EFFECT OF SALINITY ON FORAGE PRODUCTION OF RANGE GRASSES

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ABSTRACT: The prominent range grasses like Blue panic grass (*Panicum antidotale*), Blue stem grass (*Dicanthium annulatum*) and Buffel grass (*Cenchrus cilliaris*) were tested against 10, 20 and 30 dS/m ECe (Electrical conductivity) of salinity. The results showed that forage and seed production, plant height, fresh green leave weight, number of tillers per plant in all grasses decreased in response to increasing degrees of salinity. Blue panic grass gave the highest seed and forage yield.

INTRODUCTION

Range lands are valuable national resources of Pakistan which cover more than two third area of Pakistan. At present the productivity of rangeland is far less than its potential. In addition to other factors like drought, year round heavy grazing, light textured soil, unfavourable climatic conditions, salinity is also responsible for declining range productivity leading to their progressive degradation (Mirza, 2007). More than 90% of rangelands are found in arid and semi arid regions of Pakistan, where like other parts of the world, salinity is considered one of the most important limiting factor for crop production (Khan *et al.*, 2007; Soobora *et al.*, 2006; Tomar *et al.*, 2003). Raza (2005) warned about the dangerous trend of a 10% per year increase in the saline area through out the world.

Out of 20 m ha of total land available for agricultural production, 6.67 m ha is salt affected. Salinity is also a serious problem in Pakistan which adversely affects the production of all cereals like other crops to varied degrees of extent. (Akram *et al.*, 2008; Khan *et al.*, 2007; Rehman *et al.*, 2007; Saqib *et al.*, 2004; Ali, 2008; Arshadullah *et al.*, 2006; Ashraf *et al.*, 2006; Majeed *et al.*, 2008; Nisar *et al.*, 2008 a,b).

Keeping scarcity of forage in view, it was a need of the day to find out salt tolerant fodder and forage species to overcome the chronic shortage of forage in the country. Buffel grass, Blue Stem and Blue panic grasses were selected to test against salinity on merit basis and the present research project "Effect of salinity on the production of range grasses" was carried out.

MATERIALS AND METHODS

Three promising range grasses viz. Blue panic (*Panicum antidotale*), Blue stem (*Dicanthium annulatum*) and Buffel grass (*Cenchrus cilliaris*) were evaluated against four levels of salinity viz. control, with out any salinity (T1), 10 d Sm^{-1} ECe (T2), 20 dSm^{-1} ECe (T3) and 30 dSm^{-1} ECe (T4) respectively under drought conditions. The grasses were gown in 36 plots, each measuring 3 x 4 m^2. Each treatment was replicated 3 times. Each proposed salinity level was developed and maintained through out the experimental period (April to September 2003) by following techniques as described by Ryan *et al.* (2001). The research studies were carried out at Experimental Farm of Fodder Section at Ayyub Agriculture Research Institute, Faisalabad. Salinity levels and grasses were kept in main and sub plots respectively.

Morphological characters like plant height, weight of fresh green leaves, number of tillers per plant, seed and forage yield were recorded on plant and plot bases respectively against each level of salinity. Data was tabulated and statistically analysed by following the procedure as described by (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

Analysis of variance of all studied morphological characters of range grasses at different levels of salinity showed that grasses, salinity levels and grasses x salinity levels interaction exhibited highly significant differences for all plant attributes except fresh grass forage yield against salinity levels, grasses and their interaction and

leaves weight against (salinity levels x grasses) interaction, respectively (Table 1).

Table-1: MEAN SQUARES OF DIFFERENT MORPHOLOGICAL ATTRIBUTES OF RANGE GRASSES DURING 2003

Source of Variance	df (degree of freedom)	Plant Height (cm)	Tillers per plant (No.)	Leaf weight per plant (g)	Seed yield per plant (g)	Forage yield per plot (kg)
Replica--tion	2	** 430.11	** 28.02	** 927.86	** 1345.08	** 9.56
Factor (A) Salinity levels	3	** 1715.43	** 209.55	** 101.70	** 2804.69	N.S. 2.72
Error (a)	6	121.85	0.47	1.56	1.86	0.13
Factor (B) Grasses	2	** 5725.86	** 238.69	** 40.44	** 3523.00	N.S. 0.38
A x B	6	** 146.04	** 21.47	N.S 1.81	** 434.00	N.S. 1.05
Error	16	135.75	0.65	2.34	5.95	0.19

N.S - Non significant at 1% probability level.
** Highly significant at 1% probability level.

