

Forage Research in Texas, 1993

Influence of Salinity on Seedling Growth of Selected *Cenchrus*, *Panicum*, and *Pennisetum* Species

H. N. Moharram, M. A. Hussey, and E. C. Bashaw

Summary

A greenhouse technique was developed to evaluate selected *Cenchrus*, *Panicum*, and *Pennisetum* species for tolerance to salt stress. Salinity treatments consisted of a control -0.77, -2.52, and -5.04 bar (osmotic potential) treatments that were applied as sodium chloride in the irrigation water. Salinity tolerance was determined using morphological parameters including seedling dry weight. At the highest salinity level, three buffelgrass (*C. ciliaris* L.) entries (PI 409698, PI 409716, and 'Biloela') and *Pennisetum massaicum* L. had the greatest seedling dry weights. Buffelgrass PI's 409704 and 409362 and 'Common' buffelgrass represented the next best group of entries for seedling dry weight. Birdwoodgrass (*C. setigerus* L.), *Pennisetum orientale* L., and *Pennisetum flaccidum* L. were the least salt tolerant in this study.

Introduction

Buffelgrass is a tufted, perennial C_4 grass that establishes readily, tolerates grazing, survives prolonged periods of drought, and has high nutritive value (Bogdan 1977). It is grown on more than 60 million acres throughout arid, subtropical regions. One limitation of buffelgrass is that most cultivated varieties have very poor salt tolerance. More than 8 million acres in Texas are saline, and the Texas State Soil and Water Conservation Board recommends the use of salt tolerant, deep-rooted perennial grasses as a reclamation crop (Texas State Soil and Water Conservation Board 1985).

The objective of this study was to identify salt tolerance at the seedling stage of selected accessions of *Cenchrus*, *Panicum*, and *Pennisetum*. The seedling stage was chosen because it is reported to be the most sensitive to salt stress (Shannon 1990).

Procedures

Seeds were grown in cones containing fritted clay (washed with saline water to remove some of the excess calcium from clay surfaces). The top 2 in. of the cones contained a cube made of a highly porous material (Oasis Horticultubes®) into which 4 to 6 seeds

were placed before the cube was covered with fine sand. The cones were irrigated to excess daily with the appropriate salinity treatments.

A split-plot design, which consisted of salinity treatments as main plots and species as subplots, was used. Each replication consisted of three trays (containing 98 cones each) and received three salinity treatments. Five cones of each species were in each tray except for one species that was represented by three cones. Species within the trays and trays within replications were completely randomized.

The salinity treatments consisted of a control at -0.77 bars and others at -2.52 and -5.04 bars osmotic potential. These were achieved by adding 0.22 oz of a macro-nutrient fertilizer (Peters 20-20-20) per gal of water for the control solution, and to this basic nutrient solution, 0.36 oz and 0.88 oz sodium chloride (NaCl)/gal were added to obtain the -2.52 and -5.04 bar treatments, respectively. For this study, 20 accessions from 7 *Cenchrus*, *Panicum*, and *Pennisetum* species were used (Table 1).

Results and Discussion

During the first 2 weeks of the experiment, rainy, humid, and cloudy weather minimized heat and water stresses on the plants. Greenhouse temperature ranged from the low 90's °F (day) to low 70's °F (night) during this period. By day 16, salinity treatment caused seedlings to differ in size, and by day 18, the plants receiving the highest salinity level exhibited burned leaf tips. Some of the species (*P. flaccidum* and *P. orientale*) could not survive the progressive increase in salt stress used in this study.

Poor seed quality of *Panicum coloratum* ('Selection75' and 'Verde'), *P. virgatum* ('Alamo'), and *Cenchrus setigerus* (PI 226051) resulted in poor and sporadic germination of these entries. Poor germination and seedling establishment of these entries made it difficult to evaluate salt tolerance even though some accessions that germinated (i.e., Alamo) survived the highest salinity level. Dry-weight means for each species are presented in Table 2.

This study suggests that PI's 409698, 409716, and 'Biloela' buffelgrass, and that *Pennisetum massaicum* had the best salt tolerance (dry matter yield) at the young-seedling stage. The results of this

Keywords: forage grass/salt stress/seedling growth.

