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SALINITY TOLERANCE OF THREE RANGE GRASSES AT GERMINATION AND EARLY GROWTH STAGES

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Abstract

Three range grasses viz., *Bothriochloa pertusa* (L.) A. Camus, *Dichanthium annulatum* Forssk and *Panicum antidotale* Retz were subjected to 5, 10 and 15 dSm^{-1} and control (0.21 dSm^{-1}) salinity levels in the laboratory. Germination percent, early seedling growth rate and moisture contents were determined. Salinity reduced germination in *Panicum antidotale* more than *Bothriochloa pertusa* and *Dichanthium annulatum* at all levels of applied salinity. The fresh weight of all the three grasses significantly declined specially in high concentration. The reduction in dry weight was obvious only at 15dSm^{-1} in all the tested grasses.

Introduction

Pakistan is the ninth populous country in the world with a population of more than 160 million. Unfortunately about 6.5 million hectare of land in Pakistan has got different degree of salinity and alkalinity hazard (Alam, 2002). The need for fodder and shelter for increasing population demands the use of unproductive salted land through the cultivation of salt tolerant plants as one of the possible approaches. Utilizing saline habitat for the production of fodder crops, besides providing vegetation cover, might also improve the health, milk and meat production of livestock. Studies made on the salinity tolerance of fodder plants have shown differential response to varying degrees of salinity (Jan *et al.*, 2000, Badger & Unger, 1998, White & Gartner, 1997; Tobe *et al*., 2002; Li, 2007). Song *et al*., (2006) worked on the effect of salinity and temperature on three salt resistant euhalophytes. Qu *et al*., (2007) investigated the effects of salinity on germination and radicle growth of forage plants. It has been observed that salinity affects the germination and early seedling growth of susceptible species (Munns & James, 2003; Hanselin & Eggen, 2005; Khan & Gul, 2006). Sabir & Ashraf (2007) screened *Panicum maliaceum* accession for salinity tolerance at seedling stage. Similarly, Zehra & Khan (2007) worked on the effect of NaCl salinity on germination of *Phragmites*. As no such information is available on these three range grasses therefore the present study was conducted to see the tolerance of these three range grasses at germination and early seedling growth stage. The findings would help in screening range grasses suitable for cultivation on salted land for improving the socio economic uplift of people depending upon the rangelands.

Materials and Methods

Germination and seedling growth studies were conducted under Laboratory conditions. Certified seeds of *Bothriochloa pertusa* (L.) A. Camus, *Dichanthium annulatum* Forssk and *Panicum antidotale* Retz were obtained from the Range Management Branch, Pakistan Forest Institute, Peshawar. Viability of the seeds was tested by tetrazolium test. The glassware was thoroughly washed and sterilized at 170°C for 4 hours prior to use. Ten viable seeds without covering of the above mentioned grasses were sown in 5, 10 and 15 dSm^{-1} NaCl solution along with distilled water control (0.21 dSm^{-1}) on twice folded Whatman No. 1 filter paper per seedbeds in Petri dishes. Each treatment was replicated 10

times. The Petri dishes were incubated at 25±1ºC. Germination percentage was recorded daily for upto 120 hours. Fresh weights of the 20 randomly selected seedlings from each treatment were determined and then dried at 65±1ºC for 72 hours to get dry weights. The moisture contents of the seedlings were determined on oven dry weight basis. The results were subjected to ANOVA (Steel & Torie, 1980).

Results and Discussion

Effect on % germination: The germination of all the three tested grasses significantly declined even at 5 dSm^{-1} level of treatment that further decreased at 10 dSm^{-1} and 15 dSm^{-1} (Table 1). *Panicum* was inhibited more than *Bothriochloa* and *Dichanthium* at all levels of applied salinity. Reduction in germination is in conformity with the reports of other workers (El-Nathlawy & El-Fawal, 1989; Hanselin & Eggen, 2005; Sabir & Ashraf, 2007; Khan & Gul, 2006), who also found reduced germination due to salinity. Priano & Platti (989) also observed that *Chloris gayana*, *Elytrigia elongata* and *Elytrigia scabrifolia* seeds had reduced germination under saline condition. Similar findings regarding reduced germination of other species under salinity stress have also been reported by Shadded & Zaidan (1989), Hussain *et al*., (1993); Ashraf *et al*., (1989) and Zehra & Khan (2007).

Effect on seedling growth: Salinity affects both the establishment and growth of seedlings by retarding plumule and radicle growth. In the present case, except *Dichanthium* at 5 dSm^{-1} salinity severely reduced the plumule and radicle growth of all the tested grasses in all the treatments especially at 15dSm^{-1} (Table 2). The findings are in conformity with other studies (Ali *et al*., 1992; Ilahi & Begum, 1981; Lyra *et al*., 1992; Zehra & Khan, 2007) who also observed decreased germination percentage and seedling growth with increasing salinity.

