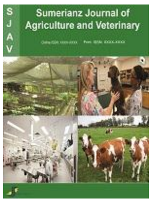
Sumerianz Journal of Agriculture and Veterinary, 2019, Vol. 2, No. 5, pp. 29-33
ISSN(e): 2617-3077, ISSN(p): 2617-3131
Website: https://www.sumerianz.com



Original Article Open Access

Evaluation of Wheat Germplasm Against Salts Presence

Muhammad Arshad Ullah*
Land Resources Research Institute, National Agricultural Research Centre, Islamabad, Pakistan

Muhammad Rasheed
PMAS - Agronomy Department, University of Arid Agriculture, Rawalpindi, Punjab, Pakistan

Syed Ishtiaq Hyder
Land Resources Research Institute, National Agricultural Research Centre, Islamabad, Pakistan

Abstract

Wheat (*Triticum aestivum*) is a quite salinity tolerance food cereal. Reminiscent of other glycophytes wheat is recognized and documented as salt sensitive plant. Reduced growth, vegetative development, and biomass accumulation in salinity stress condition caused the maximum loss in yield as well as yield components. Salinity retards water and nutrient uptake due to osmotic and ionic imbalance and further plants reduced height, less leaves and tillers as well as reduced yield. A pot study was conducted to evaluate the salt tolerance of wheat varieties under two salinity cum sodicity levels [S_1= 3.33dSm^{-1} +13.44 (mmol L^{-1})$^{1/2}$ and S_2= 16.05 dSm^{-1} +40.25 (mmol L^{-1})$^{1/2}$].Seeds of ten wheat lines/ varieties namely Galaxy, Punjab 2011,Aquab 2000, Inqlab 91, SARC 1, Punjab 85, Pak 81,LU26S, Kh 65 and KRL 19 were used for screening against salt tolerance in pots with two salinity and sodicity combinations at green house of Land Resources Research Institute, National Agricultural Research Centre, Islamabad, Pakistan during, 2017-18. Completely randomized deign was applied with three repeats. Data on plant height, chlorophyll contents, 50% days to flowering, number of grains per spikelet and grain yield were collected. Significant differences were observed in plant height parameter among ten wheat varieties under two salinity plus sodicity combinations. Galaxy wheat cultivar attained the highest plant height under both salinity and sodicity treatments SARC-1 showed the highest significant results at S_1 and S_2. Non-significant data were attained regarding 50% days to flowering meant that no influence of salts on this attribute. At S1 wheat cultivar KRL-19 got the top position significant at par with Galaxy, Kh-65 and Auqab-2000. KRL-19 wheat variety also attained the highest position under S_2 level with similar significant values of Kh-65 and Galaxy. At S_1 and S_2 Punjab-2011 produced the lowest number of grains showing the most salt sensitive wheat variety. Galaxy wheat cultivar produced the maximum grain yield under these two salinity plus sodicity combinations. % decrease at S_1over S_2 was the lowest showed the most salt tolerance as mentioned in the data that Galaxy wheat variety showed the maximum salt tolerance among these varieties or lines.

Keywords: Wheat; Galaxy; Punjab 2011; Aquab 2000; Inqlab 91; SARC 1; Punjab 85; Pak 81; LU26S; Kh 65; KRL 19; Saline-sodic; Growth and grain yield.

1. Introduction

Wheat (*Triticum aestivum*) is a quite salinity tolerance food cereal. Rice (*Oryza sativa*) will die before maturity in soil having salinity above 100 mM NaCl (about 10dSm^{-1}) and wheat will turn out low produce. Yet, barley (*Hordeum vulgare*) dies after extensive periods at higher than 250 mM NaCl being the most-tolerant cereal. Bread wheat is more salt tolerant than Durum wheat (*Triticum turgidum* ssp. durum) [1]. Merely halophytes will keep on their growth at salinities above 250 mM NaCl. Colmer, *et al.* [2], reviewed the domestication of halophytes as new crops and declaring that few species attained the class of crop plant and none has a wide usage. Timing and brutality of the salts affect the harvest index ranging 0.2 to 0.5 [3].It has been necessary to grow rice plants for several weeks to gain reproducible variations in salinity tolerance among genotypes [4]. Salinity tolerance and K^+/Na^+ discrimination relationship was also measured with K^+/Na^+ as salinity tolerance index for cultivar comparisons in rice [5]. Rice landraces with low Na^+ accumulation yield better than high Na^+ genotypes at moderate salinity under glasshouse experiments [6]. Germination is a suitable criteria for large numbers of genotypes, but little or no correlation has been found between genotypic differences in germination and later growth in salinity for species as assorted as durum wheat [7]. At germination halophytes are salt sensitive than glycophytes, while they hastily prove their better tolerance at the initiate of hypocotyl elongation [8]. Conversely plant species diverge in salts sensitivity or tolerance [9]**.** Salinity retards water and nutrient uptake due to osmotic and ionic imbalance and further plants reduced height, less leaves and tillers as well as reduced yield [10].

Less absorption of nitrogen, magnesium, and iron under saline stress abridged chlorophyll content which disturbs the chlorophyll synthetic activity metabolism [9]. Reduced growth, vegetative development, and biomass accumulation in salinity stress condition caused the maximum loss in yield as well as yield components [11, 12].

*Corresponding Author

Soil salinity problem can be addressed efficiently by the cultivation of salt loving species that demonstrate better performance under saline soils [13]. Toxic effects of salt stress on wheat plants are effectively managed with the priming of $CaCl_2$, KCl, and NaCl salts [14].

