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Dr. Mohammad Pessarakli, University of Arizona, conducted greenhouse experiments to evaluate shoot growth responses (shoot length, clipping dry matter) and general quality of saltgrass clones collected from different southwestern states under prolonged drought and mowing stress.

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PURPOSE

The purpose of *USGA Turfgrass and Environmental Research Online* is to effectively communicate the results of research projects funded under USGA's Turfgrass and Environmental Research Program to all who can benefit from such knowledge. Since 1983, the USGA has funded more than 350 projects at a cost of $29 million. The private, non-profit research program provides funding opportunities to university faculty interested in working on environmental and turf management problems affecting golf courses. The outstanding playing conditions of today's golf courses are a direct result of ***using science to benefit golf***.

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Growth Response of Various Saltgrass (*Distichlis spicata*) Clones to Combined Effects of Drought and Mowing

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SUMMARY

USGA-sponsored research studies are ongoing at Karsten Turfgrass Research Facility, Department of Plant Sciences, College of Agriculture and Life Sciences, the University of Arizona. This specific experiment was conducted in a greenhouse to evaluate growth responses, in terms of shoot lengths, clippings dry matter (DM) yield, as well as general quality of various saltgrass clones collected from different southwestern states of the US under combined effects of prolonged drought and mowing stress. The results showed:

- At either mowing height, shoot length and clippings dry matter decreased linearly as drought period progressed, and there were significant differences among the shoot lengths and dry matter of different clones at either mowing height (2.5 and 5.0 cm) and at each harvest.
- For most clones, there was no difference among the shoot lengths or clipping dry matter between the two mowing heights.
- For all clones, grass general quality followed the same pattern as the clipping dry matter, and general qualitiy of various clones were significantly different than each other at either mowing height and at any weekly evaluation.
- Considering all the study parameters together, there was a wide range of drought and mowing tolerance found among the various clones.
- Clone 72 was superior and the most tolerant to combined effects of drought and mowing stress, while clone A60 was least tolerant.

Inland desert saltgrass (*Distichlis spicata*), indigenous to the Southwest, a potential turf species, grows in both salt-affected soils and soils under drought and harsh environmental conditions (1, 4). It is dominant and most common habitats are arid and semi-arid regions (3).

The plant is found abundantly in areas of the western parts of the United States, as well as on coastal areas of the United Arab Emirates and several other Mideastern countries, Africa, and South and Central American countries (5). The species can be manipulated to modify its performance and productivity. Although the species has multipurposes, USGA is interested in its potential use as turfgrass and is supporting the research leading to this feature and usage of this grass.

The objectives of this study were to find the most tolerant saltgrass clones to combined effects of drought and mowing for use under drought or low quality/effluent water irrigation conditions.

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Materials and Methods

Plant Materials

Various clones (A37, A49, A50, A60, 72, A86, A107, A126, A128, A138, 239, and 240) of inland saltgrass collected from several southwestern states of the USA.

Saltgrass clones were clipped at two heights (2.5 and 5.0 cm) as they subjected to prolonged dry-down to assess genetic differences in drought tolerance.

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Plant Establishment

Twelve inland saltgrass (*Distichlis spicata*) clones (A37, A49, A50, A60, 72, A86, A107, A126, A128, A138, 239, and 240), collected from several western states of the United States (2) were studied in a greenhouse to evaluate their growth responses in terms of shoot length, clipping dry weight, and general quality of the grass under drought stress condition at 2.5- and 5-cm mowing heights.

The grasses were grown as vegetative propagules in cups (9-cm diameter and cut to 7 cm height). Cups were placed in stainless steel cans (46-cm diameter, 56-cm height), filled with fritted clay as plant anchor medium. Two mowing heights (2.5 and 5 cm) and 3 replications of each mowing height were used in a split-plot design, where drought stress was tested as the whole plot factor and mowing height and grass selection combinations as sub-plot factors.

The grasses were grown under daily irrigation, weekly fertilization, and weekly clipping (clippings discarded) for 6 months to produce equal size and uniform plants before initiation of the drought stress period phase of the experiment.

Drought Stress

A dry-down fritted clay system which mimics progressive drought (9) was used in this investigation. This procedure has been used successfully in our preliminary drought stress screening (6, 7). The system imposes a gradually prolonged drought stress to clones planted in separate cups.

The drought stress started by completely saturating the cans and then depriving the grasses from water and fertilizer for a period of 4 months. During the stress period, shoots were clipped bi-weekly and evaluated for dry matter (DM) production. The harvested plant materials were oven dried at 60^{o} C and dry matter was recorded. Grass general quality (1-9, subjective quality scale) was evaluated weekly and recorded.