Table 1. List of species included in the salinity-screening study, June 1993.

<i>Cenchrus ciliaris</i>	Cultivars: PI:	Biloela and Common 409338, 409346, 409362, 409698, 409704, and 409716
<i>Cenchrus setigerus</i>	PI:	193444, 226051, 271527, 271528, 271529, and 315682
<i>Panicum coloratum</i>	Cultivars:	Selection 75 and Verde
<i>Panicum virgatum</i>	Cultivar:	Alamo
<i>Pennisetum flaccidum</i>	PI:	315868
<i>Pennisetum massaicum</i>		
<i>Pennisetum orientale</i>	PI.	269961

N.B. Species will be referred to by cultivar or PI when reporting dry weights.

Table 2. Dry weights of *Cenchrus*, *Panicum*, and *Pennisetum* species seedlings under salinity stress, June 1993.

Treatments:	-0.77 bars (Control - no salt)			-2.52 bars (0.36 oz NaCl/gal)			-5.04 bars (0.88 oz NaCl/gal)		
Rank	Entry [†]	DW [§]		Entry	DW		Entry	DW	
1	<i>P. massaicum</i>	9.63	a [†]	PI 409716	8.68	a	PI 409698	6.02	a
2	Biloela	8.99	a	Biloela	7.95	ab	Biloela	5.25	ab
3	PI 409716	8.65	ab	<i>P. massaicum</i>	6.97	bc	PI 409716	4.80	b
4	PI 315868	7.07	bc	PI 409698	6.06	c	<i>P. massaicum</i>	4.59	b
5	PI 271527	6.76	c	Common	5.71	c	PI 409704	3.29	c
6	Common	5.95	cd	PI 409362	3.68	d	PI 409362	2.73	c
7	PI 409698	5.53	cde	PI 271527	3.64	d	Common	2.24	cd
8	PI 409704	4.20	def	PI 409704	3.57	d	PI 409338	1.44	de
9	PI 409362	3.78	efg	PI 409338	2.77	de	Alamo	0.81	def
10	PI 269961	3.54	fgh	PI 409346	2.45	def	PI 409346	0.81	ef
11	PI 193444	3.15	fgh	PI 315868	1.93	defg	Selection75	0.63	ef
12	PI 409338	3.01	fgh	PI 269961	1.58	efg	Verde	0.60	ef
13	PI 409346	2.98	fgh	PI 226051	1.47	efg	PI 271529	0.60	ef
14	PI 271528	1.82	ghi	Verde	1.12	efg	PI 226051	0.56	ef
15	PI 271529	1.65	hi	PI 271528	0.95	efg	PI 271528	0.32	ef
16	Verde	1.51	hi	Alamo	0.63	gf	PI 315868	0.32	ef
17	PI 226051	0.88	i	PI 193444	0.56	g	PI 271527	0.32	ef
18	Alamo	0.84	i	Selection75	0.46	g	PI 193444	0.18	ef
19	PI 315682	0.63	i	PI 271529	0.42	g	PI 269961	0.04	f
20	Selection 75	0.32	i	PI 315682	0.39	g	PI 315682	0.00	f

[†] Dry weight means ranked by a Duncan's multiple range test, alpha = 0.05.

^{*} Species in experiment, by cultivar or PI.

[§] Dry weight, x10⁻² oz/cone (2.356 sq in.).

study should be verified under field conditions. Work will continue to improve our techniques for screening of forage grasses for salt tolerance and to improve the practical utility of this selection technique for breeding more salt tolerant plants.

Literature Cited

Bogdan, A.V. 1977. Tropical pasture and fodder plants. p. 66 - 74. Longman Inc., New York, NY.

Shannon, M.C. 1990. Genetic approaches for developing economic salt tolerant crops. p. 161 - 185. In Kenneth Tanji (ed.), Agricultural salinity assessment and management, 1990. American Society of Civil Engineers.

Texas State Soil and Water Conservation Board. 1985. Final report on assessment of salinity in Texas, August 31, 1985.