http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 4 (3): 359-360, 2001

Effect of Salt Stress on Germination and Seedling Growth of Barley (*Hordeum vulgare* L.)

Shazia Naseer, A. Nisar and M. Ashraf
Department of Botany, University of Agriculture, Faisalabad, Pakistan

Abstract: A laboratory experiment was conducted to determine the effect of salt stress on germination and seedling growth of two barley varieties, Jow-83 and Jow-87, during winter 1996-97. The results showed that the germination percentage, root and shoot lengths and fresh and dry weights decreased in both barley varieties with increase in salt level. However, variety Jow-83 showed better response at all salinity levels.

Key words: *Hordeum vulgare* L., chloride salinity, germination, seedling growth

Introduction

Salinity is *a* world-wide problem, and it is particularly serious in arid and semi-arid regions of the world where most of the developing and underdeveloped countries happen to fall. The problem of salinity is very serious in Pakistan, where 6.3 million hectares of land is affected to various degrees by soil salinity (Khan, 1993). Two approaches have been followed to cope with soil salinity. The first is to modify the soil conditions to suit the crop plants. The second approach is to exploit the genetic potential of plants for their adaptability to adverse soil conditions. The former is a long term process and very little success has been achieved in our country even after spending Rs.21 billion upto 1988 (Aslam *et al.,* 1993). However the later is a short-term strategy and includes the crop cultivation on the salt affected fields. To employ this approach the screening of salt tolerant genotypes is necessary. Germination and seedling growth under saline environment are the screening criteria which are widely used to select the salt tolerant genotype (Ashraf *et al.,* 1990; Khan *et al.* 1993). As for better cropping highest plant population is required, which is only possible if seed germination is satisfactory under saline conditions. The present investigation was, therefore, undertaken to determine the salt tolerance potential of two barley varieties at germination and early seedling growth stages.

Materials and Methods

A Lab. experiment was conducted in Perti-dishes (diatom dep 2 cm) at Botany Department, University of Agriculture, Faisalabad, to study the germination and seedling growth of two barley varieties (Jow-83 and Jow-87) under four levels of NaCl salt with three replications completely randomized in a factorial fashion. Twenty five seeds of each barley variety were placed on moistened filter paper in each Petri dish. 10 ml of water (control) or solution of the specific salinity level (8, 12 and 16 dS m^{-1}) were added to the Petri dishes. The requisite amount of water and saline solution was applied regularly and carefully so as to prevent saturation of filter papers. Seed germination was recorded daily upto seven days to calculate their germination percentage. Seeds were considered germinated when the radicle emerged from the coleorhiza and was at least 2 mm long. At the end of experiment, germination percentage, shoot *and* root length, fresh and dry weights of germinated seedlings were measured, Data were analyzed statistically using analysis of variance technique and means were compared according to DMR test (Steel and Torrie, 1980).

Results

Analysis of variance of data presented in Table 1 showed that salt stress had adverse effect on germination and seedling growth of barley. Germination percentage decreased with increased in salt concentration in both barley varieties (Fig. 1 a).