Two months after initiation of the drought period, the first sign of stress (leaf curling) became apparent. Grasses gradually showed more signs of wilting (finally, permanent wilting, and eventually death or dormancy). At the end of

Grass ID	**Shoot length (cm)**		**Shoot dry matter (g)**	
	5-cm ht.	**2.5-cm ht.**	**5-cm ht.**	**2.5-cm ht.**
A37	3.8ab*	2.6ab**	0.15bc	0.12bc
A49	3.1bc	2.5abc	0.20ab	0.23a
A50	2.0de	2.1bcd	0.18ab	0.24a
A60	2.0de	2.1bcd	0.05d	0.07c
72	2.6cd	2.8a	0.23a	0.26a
A86	2.7cd	1.8de	0.12c	0.15b
A107	2.3cde	2.0cd	0.10cd	0.12bc
A126	2.7cd	1.7de	0.12c	0.13b
A128	4.4a	2.9a	0.18ab	0.23a
A138	1.9de	1.9d	0.19ab	0.26a
239	1.7de	1.7de	0.23a	0.26a
240	1.4e	1.3e	0.20ab	0.23a

* The values are the means of 3 replications of each treatment at 7 bi-weekly harvests.

** The values followed by the same letters in each column are not statistically different at the 0.05 probability level.

Table 1. Saltgrass shoot length (cm) and dry weight (g) under drought stress condition at two mowing heights. Values represent means of 3 replications and 7 bi-weekly harvests.

Grass ID	Turf Quality (1-9)	
	5cm	2.5cm
A37	6.5bcd	6.5bcd
A49	5.9cd	7.6a
A50	5.8d	5.4ef
A60	5.9cd	4.8f
72	7.5a	7.9a
A86	6.5bcd	5.9de
A107	6.4bcd	6.5bcd
A126	5.8d	6.2cde
A128	5.9cd	6.2cde
A138	7.1ab	7.0abc
239	7.1ab	7.2ab
240	6.6bc	7.2ab

* The values are the means of 3 replications of each treatment at 14 weekly (7 bi-weekly) evaluations.
** The values followed by the same letters in each column are not statistically different at the 0.05 probability level.

Table 2. Saltgrass quality [average of 3 replications and 14 weekly (7 bi-weekly) evaluations] under drought stress at 2 mowing heights (2.5 and 5.0 cm).

the 4-month drought stress period, the majority of the plants were dead or dormant. Then, all the grasses were re-watered for recovery rate determination.

Statistical Analysis

Data were subjected to the analysis of variance technique (8). Treatment means were separated using Duncan Multiple Range test.

Results and Discussion

The results for the shoot length, clippings dry matter production, and the grass quality are presented in Tables 1 and 2.

Shoot Length

For most of the clones, shoot length was decreased more by drought stress at the 2.5- compared to the 5-cm mowing height (Table 1). There was a wide range of differences found in shoot lengths among the clones at either 2.5- or 5-cm mowing height. The shoot length of A128 was the highest at either mowing height. The shoot lengths of clones 239 and 240 which are turf-type grasses were the lowest at either 2.5- or 5-cm mowing height. There was not a significant difference detected between the shoot lengths of either one of these clones at the 2.5- compared with the 5-cm mowing heights (Table 1).

Shoot Dry Matter (DM)

The shoot dry matter generally followed the same pattern as shoot length, it decreased under drought stress at either 2.5- or 5-cm mowing height. However, in contrast to the shoot length, for most of the clones, shoot dry matter was higher at the 2.5- compared with the 5-cm mowing height (Table 1). At both 2.5- and 5-cm mowing heights, clones 72 and 239 produced numerically the highest dry matter yield. However, there was not a statistically significant difference between shoot dry matter of these two clones and A49, A50, A128, and 240 at either mowing height (Table 1). Among all the clones, clone A 60 produced the lowest dry matter at either 2.5- or 5-cm mowing height.

Grass Quality

Grass general quality followed the same pattern as shoot dry matter--it decreased with increasing drought stress at either 2.5- or 5-cm mowing height (Table 2). For most of the clones, grass general quality was affected more by drought stress at the 5- than at the 2.5-cm mowing height. There was a wide range of differences found in grass general quality among the clones at either 2.5- or 5-cm mowing height. Clone 72 had the best general quality scores at either mowing height.

At the 5-cm mowing height, statistically there was no difference between this clone and clones A138 and 239. At the 2.5-cm mowing height, clones A49, A138, 239, and 240 were statistically the same as clone 72. Under drought stress, clones A49, A50, A60, A126, and A128 scored the lowest at the 5-cm mowing height (Table 2). At the 2.5-cm mowing height, clone A60 scored the lowest under drought stress. The scores of Clone A50 and A86 were slightly higher than that of A60 at the 2.5 cm mowing height under drought stress (Table 2).

Conclusions

At either mowing height, saltgrass shoot length and shoot dry matter (clippings) decreased linearly as drought period progressed. However, there were significant differences among shoot lengths and dry matter of different clones at any mowing height and at each harvest. There was no difference among the shoot lengths or clipping dry matter of most clones between the two mowing heights. General quality of most clones followed the same pattern as the shoot dry matter--it decreased linearly as drought period progressed. However, general qualities of various clones were significantly different than each other at either mowing height and at any weekly evaluation.

Most of the clones at the 2.5-cm mowing height maintained green color for a longer period compared with those mowed at 5 cm. Considering all the study parameters together, there was a wide range of drought and mowing tolerances found among the various clones. Among all the studied clones, clone 72 was superior and the most tolerant to combined effects of drought and mowing stress, while clone A60 was the least tolerant.

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