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SALT TOLERANCE STUDIES ON SOME GRASSES 1. *DICANTHIUM ANNULATUM*

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Effect of different salinity levels on plant growth and ionic composition of *Dicanthium annulatum* was studied in gravel culture experiment. Salinity decreased the plant growth of this species. Na^+ concentration was significantly increased in response to salinity whereas K^+ concentration was decreased at higher salinity level. Ca^{2+} contents were increased but non-significantly, whereas Cl contents alongwith N and protein percentages were significantly increased with increase in root zone salinity.

INTRODUCTION

Salinity is a global problem which is not only deteriorating our soil but also affecting the economy of our country. This menace has made a large area of our soil unavailable for cultivation. There are some methods to reclaim the salt-affected soil and to bring it into economic use. These are the leaching of salt, providing drainage, use of amendments like gypsum, sulphur, etc. But on account of certain limitations, these practices are not fully applicable. This has led to suggestions for the use of salt tolerant plants for effective utilization and improvement of salt affected soils (Sandhu and Malik, 1975).

D. annulatum is a perennial and densely tufted grass with erect or geniculate ascending culms. Culms are upto 90 cm tall, branched and slightly compressed. Nodes and internodes are also present. It is common throughout the area in lawns and cultivated fields and is used as forage.

MATERIALS AND METHODS

To study the effect of salinity on plant growth, stubbles of *Dicanthium annulatum* were obtained and transplanted in glazed pots. Pots contained gravel saturated with Hoagland culture medium (Hoagland and Arnon, 1950). Four stumps of similar size and shape were transplanted as there were four replicates. Stumps were allowed to grow upto 14 days and were then subjected to incremental salt stress. Salt concentration was increased by 2.5 dSm^{-1} on alternate days. Na_2SO_4, $CaCl_2$, $MgCl_2$, and NaCl were added to the nutrient solution in the ratio of 10:15:1:4 (Qureshi *et al.*, 1977) and the following salinity levels were developed:

1. Control (Hoagland nutrient solution EC = 3 dSm^{-1})
2. EC = 10 dSm^{-1}
3. EC = 20 dSm^{-1}

The electrical conductivities were maintained on alternate days and any loss of water was made up. The plants were harvested after two months. Fresh and dry weights of shoot and root were recorded. The samples were kept in the oven at 70°C to obtain the constant dry weight. Na, K and Ca analyses were carried out by digesting the shoot samples in HNO_3 and determination was carried out by flame photometry. Cl contents were estimated by titration with silver nitrate. N was determined by Micro Kjeldahl method and protein content was obtained by multiplying this value by 5.7. The results were subjected to statistical analysis and significance of differences between the means was determined by Duncan's Multiple Range test.

RESULTS

Data regarding growth of *Dicanthium annulatum* are given in Table 1. Salinity decreased the fresh and dry shoot weights of this species. Fresh and dry shoot weights were recorded maximum in control and were significantly lower at EC 10 dSm^{-1} as compared with control but, non-significantly at EC 20 dSm^{-1} when compared with EC 10 dSm^{-1} (Table 1). Similarly, root dry weight was gradually decreased with increase in root zone salinity. This decrease was significant at EC 10 dSm^{-1} but non-significant at EC 20 dSm^{-1}. Salt tolerance limit of *D. annulatum* i.e., EC causing 50% reduction in growth compared with control was 18.5 dSm^{-1} for fresh weight and 10.00 dSm^{-1} for dry weight (Fig 1).

Data regarding the ionic composition of *Dicanthium* are presented in Table 2. Salinity significantly raised the Na concentration in this species. Na was minimum in control and maximum in EC 20 dSm^{-1}. K concentration was significantly increased at EC 10 dSm^{-1} but decreased non-significantly at EC 20 dSm-1 (Table 2).

Ca concentration was non-significantly increased with increase in root zone salinity. However, it was maximum in EC 20 dSm^{-1}. Cl contents were significantly increased with increase in root zone salinity. These were observed minimum in control and maximum in EC 20 dSm^{-1}. Nitrogen and protein percentages were also significantly increased with increase in salinity levels (Table 2).