Effect on biomass and moisture contents: There has been considerable variation in the behavior of biomass and moisture contents under test condition among the grasses. However, it is seen that dry mass generally reduces while fresh biomass may increase or decrease under saline condition. The fresh weight of all the three grasses significantly declined especially at 10 dSm^{-1} (Table 3), while the reduction in dry weight was obvious only at 15 dSm^{-1} in all the tested grasses. The present findings are in conformity with those of Lyra *et al*., (1992) who observed poor germination percentage, fresh weight and dry mass in *Sesamum* under salinity. Naqvi & Mahmood (1994) also reported that fresh dry weight and moisture contents of *Sesbania sesban* seedlings decreased with increasing levels of NaCl salinity. Likewise, Shadded & Zaidan (1989) concluded that NaCl salinity reduced the germination and seedling growth of *Raphanus sativus* and *Trigonela foenum-graecum*. The moisture contents showed inconsistent increase or decrease under saline conditions in the present study. The moisture contents of *Bothriochloa* in all the test condition and that of *Panicum* decreased at 10 dSm^{-1} only. The reduction in moisture contents agrees with Shadded & Zaidan (1989) who reported reduced seedlings moisture contents under saline conditions. In most cases seedling exhibited higher moisture contents than control. This might be an adaptive mechanism to overcome salinity stress by becoming succulent by retaining more moisture. The present study suggests that the three tested grasses might germinate and survive under mild salinity levels on marginal salted soils. However, further study is needed in the field to see their germination and growth behavior in soil. The preliminary study just points at the possibility of further testing these grasses under more natural condition.

Table 1. Effect of various levels of NaCl (dSm^{-1}) salinization on the average germination % of three grasses under laboratory condition. Each value is a mean of 10 replicates, each with 10 seeds.

Species	Control	Salinity (dSm^{-1}) levels						
		5	% of control	10	% of control	15	% of control	Average
Bothriochloa pertusa	65	41	63.08	31	47.69	15	23.08	29.00
Dichanthium annulatum	60	48	80.00	31	51.67	13	21.67	30.66
Panicum antidotale	92	41	44.56	37	40.22	17	18.48	31.66

Table 2. Effect of various levels of NaCl (dSm^{-1}) salinization on the radicle and plumule length in three grasses under laboratory condition. Each value is a mean of 10 replicates, each with 10 seeds

Species	Control	Salinity (dSm^{-1}) levels					
		5	% of Control	10	% of Control	15	% of Control
		Radicle Growth (mm)					
Bothriochloa pertusa	35	31	88.57	26	74.29	19	54.29
Dichanthium annulatum	26	24	92.31	17	65.38	14	53.85
Panicum antidotale	35	19	54.29	11	31.43	5	14.29
		Plumule Growth (mm)					
Bothriochloa pertusa	33	26	78.79	19	57.58	10	30.30
Dichanthium annulatum	21	18	85.71	10	47.62	8	30.10
Panicum antidotale	36	25	69.44	9	25.00	8	22.22

Table 3. Effect of various levels of NaCl (dSm^{-1}) salinization on the fresh weight, dry weight (mg) and % moisture of seedlings of three grasses.

Salinity dSm^{-1}	Biomass (mg)					
	Fresh weight (mg)		Dry weight (mg)		% Moisture	
	Test	% of Control	Test	% of Control	Test	% of Control
Bothriochloa pertusa						
Control	45.50 a	100.00	19.98 a	100	127.73 a	100
5	39.90 b	87.69	19.00 a	95.10	110.00 b	86.12
10	28.90 c	62.96	18.99 a	95.05	52.18 c	40.85
15	19.90 d	43.74	10.00 b	50.05	99.00 b	77.51
Dichanthium annulatum						
Control	53.6 a	100	19.00 a	10	182.11 a	100
5	46.5 b	86.75	15.50 b	81.58	200.00 a	109.82
10	35.0 c	65.30	10.00 c	52.63	250 b	137.28
15	29.90 d	55.78	9.90 c	52.10	202.02 a	110.93
Panicum antidotale						
Control	47.2 a	100	11.00 a	100	229.89 a	100
5	37.70 b	79.87	10.00 a	90.91	277.00 b	120.49
10	21.00 c	44.49	10.00 a	90.91	110.00 c	47.85
15	20.0 c	42.37	5.00 b	45.45	300.00 d	130.50

Means followed by the same letter within a column for the species are not significantly different from each other.

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