW [3]
		JULY 99	AUG 99	AUG 99	SEPT 99	SEPT 99
1	A61	68	65	4	83	5
2	A55	92	85	5	94	3
3	C8	83	62	9	82	8
4	C92	92	57	15	70	8
5	A138	62	63	3	77	2
6	A65	75	70	4	92	1
7	C56	45	22	10	25	4
8	C11	95	62	18	88	5
9	A72	77	57	8	73	7
10	A119	50	48	5	70	3
11	A86	82	82	7	95	2
12	A77	78	55	5	77	5
13	A137	77	80	7	92	3
14	A41	72	63	5	75	5
15	C66	93	20	25	18	11
16	A48	65	53	4	82	3
17	A51	75	77	2	83	4
18	C12	88	67	20	83	6
19	C10	92	53	15	82	8
20	A40	85	78	3	92	4
21	A53	65	55	7	80	4
TEST MEAN [4]	- -	77	61	9	77	5
LSD VALUE [5]	- -	20	19	9	14	5

[1]Percent of plot surface covered with turf (0%-100%). Values are the mean of three replications.
[2]Percent of plot surface covered with green vegetation (0%-100%). Values are the mean of three replications.
[3]Percent of plot surface covered with straw/necrotic turf (0%-100%). Values are the mean of three replications.
[4]Test Mean = value of all twenty-one accessions.
[5]LSD Value = mean separation statistic. The absolute difference between two treatments, if larger than the LSD value, indicates those treatments are different from each other, statistically.

Table 3. Mean turfgrass, color, quality and density values of mowed Distichlis clones. University of Arizona, 1999.

TRT	NAME	COLOR[1]	QUALITY [2]	DENSITY[3]	COLOR[1]	QUALITY[2]	DENSITY[3]
		AUG 99	AUG 99	AUG 99	SEPT 99	SEPT 99	SEPT 99
1	A61	6	3	4	6	5	5
2	A55	6	6	7	6	7	7
3	C8	6	4	4	6	5	5
4	C92	5	3	4	5	4	4
5	A138	8	4	4	8	5	6
6	A65	6	4	6	6	7	8
7	C56	6	2	3	6	3	3
8	C11	5	4	5	6	5	5
9	A72	7	4	4	7	5	5
10	A119	7	3	3	8	4	6
11	A86	8	6	6	8	7	7
12	A77	8	4	4	6	4	4
13	A137	7	5	5	7	6	7
14	A41	7	4	4	6	5	6
15	C66	3	2	2	4	3	3
16	A48	7	4	4	7	6	6
17	A51	8	5	6	6	6	7
18	C12	5	3	4	6	4	5
19	C10	6	4	4	7	5	4
20	A40	8	5	6	7	6	6
21	A53	7	4	4	7	6	6
TEST MEAN [4]	- -	6	4	4	6	5	5
LSD VALUE [5]	- -	1.0	1.1	1.1	1.2	1.1	1.0

[1]Color equals 1 - 9; 1 = dead, 9 = dark green. Values are the mean of three replications.
[2]Quality equals 1-9; 1 = dead, 9 = best possible. Values are the mean of three replications.
[3]Density equals 1-9; 1 = dead, 9 = best possible. Values are the mean of three replications.
[4]Test Mean = value of all twenty-one accessions.
[5]LSD Value = mean separation statistic. The absolute difference between two treatments, if larger than the LSD value, indicates those treatments are different from each other, statistically.

Table 4. Mean unmowed canopy heights (cm) in May 1999 and mean number of shoots per ring, October 1999. University of Arizona, 1999.

TRT	NAME	MEAN[1]	MEAN[2]
		HEIGHT	SHOOTS
1	A61	9	46
2	A55	14	58
3	C8	5	59
4	C92	17	38
5	A138	8	107
6	A65	5	84
7	C56	4	33
8	C11	14	41
9	A72	11	54
10	A119	8	54
11	A86	10	88
12	A77	7	54
13	A137	9	81
14	A41	10	55
15	C66	21	30
16	A48	6	53
17	A51	10	76
18	C12	13	45
19	C10	10	26
20	A40	6	65
21	A53	7	64
TEST MEAN [3]	- -	10	58
LSD VALUE [4]	- -	3	32

[1]Values are the mean of three replications.
[2]Values are the mean of three replications.
[3]Test Mean = value of all twenty-one accessions.
[4]LSD Value = mean separation statistic. The absolute difference between two treatments, if larger than the LSD value, indicates those treatments are different from each other, statistically.

Table 5. Polynomial orthogonal contrast[1] significance of seven Colorado and twenty-one Arizona selections for turf variables under mowed conditions. University of Arizona, 1999.

RESPONSE	**MONTH**	**SIG[2]**	**MEAN[3]** -AZ-	**MEAN[4]** -CO-	**TEST[5]** MEAN
% plot cover[6]	May	N.S.	12	22	15
% of actual green turf[7]	May	XXX	95	93	94
% plot cover[6]	July	N.S.	73	84	76
% plot green turf[8]	Aug	XXX	67	48	60
% plot straw turf[9]	Aug	N.S.	5	16	7
Color[10]	Aug	N.S.	7	5	6
Density[11]	Aug	XXX	5	4	4
Quality[12]	Aug	X	4	3	4
% plot green turf[8]	Sept	XXX	83	64	77
% plot straw turf[9]	Sept	N.S.	4	7	5
Color[10]	Sept	N.S.	7	6	6
Density[11]	Sept	XXX	6	4	5
Quality[12]	Sept	XXX	6	4	5
Unmowed canopy (cm)[13]	May	N.S.	9	12	10
Shoot density (#plants)[14]	Oct	N.S.	67	39	58

[1]Contrast devised for treatment comparisons of (7) selections from Colorado vs. (14) selections derived from glass house tests in Arizona.
[2]Significance of single polynomial contrast. N.S. = nonsignificant; X = 0.05; XXX = 0.001.
[3]Mean of 14 Arizona selections.
[4]Mean of 7 Colorado selections.
[5]Mean of all 21 selections.
[6]Percent of entire plot surface covered with turf (0%-100%) of plot surface.
[7]Percent of actual turf surface which is green in color (0%-100%) of actual turf.
[8]Percent of entire plot surface covered with fully green turf (0%-100%) of plot surface.
[9]Percent of entire plot surface covered with straw/necrotic turf (0%-100%) of plot surface.
[10]Color 1-9; 1 = dead, 9 = best possible.
[11]Density 1-9; 1 = no turf, 9 = best possible.
[12]Quality 1-9; 1 = dead, 9 = best possible.
[13]Unmowed canopy height (cm), in which 90% of foliage reaches.
[14]Shoot density = number of shoots per 2.375" ring.