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 3 (2): 350-351, 2000

Germination and Seedling Growth of Rice (*Oryza sativa* L.) Under Saline Conditions

Iftikhar Ahmad, Naeem Iqbal, Muhammad Iqbal, Zahoor Aslam[1] and Ejaz Rasul
Department of Botany, University of Agriculture, Faisalabad
[1]Nuclear Institute for Agriculture and Biology, Jhang Road, Faisalabad, Pakistan

Abstract: The studies were undertaken to investigate the response of rice cultivars under saline conditions. Salinity upto 10 dSm^{-1} did not affect germination percentage in all varieties but the same level of salinity significantly affected plant height, fresh as well as dry weight of root and shoot and total number of tillers per plant. Germination percentage was not affected in NR1 and NR6 even at 20 dSm^{-1} salinity level but BAS 370 was severely affected (70.00 percent) at this level of salinity. Regarding parameters studied, NR6 and IR6 showed adaptability under saline conditions.

Key word: Rice, Salinity, Germination, Seedling growth

Introduction

Salinity is a worldwide problem of being serious in arid and semiarid regions where most of the developing and under developed countries happen to fall. It is one of the important factors in reducing crop yields in most of the countries of the world (Khan *et al.*, 1999). The reduction in yield of rice from salinity accounts for 40 to 70 percent in Pakistan (Aslam *et al.*, 1995). With the increase in population, effective utilization of these soils has become necessary, either by reclamation or by growing some salt tolerant crops.

Rice is usually considered as moderately senstive to salinity (Maas and Hoffman, 1977) and is the second major crop being grown as a staple food in the world particularly in south east Asian countries. There is a variable degree of susceptibility to salinity at germination stage and water requirements of this crop is quite high. Thus this crop is a usual choice during soil reclamation process which helps in quick leaching of salts from the root zone. Thus selection of salt tolerant cultivars is a pre-requisite in this regard (Cheema *et al.*, 1999).

Keeping in view the above factors the present studies were planed to determine whether there is any correlation between sensitivities to salinity at germination and at seedling growth stage in rice cultivars. This will help the plant breeders to evolve salt tolerant rice cultivars. Another aim was to evaluate varietal tendency to endure salt stress.

Materials and Methods

Five varieties of rice i.e., NR1, NR6, IR6, BAS 370 and RST 24 were tested for their salt tolerance at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad. Germination percentage of above mentioned varieties was studied in petriplates at different salinity levels (2, 4, 5, 7, 10, 15 and 20 dSm^{-1}) with three replications for each. Salinity levels were developed by the addition of Na_2SO_4 $CaCl_2$, $MgCl_2$ and NaCl in the ratio of 10:5:4:1 to the Hoagland nutrient solution. Twenty seeds of each variety were placed in these pertriplates and these petriplates were kept in controlled room temperature at 20°C day/night temperature. Number of germinated seeds was counted every day until germination was completed in all varieties.

For seedling growth studies, nursery of all the five varieties was raised in plastic bags filled with soil. When the seedlings were just before two leaf stage, they were transplanted to gravel filled pots saturated with Hoaglands nutrient solution. Two days after transplantation the plants were subjected to two levels of salinity (control and 10 dSm^{-1}). Three plants from each replication were randomly selected and data for plant height, fresh and dry weight of root and shoot and number of tillers per plant were collected.

Statistical analysis of the data was carried out by using completely randomized design (C.R.D) in factorial layout (Steel and Torrie, 1980). The comparison among the treatments and the varieties was made by applying Duncan's Multiple Range Test (Duncan, 1955).

Results and Discussion

The data regarding the germination percentage (Table 1) shows that salinity up to 10 dSm^{-1} did not affect germination percentage in all the varieties. NR1 and NR6 were not affected even at 20 dSm^{-1} and showed 100 percent germination at all salinity levels. Under salinity level of 15 and 20 dSm^{-1}, BAS 370 was severely affected. Salinity caused 10, 10 and 18 percent reduction in germination in IR6, RST 24 and BAS 370 respectively. Salinity may affect germination of seeds in two ways (a) by decreasing the ease with which seeds may take up water and (b) by facilitating the entry of ions in a sufficient amount to inhibitory levels (Ayers *et al.*, 1952). Moreover, deleterious effects of certain ions on the embryos may also affect germiantion. Decrease in germination percentaage due to salinty was also reported by Ahmed and Gupta (1991).

