EFFECT OF SALINITY ON SEEDLING PARAMETERS OF INDIAN WHEAT VARIETIES

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Abstract: Salinity is one of the most important abiotic stress conditions. Wheat (*Triticum aestivum* L.) is major cereal crop of world; it's grown in worldwide under different agro climatic, environmental condition and geographical condition as well as in tremendous heterogeneity of saline soil. Response of salt stress under four salinity concentrations levels 0 (only distilled water: control), 1.227, 2.629 and 5.550 g l^{-1}) on five varieties of wheat *viz.*, U 2594, K-816, Sujata, HD-2733 and PBW 373 were conducted The data showed that reduced significantly with subsequent treatment affected the growth attributes such as germination percentage (%), plumule and redical length, fresh and dry weight of root and shoot for all varieties. Number of germinated seeds was finally recorded after seven days. Results showed significant decreases in germination percentage of Indian wheat varieties due to increasing salinity. Among the wheat varieties Sujata showed that tolerable against salinity while UP 2594 most susceptible variety.). Any impairment in seed germination or seedling development due to salt stress can cause significant depressions in yield formation. It appears that the bread wheat genotypes Sujata can perform well on saline soils, at least during the early growth stages. The existence of such impressive genotypic variation in tolerance to NaCl could be very useful for the development of high-yielding salt-tolerant genotypes and better understanding of the physiological and molecular mechanisms contributing to salt-stress tolerance in wheat. This study showed the existence of an impressive variation in tolerance to increasing NaCl treatments during the early growth stage.

Keywords: Abiotic stress, salinity, seed germination and variety

INTRODUCTION

Salinity is the scourge of intensive agriculture (Mer *et al.*, 2000). Salinity causes undesirable effects on plant growth, development, physiological and biochemical activities (Kayani *et al.*, 1987 and Rehman *et al.*, 2000), which causes due to the low osmotic potential of soil solution (Osmotic stress); specific ion effects (Salt stress); nutritional imbalance or a combination of these factors (Ashaf, 2004). Winter crop is more extensively grown than spring in saline condition due to good ion transport properties and cellular compartmentation (Munns, 1988). Sodium exclusion was a general characteristic of salt tolerance in wheat lines, salt tolerant display much higher shoots sodium level than sensitive lines. Shoot growth was reduced by salinity due to inhibitory effect of salt cell division and enlargement in growing period (Mecue *et al.*, 1990).

Early flowering reduced by dry matter, increased root: shoot ratio and leaf ratio and leaf size caused by salinity may be considered as possible ways of decreasing yield in wheat under salt stress condition (Mass *et al.*, 1989 and Rawson *et al.*, 1986). Physiological salt tolerance mechanism revealed that plants may reduce detrimental effects of salts by control of salt uptake (Wye *et al.*, 1980) reduced damages under excessive ion uptake and osmotic adjustment (Jeschke *et al.*, 1984).

Salt stress effect on wheat seedling respiration is not demonstrated while other environment stresses including drought and submergence have been shown to affect electron partitioning and alternative pathways in leaves. Net photosynthesis was decreased due to reduction rate per leaf area. Salt tolerance wheat cultivars were showed to produce more ATP than a salt sensitive one (Miqual *et al.*, 2005). Rapid and uniform seed germination under saline condition not only increase early seedling establishment but also has the advantage of higher drought tolerance (Bradford *et al.*, 1995).

Wheat is major cereal crop of world; it's grown in worldwide under different agro climatic, environmental condition and geographical condition as well as in tremendous heterogeneity of saline soil. Screening in filed for salinity tolerance in wheat crop is inefficient and impossible to carry in controlled condition. (Meneguzoo *et al.*, 2000; Sabir and Ashaf, 2007; E1-Hendway, 2009) concluded that all plant growth stages are to salinity especially seedling. Morpho-physiological traits have been used previously to evaluate the genetic diversity for salt tolerance in crop species.