Table 1. Summary of the data concerning growth of *Dicanthium annulatum*

EC of the root medium dSm^{-1}	Shoot fresh weight (g) $plant^{-1}$	Shoot dry weight (g) $plant^{-1}$	Root dry weight (g) $plant^{-1}$
Control	26.55 a	9.89 a	3.39 a
10	14.82 b	4.94 b	1.78 b
20	13.50 b	4.57 b	1.56

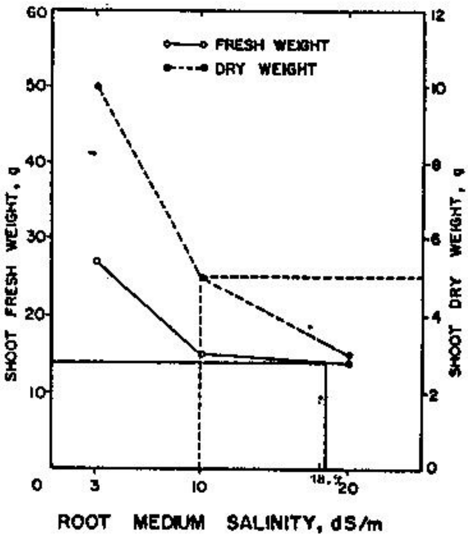

Fig. 1. Relationship between shoot fresh and dry weight of *Dicanthium annulatum* and root medium salinity

Table 2. Effect of salinity on ionic composition of *Dicanthium annulatum*. Values are the means of four replicates and where followed by the same letters are not significantly different at P = 0.05

EC of the root medium dSm^{-1}	Na	K	Ca	Cl	N	Protein
	(meq 100 g^{-1})				(%)	
Control	2.80 c	16.70 b	8.00 a	20.00 c	0.64 c	3.64 c
10	14.20 b	23.00 a	8.75 a	36.00 b	1.25 b	7.12 b
20	28.20 a	20.25 a	10.00 a	1.50 a	8.55 a	

DISCUSSION

The fresh and dry matter yield of *D. annulatum* was decreased with increasing root medium salinity (Table 1). This inhibition in growth in response to salinity is not uncommon. Reduction in biomass yield in saline media was reported for rice (Verma and Neue, 1984) and *Echinochloa crusgalli* (Aslam *et al.*, 1987). The reduction in growth in saline media may be due to osmotic effects or ionic toxicities due to high salt concentration leading to decreased water uptake and physiological disorder. Nearly 50% reduction in control yield was caused by 18.5 dSm^{-1} for fresh weight and 10.00 dSm^{-1} for dry weight. The higher salt tolerance on fresh weight basis than dry weight basis may be attributed to excessive moisture uptake by plants.

Na and Ca concentrations in plant shoot of *Dicanthium* were increased with increase in salinity, while K concentration was decreased at high salinity level (Table 2). Russell (1976) observed that Na percentage increased in legumes and grasses with increase in salinity. Wallace *et al.* (1982) found an increase in Na concentration in leaves and stems of *Atriplex polycarpa* and *Atriple canescens* with increase in salt concentration. This species absorbed an appreciable amount of K even at the highest salinity level. Ability for K absorption at high salinity could contribute to high tolerance of *D. annulatum* as reported by Aslam *et al.* (1987) for *Echinochloa crusgalli*. Sinha et al. (1986) observed an increase in Ca concentration in *Sorghum halepense* in response to salinity. On the other hand, Mahmood and Malik (1986) reported that Ca contents decreased in stem, shoot and root of *Atriplex undulata* in response to higher root medium salinity.

Cl contents were also increased with increase in salinity. Shannon *et al.* (1981) reported that increased soil salinity also increased the Cl contents in stem and leaves of Australian channel millet. Aslam *et al.* (1987) observed an increase in Cl concentration in *Echinochloa* with increase in root zone salinity.

Nitrogen and protein percentage was increased in response to salinity. Wallace *et al.* (1982) reported that Cl decreased the nitrogen concentration in leaves of *A. polycarpa*. Sinha *et al.* (1986) reported an increase in N concentration in *S. halepense* in response to salinity. This increase in concentration was due to reduced dry matter production, resulting in lesser dilution of accumulated nutrient.

The overall picture which has emerged from this work suggests that *Dicanthium annulatum* is a tolerant grass species. The possible factor for its high salt tolerance is that the Na and Cl ions could not be accumulated to toxic levels in the plant body. Another possible factor is the high moisture uptake of this species even at high salinity level.

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