Plant height (84.33 cm), number of tillers per plant (18.44), leaf weight per plant (14.44 g), seed yield per plant (191.33 g) and green forage yield per plot 7.33 kg (6108.33 kg ha^{-1}) were the highest values obtained at T1 level of salinity which was free of salts. On the other hand, lowest values i.e. 52.11 cm, 7.11, 7.00 g, 150.55 g and 6.33 kg (5275.83 kg ha^{-1}) were recorded for the same growth parameters in order at maximum level of salinity (30 dSm^{-1} ECe) in T4 treatment (Table 2).

The mean differences of different levels of salinity revealed that all these differences were found statistically significant except the mean differences of T1 and T2 for plant height, and fresh green forage which were found non significant. The mean differences for T2 and T3 were also found non significant for plant height, leaf weight per plant. The mean differences of T3 and T4 of all morphological characters were significant except for plant height and leaf weight per plant (Table 2).

TABLE-2: EFFECT OF SALINITY ON DIFFERENT MORPHOLOGICAL CHARACTERISTICS OF RANGE GRASSES (Mean Values)

Character Treatment	Plant height (cm)	No. of tillers per plant	Leaf Weight per plant (g)	Seed yield/ plant (g)	Forage/ plot (kg)
T_1	84.33a	18.44a	14.44a	191.33a	07.33a
T_2	75.11ab	15.22b	09.00b	182.55b	07.33a
T_3	65.22b	12.11c	07.77 bc	170.55c	06.81b
T_4	52.11c	07.11d	07.00c	150.55d	06.33c

T1 = Controlled (without salinity) T2 = 5 dSm^{-1} Ece., T3 = 10 dSm^{-1} ECe. and T4 = 20 dSm^{-1} Ece.

Means not sharing the similar letters in a column differ significantly at 1% probability level.

Keeping the over all mean values of morphological attributes (Table 3) in view, Blue panic grass (*Panicum antidotale*) produced significantly the highest number of tillers per plant (17.75) and seed yield of plant (192.91 g), respectively whereas Blue stem grass (*Dicanthum annulatum*) gained the highest values for fresh green leaf weight per plant (11.66 g), Buffel grass (*Cenchrus cilliaris*) gave the maximum plant height (89.50 cm) and fresh forage yield 7.20 kg per plot (6002.50 kg ha^{-1}) whereas the lowest values of plant height (46.08 cm) and fresh leaves weight (8.33 g) were given by blue Panic grass. Blue stem grass (Dicanthuim annulatum) was found the second best range grass during the study.

Table-3: Overall performance of different range grasses as affected by different levels of salinity

	1.*Panicum antidotale (Blue panic grass)*	2.*Dicanthum annulatum (Blue stem grass)*	3.*Cenchrus cilliaris (Buffel grass)*
Character	**Mean values**	**Mean Value**	**Mean Value**
Plant height (cm)	46.08a	72.00b	89.50c
No. of Tillers / plant	17.75a	13.08b	08.83c
Fresh leaf weight / plant (g)	08.33a	11.66b	08.66a
Seed yield / plant (g)	192.91a	168.41b	159.91c
Forage yield / plot (kg)	06.98a	06.84a	07.20ub

Means not sharing the similar letters in a row differ significantly at 1% probability level.

Regarding interaction between range grasses x salinity levels (Table 4), *Cenchrus cilliaris* gave the maximum plant height (106.66 cm), whereas maximum number of tillers per plant (26.66), seed yield per plant (205.33 g) and forage yield (673.91 kg/ha) were contributed by *Panicum antidotale* and maximum leaf weight (16.667 g), was shown by *Dicanthuim annulatum* in salts free treatment (T1). But when the salinity level was increased, the values of these morphological characters also decreased. This trend was exhibited by all range grasses evaluated in the present studies. Lowest values of plant height (37.33 cm), leaf weight per plant (5.00 g) and forage yield per plot (5.88 kg) were given by blue stem grass whereas Buffel grass gave the lowest values of No. of tillers per plant (5.67) and seed yield per plant (120.33 g) respectively.