In this experiment was conducted at Department of Agri. Biotechnology at Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. The wheat varieties used in the studies were UP 2594, K-816, Sujata, HD-2733 and PBW-373. The characteristics of the five varieties wheat varieties are shown in Table 1. All varieties are improved and are under production by farmers.

Table 1. Characteristics of Five varieties of wheat

Wheat Variety	Height (cm)	No. of Tiller	Length of spikelet	Spikelet/ spike	Ripening Period (days)	No. of grain per spike	Harvest Index (%)	1000 gm weight
UP 2594	90-95	9-11	9-11	49-52	130-135	50-55	31.77	34-37
PBW 373	90-95	8-10	10-12	40-43	130-135	53-57	32.42	36-39
Sujata (HI-617)	120-130	10-11	12-14	35-37	135-140	40-43	39.44	42-45
K-816	78-80	10-12	9-11	45-47	135-140	52-54	32.88	38-41
HD-2733	84-87	13-15	11-13	45-47	130-135	56-62	37.30	40-43

Germination Experiment

The experiments were carried out to assess total germination percentage and seedling growth (radicle and plumule) in response to salt levels. Uniform 20 seeds of each variety were placed on filter paper lined glass petri dishes. NaCl treatments of 0, 1.227 g l^{-1}, 2.629 g l^{-1} and 5.550 g l^{-1} were dissolved in distilled water corresponding to 0 (control), 2, 4 and 8 dSm^{-1}. 10 ml of appropriate solution was applied to each petri dish. The germination was conducted in a laboratory; the room temperature was 25 ±1 °C with 12 h daylight. The petri dishes were arranged in a completely randomized block design with four replications.

The number of germinated seeds was counted after 5 days. A seed was considered to have germinated when both plumule and radicle had emerged ≥0.5 cm. Seedling shoot dry weight and root dry weight, in form of combind (root and shoot) and fresh weight were taken after 12 days. Total germination was expressed as a percentage of that in the control treatment for each variety.

Wheat Plumule length

Mean length of plumule of wheat seedling were significantly influenced by different salt levels, varietal differences and the interaction of both. The data show that wheat plumule lengths of all varieties were reduced by increasing salt levels. In general variety Sujata had the highest mean seedling plumule length while PBW-373 had the lowest. Maximum plumule length have secured in 6.47cm at 0 dSm^{-1}, 5.74 cm at 2 dSm^{-1}, 5.31 cm at 4 dSm^{-1}, 2.18 cm at 8 dSm^{-1} for Sujata although minimum plumule length founded in UP-2594 4.93cm at 0 dSm^{-1}, 4.02 cm at 2 dSm^{-1}, 3.64 cm in K-816 at 4 dSm^{-1} and 2.03 cm for HD-2733 at 8 dSm^{-1}.

Wheat radical length

The highest mean radical length was recorded for variety Sujata and the lowest for the PBW-373. The radical length of Sujata 8.70 cm, 10.39 cm, 7.77 and 6.29 at 0 dSm^{-1}, 2 dSm^{-1}, 4 dSm^{-1} and 8 dSm^{-1} respectively. Minimum mean radical length were 8.42 cm for K-816, 7.52 for HD-2733, 5.95 cm for PBW-373 and 4.57cm for PBW-373 at 0 dSm^{-1}, 2 dSm^{-1} 4 dSm^{-1} and 8 dSm^{-1} respectively.

Germination

The highest mean germination percentages (100-95 %) were recorded for variety Sujata and the lowest variety for (100-78%) for PBW-373. Seeds for the latter practically failed to germinate at 8 dSm^{-1} salt concentration. The germination of UP-2594 and K-816 were similar in their germination at 4 dSm^{-1} concentration. The germination of Sujata between 0 dSm^{-1} and 4 dSm^{-1} was not different.