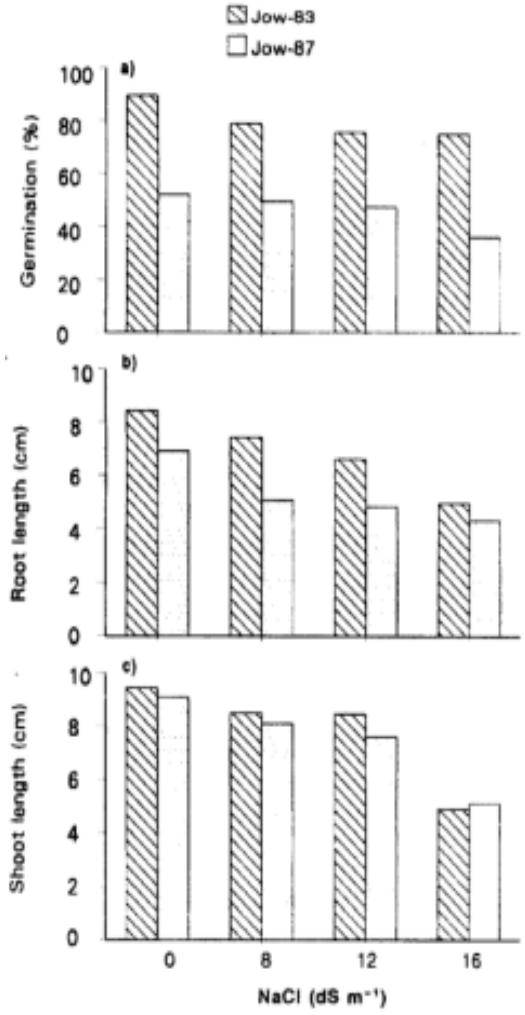

Fig. 1: (a) Germination percentage (b) Root length Shoot length of two barley varieties grown under salt stress

The maximum percentage was recorded under non-saline control and minimum at highest salinity level. However, the differences among treatment means were statistically nonsignificant. The varieties differed significantly. Maximum germination percentage was recorded in Jow-83 at all salinity

Table 1: Analysis of variance summaries (mean squares) of data for germination and seedling growth of barley under salt stress

S.O.V.	D.F.	Germination %age	Root length	Shoot length	Fresh weight of root	Fresh weight of root	Dry weight of root	Dry weight of shoot
Varieties	1	6666.67**	14.98**	0.74NS	0.003**	0.001NS	0.000*	0.000*
Treatments	3	704.67NS	5.57**	20.38**	0.002**	0.004**	0.000**	0.000**
V×T	3	156.00NS	4.84**	0.29	0.000**	0.001NS	0.000NS	0.000NS
Error	16	1488.00	0.38	0.27	0.000	0.001	0.000	0.000
Total	23							

* = Significant: ** = Highly significant: NS = Non significant at 5% and 1% level of probability

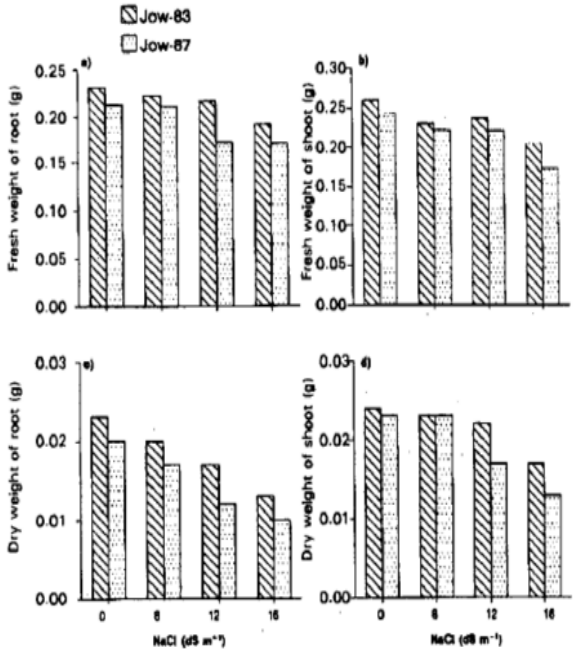

Fig. 2: (a) Fresh weigh of root (b) Fresh weight of shoot (c) Dry weight of root (d) Dry weight of shoot of two barley varieties grown under salt stress

levels compared with Jow-87. Highly significant decrease occurred in shoot and root length as the salinity levels increased (Table 1). Highest root and shoot lengths were observed in control (non-salinized) treatment as compared to salinized treatments (Fig. 1b, c). However, Jow-83 had significantly greater root length than Jow-87 under salt stress. Regarding the shoot length there was no significant difference among varieties (Table 1). The response of both the varieties to external salt regimes was almost same.

Fresh weights of root and shoot of both varieties decreased significantly under salt stress (Fig. 2a, b). Varieties differed significantly in case of root fresh weight but in case of shoot fresh weight non-significant difference was observed between varieties. However, maximum fresh weights were recorded in variety Jow-83. Dry weights of root and shoot showed similar pattern of reduction under NaCl levels (Fig. 2c, d), but in this case varieties also showed significant difference in shoot dry weight as in root dry weight (Table 1).