Plant height of all the varieties reduced as the level of salinity increased from control to 10 dSm^{-1} (Table 1). Among the varieties, IR6 showed least reduction in plant height (5.8 percent) followed by NR6 (11.4 percent), RST24 (16.8 percent), NRI (20.5 percent) and BAS 370 (29.2 percent) respectively. The decrease in plant height with increasing salinity might be due to reduction in physiological availability of water with increase in solute suction or accumulation of toxic ions (Na^+, Cl^- etc.) within the plants. Consumption of energy in biosynthetic process required for maintenance of salinity tolerance may also be the antoher factor. Moreover, under salinity stress, turgor pressure efficiency in cell enlargement is decreased. This process may cause plants to remain small. Ahmed *et al.* (1990), Ahmed and Gupta (1991) and Ashraf *et al*. (1999) have also reported decrease in plant height in response to salinity. Salinity stress significantly affected fresh as well as dry weights of root and shoot as the level increased from control to 10 dSm^{-1}. Among the varieties IR6 showed least reduction in shoot fresh as well as dry weight. As regards the fresh and dry weight of root NR6 performed better than 1136. Variety BAS 370 was severely affected by salinity. Reduction in weight with increasing salinity stress may be due to direct contact of roots with toxic salt ions which not only decrease the water availability to plant roots but may also disturb normal metabolism (Greenway and Munns, 1980; Terry and Waldron, 1984).

Total number of tillers per plant were also decreased by salinity. Reduction in number of tillers was more pronounced in BAS 370 which showed 54.8 percent reduction in number of tillers under

Table 1: The statistical manipulation of the data showing the effect of salinity on germination percentage of rice

Treatments	Varieties					Mean
	NR6	IR6	BAS-370	RST24	NRI	
Control	100a	100a	100a	100a	100a	1008
5.0 dSm^{-1}	100a	100a	100a	100a	100a	100a
7.0 dSm^{-1}	100a	1000	100a	100a	100a	100a
10.0 dSm^{-1}	100a	100a	100a	100a	100a	100a
15.0 dSm^{-1}	100a	93a	66b	93a	100a	90.4b
20.0 dSm^{-1}	100a	46.6c	30d	46.6c	1008	64.64c
Mean	100a	90b	82b	90b	100a	

Means sharing the same letter are statistically non-significant

salinity level of 10 dSm^{-1} as compared with control. Variety IR6 showed much better results and produced 48 percent more tillers than BAS 370. The decrease in number of tillers is in agreement with Ashraf *et al*., 1999. The decreased tillring capacity might be due to the inhibitory effects of salts on plant growth. Form salt tolerance point of view greater number of tillers are most important in crop production, particularly in grass species because glaring cause dilution to salts. Thus the tillering capacity could be used as a criteria for salt tolerance in rice (Aslam, 1987).

The above results reveal that salinity stress reduced germination percentage as well as seedling growth. Variety IR6 performed much better while, BAS 370 was severely affected by salinity.

References

Ahmed, I.U., A.S.M. Mohiuddin, B. Faiz, A.K.M.K. Hossain and K.R. Islam, 1990. Effect of saline water on seedling emergence of some rice cultivars of Bangladesh. J. Indian Soc. Soil Sci., 38: 183-185.

Ahmed, J. and S. Gupta, 1991. Germination and growth of some salt-resistant selections in high salt concentration solutions. Int. Rice Res. Newslett., 16: 15-15.

Ashraf, M., A. Khalid and K. Ali, 1999. Effect of seedling age and density on growth and yield of rice in saline soil. Pak. J. Biol. Sci., 2: 860-862.

Aslam, M., 1987. Mechanism of salt tolerance in rice. Ph.D. Thesis, University of Agriculture, Faisalabad, Pakistan.

Aslam, M., I. Ahmad, I.A. Mahmood, J. Akhtar and S. Nawaz, 1995. Physiological basis of differential tolerance in rice to salinity. Pak. J. Soil Sci., 10: 38-41.

Ayers, A.D., J.W. Brown and C.H. Wadleigh, 1952. Salt tolerance of barley and wheat in soil plots receiving several salinization regimes. Agron. J., 44: 307-310.

Cheema, A.A., M.A. Awan and Y. Ali, 1999. Niab-irri-9: A new salt tolerant and high yielding rice variety. Pak. J. Biol. Sci., 2: 869-870.

Duncan, D.B., 1955. Multiple range and multiple F tests. Biometrics, 11: 1-42.

Greenway, H. and R. Munns, 1980. Mechanisms of salt tolerance in nonhalophytes. Annu. Rev. Plant Physiol., 31: 149-190.

Khan, M.J., H. Rashid, A. Rashid and R. Ali, 1999. Intravarietal variability in wheat grown under saline conditions. Pak. J. Biol. Sci., 2: 693-696.

Maas, E.V. and G.J. Hoffman, 1977. Crop salt tolerance current assessment. J. Irrig. Drain, 103: 115-134.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics: A Biometrical Approach. 2nd Edn., McGraw Hill Book Co., New York, USA., ISBN-13: 9780070609266, Pages: 633.

Terry, N. and L.J. Waldron, 1984. Salinity, photosynthesis and leaf growth. California Agric., 38: 38-39.