Dry weight

Dry weight of wheat radical and plumule in salinity condition was recorded in broad variation range under the salinity condition. The dry weight of 0.62 gm, 0.50, 0.52 and 0.50 of Sujata at 2 dSm^{-1} , 0 dSm^{-1}, 4dSm^{-1} and 8 dSm^{-1} respectively. Least minimum range have got in 0.24 gm ,0.30 gm , 0.26 gm , 0.28 gm in HD-2733 at 0 dSm^{-1}, 2 dSm^{-1} 4 dSm^{-1} and 8 dSm^{-1} respectively.

Fresh weight

The total fresh weight of wheat seedlings were varied from high to low in different varieties at different ranges of salinity. The fresh weight of Sujata wheat seedlings 1.95 gm, 1.90gm 0.99 gm , 0.90 gm at 0 dSm^{-1}, 2 dSm^{-1} 4 dSm^{-1} and 8 dSm^{-1} respectively while K-816 have showed 1.46 gm, 1.29 gm, 1.27 gm and 0.73 gm at 0 dSm^{-1}, 2 dSm^{-1} 4 dSm^{-1} and 8 dSm^{-1} respectively. UP-2594 wheat variety showed 1.25 gm at 0 dSm^{-1}, 2 dSm^{-1} 4 dSm^{-1} and 8 dSm^{-1} respectively.

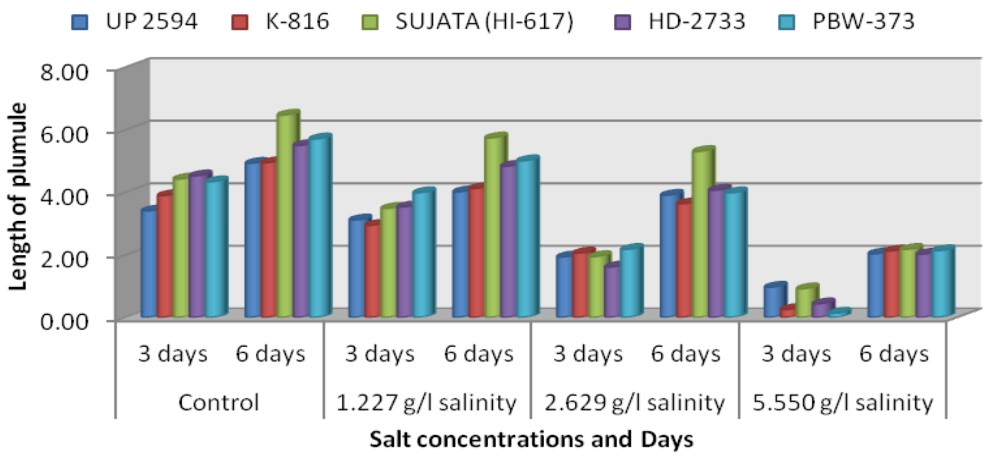

Fig.1. Mean length of plumule of five wheat varieties at different salt concentration.

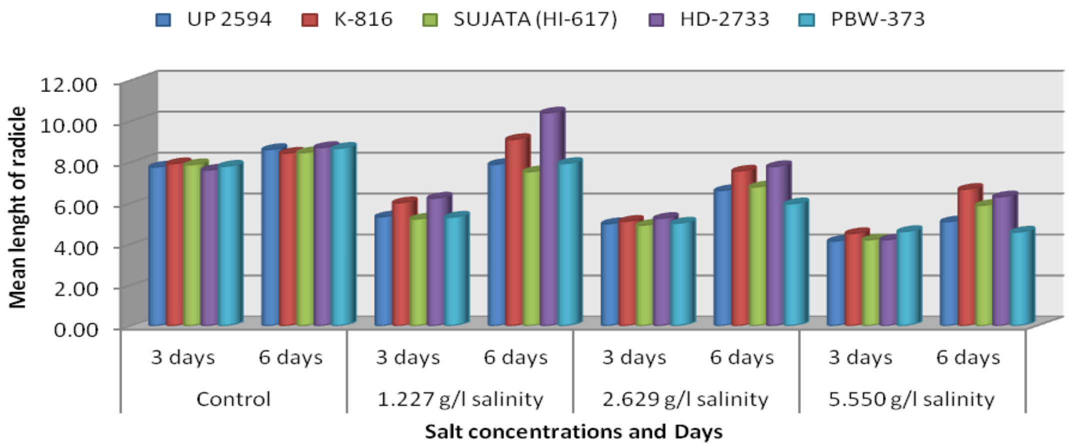

Fig.2. Mean length of radical of five wheat varieties at different salt concentration.