The results showed that rate of reduction with increasing salinity was more in seed production as compared to forage production. This might be due to different genetic makeup of range grasses and their behavior and interaction in stress environment. The plant height showed more reduction with increasing salinity level which was 18.930, 22.66 and 38.20 % reduction at T2, T3 and T4 level of salinity.

From the results obtained during research studies, it can safely be concluded that all morphological characters of all range grasses were adversely affected by increasing salinity level.

The results of the same nature were found by a number of research workers. Hendawy *et al.* (2004), Saqib *et al.* (2004) and Saboora *et al.* (2006) reported that germination, growth and seed production of wheat decreased due to salinity while Sharma *et al.* (2004), Mansour *et al.* (2005) and Neves et al (2005) reported that same fact was due to salinity for same morphological characters in corn. A significant reduction in plant height, number of tillers, fresh weight of leaves per plant, fresh weight per plant of grasses was also reported by Tomar *et al.* (2003), Arshadullah (2006), Ashraf *et al.* (2006), Dakheel *et al.* (2007), Khan *et al.* (2007), Ali (2008), Rehman *et al.* (2007), Akram *et al.* (2008), Majeed *et al.* (2008), and Nisar *et al.* (2008 a, b). The main reason in declining the vegetative and reproductive attributes of cereals and range grasses was adverse disturbance in physiological and metabolic processes occurring in plant body due to salt accumulation and ion concentration as reported by Ashraf *et al.* (2004), Afzal *et al.* (2005), Afzal *et al.* (2006), Basra *et al.* (2005 a, b) and Munns (2006).

Table 4-a: Grasses and Salinity levels interaction for Blue Panic grass (*Panicum antidotale*)

	Salinity levels			
Characters	T_1	T_2	T_2	T_4
Plant Height N.S. (cm)	56.00	48.33	42.66	37.33
Tiller per plant	26.66a	20.33b	15.00d	9.00gh
Leaf weight per plant (g) N.S.	13.00	8.66	6.66	5.00
Seed yield per plant (g)	205.33a	194.66b	189.33c	182.33d
Forage yield per plot (kg)	8.08a	7.90ab	6.06e	5.88e

Table 4-b: Grasses and Salinity levels interaction for Blue stem grass (*Dicanthium annulatum*)

	Salinity levels			
Characters	T_1	T_2	T_2	T_4
Plant Height N.S. (cm)	90.33	78.33	62.66	56.66
Tiller per plant	17.33c	15.33d	13.00e	6.667
Leaf weight per plant (g) N.S.	16.66	11.33	9.33	9.33
Seed yield per plant (g)	181.66d	172.00e	171.00e	149.00f
Forage yield per plot (kg)	7.07c	6.86cd	7.163bc	6.28de

Table 4-c: Grasses and Salinity levels interaction for Buffel grass (*Cenchrus cilliaris*)

	Salinity levels			
Characters	**T_1**	**T_2**	**T_2**	**T_4**
Plant Height N.S. (cm)	106.66	98.66	90.33	62.33
Tiller per plant	11.33f	10.00fg	8.33h	5.667
Leaf weight per plant (g) N.S.	13.66	7.00	7.33	6.66
Seed yield per plant (g)	187.00c	181.00d	151.33f	120.33g
Forage yield per plot (kg)	7.51abc	7.24bc	7.22bc	6.82cd

T1 = Controlled (without salinity) T2 = 5 dSm^{-1} Ece., T3 = 10 dSm^{-1} ECe. and T4 = 20 dSm^{-1} Ece

Means not sharing the similar letter differ significantly.
Means carrying no letter differ non-significantly.

CONCLUSION

The results showed that forage and seed production, plant height, number of tillers per plant weight of fresh green leaves in all grasses decreased in response to increasing degrees of salinity. Blue panic grass gave the highest seed and forage yield and number of tillers per plant.

From the results of this research work, it may be concluded that for achieving maximum forage and seed production in range grasses, the salinity level should be reduced to its maximum extent.

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