Discussion

Results of the present study indicate that percent germination decreased in response to salinity in both barley varieties. These results are in close conformity with the earlier findings of Alka *et al.* (1981) and Iqbal *et al.* (1998) in which they reported that increasing salinity decreased percent germina on in wheat, barley and triticale. Allen *et al.* (1986) proposed that the reduction in germination percentage under same conditions might be due to the ion toxicity and reduced uptake of water, which affected the physiological and biochemical activities through inhibition of the anabolic or stimulation of catabolic processes (Corchete and Guerra, 1986).

As in the germination percentage, there was also a considerable decrease in root and shoot length of both barley varieties with increasing salinity levels of the growth medium. The reduction in shoot length is due to excessive accumulation of salts in the cell wall which modify the metabolic activities and limit the cell wall elasticity. Further, secondary cell appears sooner and cell wall becomes rigid, as a consequence the turgor pressure efficiency in cell enlargement decreases. These processes may cause the shoot to remain small (Aslam *et al.,* 1993). These findings are parallel to those of Larik and Al-Saheal (1986) and Iqbal *et al.* (1998) who also found that increasing salinity in the growth medium reduced the root and shoot length in wheat, barley and triticale. Our results showed that under salt stress, fresh and dry weights decreased. This reduction in weights with increasing salinity may be due to limited supply of metabolites to young growing tissues, because metabolic production is significantly perturbed at high salt stress, either due to the low water uptake or toxic effect of NaCl (Waisel, 1972).

References

Alka, P.K., A. Kumar, S.N. Masih and A.P. Shamshery, 1981. Tolerance of some barely varities to salt stress at seedling stage. Indian J. Plant Physiol., 24: 304-311.

Allen, S.G., A.K. Dobrenz and P.G. Bartels, 1986. Physiological response of salt-tolerant and nontolerant alfalfa to salinity during germination. Crop Sci., 26: 1004-1008.

Ashraf, M.Y., M.A. Khan and S.A. Ahsan, 1990. Effect of salinity (NaCl) and polyethylene glycol (PEG) on germination, seedling growth and water uptake of sorghum. Pak. J. Agric. Eng. Vet. Sci., 6: 33-36.

Aslam, M., R.H. Qureshi and N. Ahmed, 1993. A rapid screening technique for salt tolerance in rice (*Oryza sativa* L.). Plant Soil, 150: 99-107.

Corchete, P. and H. Guerra, 1986. Effect of NaCl and polyethylene glycol on solute content and glycosidase activities during germination of lentil seeds. Plant Cell Environ., 9: 589-593.

Iqbal, N., H.Y. Ashraf, F. Javed, Z. Iqbal and G.H. Shah, 1998. Effect of salinity on germination and seedling growth of wheat (*Triticum aestivum* L.). Pak. J. Biol. Sci., 1: 226-227.

Khan, G.S., 1993. Characterization and genesis of saline sodic soils in Indus plains of Pakistan. Ph.D. Thesis, Department of Soil Science University of Agriculture, Faisalabad, Pakistan.

Khan, M.A., M.Y. Ashraf and S.S.M. Naqvi, 1993. Influence of Salinity on Protein, RNA and Alpha Amino Nitrogen of Wheat Seedling. In: Current Development in Salinity and drought Tolerance of Plants, Naqvi, S.S.M., M.R. Ansari, T.J. Flower and A.R. Azmi (Eds.). AEARC., Tando Jam, Pakistan, pp: 89-93.

Larik, A.S. and Y.A. Al-Saheal, 1986. Effect of salt stress on germination and seedling growth of wheat, triticale and barley. J. Coll. Sci., 17: 37-44.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics: A Biological Approach. 2nd Edn., McGraw Hill Book Co. Inc., New York, USA.

Waisel, Y., 1972. Biology of Halophytes. Academic Press, New York, Pages: 395.