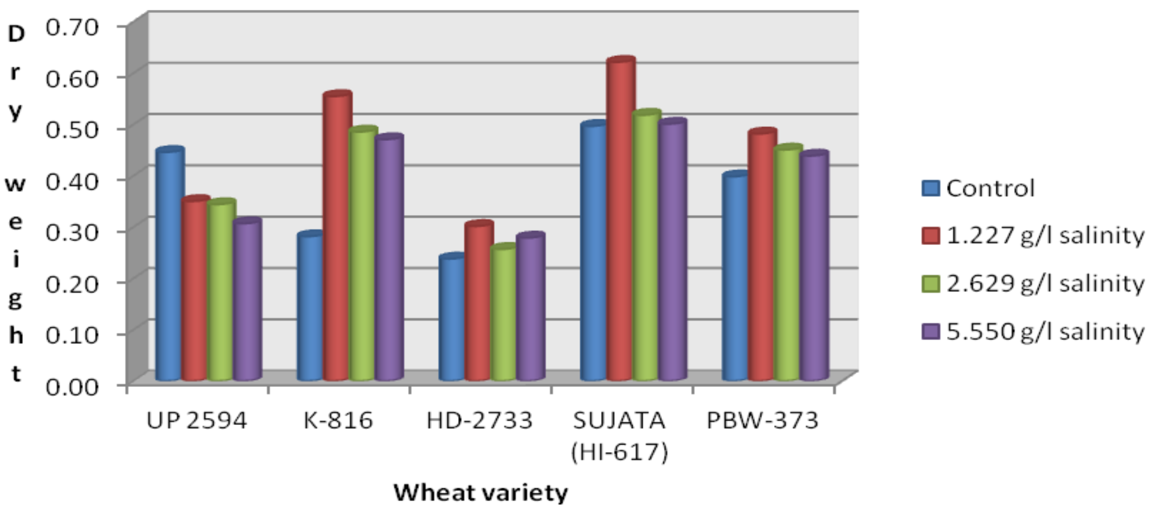

Fig.3. Mean of dry weight of five wheat varieties at different salt concentration.

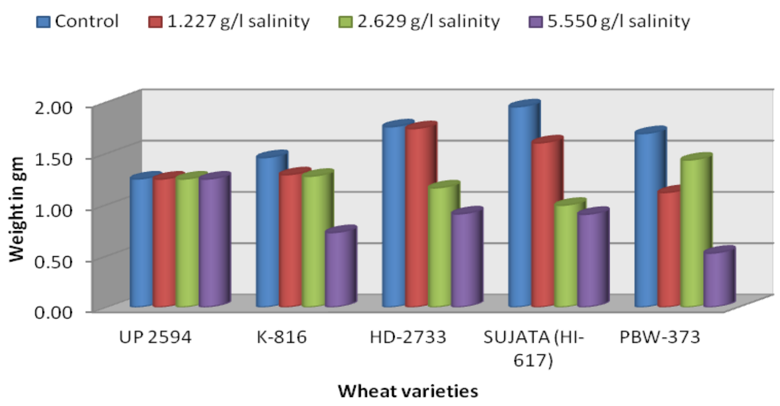

Fig.4. Mean of fresh weight of five wheat varieties at different salt concentration.

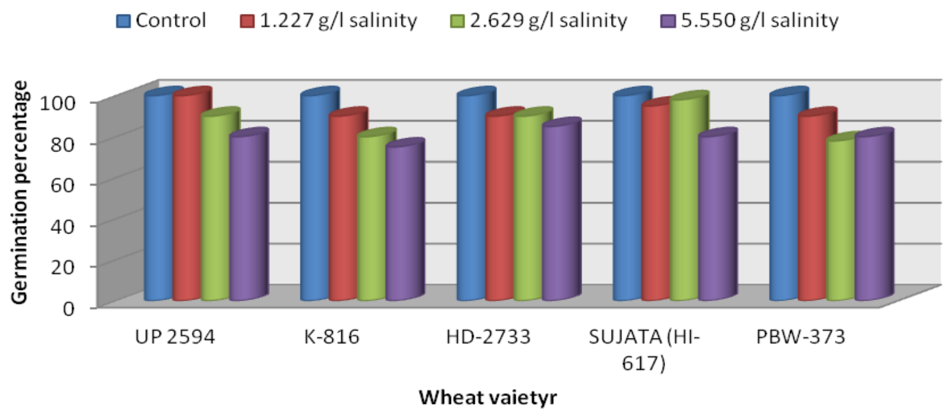

Fig.5. Mean of germination of five wheat varieties at different salt concentration.

Fig.6

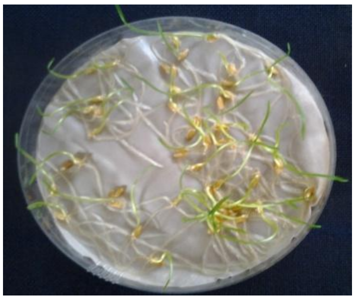

Fig.7

Fig.8

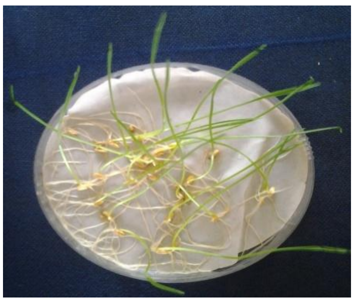

Fig. 9

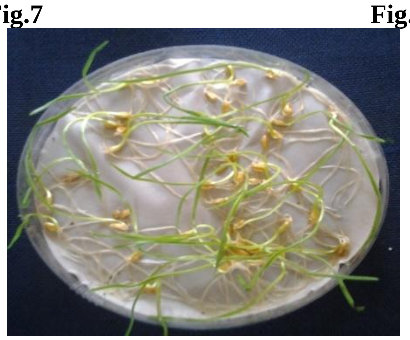

Fig.10

Fig. 6-10. Germinated seed of Wheat varieties under salinity condition *viz;* UP 2594, Sujata, PBW-373 HD-2733, and K-616.

DISCUSSION

This study showed the existence of an impressive variation in tolerance to increasing NaCl treatments during the early growth stage. Of the 5 bread wheat genotypes tested, all varities have given moderate and good response in salinity condition (Figure 6-10; Table 1). The existence of such impressive genotypic variation in tolerance to NaCl could be very useful for the development of high-yielding salt-tolerant genotypes and better understanding of the physiological and molecular mechanisms contributing to salt-stress tolerance in wheat. In a previous study, Gunefl et al. (1997) also indicated that Gerek-79 possesses a very high tolerance to salt stress. Genotypic variation in tolerance to NaCl stress has been reported several times for wheat (Ashraf *et al*., 1997; Singh *et al*., 1997; Munns *et al*., 2000). It is also reported that the salt tolerance at the early growth stage differs from that developed during the late growth stages (Ashraf et al., 1997; Mano and Takeda, 1997; Almansouri et al., 2001).

However, there is increasing evidence showing that better germination and seedling growth have a great effect on final yield as shown in different cereals (Mosaad et al., 1995; Grieve et al., 2001; Willenborg et al., 2005). Any impairment in seed germination or seedling development due to salt stress can cause significant depressions in yield formation. It appears that the bread wheat genotypes Sujata can perform well on saline soils, at least during the early growth stages. Thus, these genotypes should be exploited in breeding programs.

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