Reminiscent of other glycophytes wheat is recognized and documented as salt sensitive plant [15].Wheat crop is considered as salts receptive crop [16]. Excessive accumulation of Na^+ within the plant body caused reduction in shoot growth and consequently reduction of enzymatic process and synthesis of protein [17, 18]. Bakht, *et al.* [19]; Bhatti, *et al.* [20] accomplished severe effects on shoot fresh and dry weight due to salinity. They further found that reduction was the highest in salt sensitive lines as comparing to salt tolerant lines with lowest reduction in fresh and dry weight.

Growth and development of plants is very associated with K^+ uptake [21]. [22] investigated that seedling vigor, metabolism of reserves, enhanced K^+ and Ca^{2+} and reduced Na^+ accumulation in wheat plants under priming-induced salinity tolerance. Shafi, *et al.* [23]; Naseem, *et al.* [24] indicated that due to exclusion of Na^+ and Cl^- ions, Bakhtawar-92 showed as salt resistant cultivar. Maximum K^+ concentrations and minimum Na^+ uptake may be one of the possible phenomena of increased salt tolerance in wheat by Si application [25]. Munns and James [26], concluded that genotypes with lowest Na^+ contents resulted highest dry matter. The aptitude of cells to sustain best possible K^+/Na^+ ratio is the important trait of salt tolerant plants [18]. Seed priming of wheat seeds caused the high salinity tolerance of wheat plants due to higher capacity for osmotic adjustments and maintenance of ionic homeostasis by enhancing K^+ and Ca^{2+} accumulation [27].

Different researchers opted various ways of plants salt tolerance [28]. Ali, *et al.* [29], recognized that different cultivars possibly will accept special methods for high external salinity tolerance. Flowers and Hajibagheri [28], reported that NaCl salinity decreases K^+ concentration in many species e.g. barley. They also concluded that greater dry matter accumulation, K^+ and nitrogen contents and reduced uptake of Na^+ and Cl^- are characters responsible for salt resistance and recommended that these characters could be used as a measure for speedy screening programmes for diverse crops. The increase K^+/Na^+ ratio was highest in salt tolerant cultivars [30].

2. Materials and Methods

A pot study was conducted to evaluate the salt tolerance of wheat varieties under two salinity cum sodicity levels [S_1= 3.33dSm^{-1} +13.44 (mmol L^{-1})$^{1/2}$ and S_2= 16.05 dSm^{-1} +40.25 (mmol L^{-1})$^{1/2}$].Seeds of ten wheat lines/ varieties namely Galaxy, Punjab 2011,Aquab 2000, Inqlab 91, SARC 1, Punjab 85, Pak 81,LU26S, Kh 65 and KRL 19 were used for screening against salt tolerance in pots with two salinity and sodicity combinations at green house of Land Resources Research Institute, National Agricultural Research Centre, Islamabad, Pakistan during, 2017-18. Completely randomized deign was applied with three repeats. Data on plant height, chlorophyll contents, 50% days to flowering, number of grains per spikelet and grain yield were collected. 10 Kg soil was used to fill each pot. 10 seeds of Wheat (*Triticum aestivum*) were sown in each pot. Fertilizer was applied @55-55-45 NPK Kg ha^{-1}. Completely randomized deign was applied with three repeats. Data on grain yield were collected. Collected data were statistically analysed and means were compared by LSD at 5 % [31].

3. Results and Disussions

Wheat (*Triticum aestivum*) is a quite salinity tolerance food cereal. Reminiscent of other glycophytes wheat is recognized and documented as salt sensitive plant. Reduced growth, vegetative development, and biomass accumulation in salinity stress condition caused the maximum loss in yield as well as yield components. Salinity retards water and nutrient uptake due to osmotic and ionic imbalance and further plants reduced height, less leaves and tillers as well as reduced yield.

Significant differences were observed in plant height parameter among ten wheat varieties under two salinity plus sodicity combinations. Galaxy wheat cultivar attained the highest position regarding this parameter under both salinity and sodicity treatments and significant similar with KRL-19 and Kh-65. Under this study Punjab-2011 showed salt sensitive characteristic among these varieties. Chlorophyll contents dealt with photosynthesis finally concerned with growth and yield production of a plant or crop. SARC-1 showed the highest significant results at S_1 and S_2. Salinity stress affects seed germination, seedling growth, leaf size, shoot growth, shoot and root length, shoot dry weight, shoot fresh weight, number of tillers per plant, flowering stage, spikelet number, percent of sterile florets and productivity [32-37].

Non-significant data were attained regarding 50% days to flowering meant that no influence of salts on this attribute. High salinity can lead to osmotic stress similar to physiological drought, and high salt deposition in soils makes plants increasingly difficult to acquire water and nutrients [38]. Growth differences among various genotypes in response to salinity are dependent on the salt concentration and the degree of salt tolerance [39].

Number of grains per spikelet is the main yield determinant factor. Significant variations were found among wheat lines and cultivars with two varied saline sodic combinations considering the parameter of number of grains per spikelet. At S_1 wheat cultivar KRL-19 got the top position significant at par with Galaxy, Kh-65 and Auqab-2000. KRL-19 wheat variety also attained the highest position under S_2 level with similar significant values of Kh-65 and Galaxy. At S_1 and S_2 Punjab-2011 produced the lowest number of grains showing the most salt sensitive wheat variety. The end product of every plant or crop is its yield or fruit. Significant results were indicated in this parameter. Galaxy wheat cultivar produced the maximum grain yield under these two salinity plus sodicity combinations. However the grains yield was reduced as the salt concentration was increased mentioning in the reduction of grain yield (3.85 -- 1.64tha^{-1}) under S_2 of the same variety. % decrease at S_1over S_2 is the main key to evaluate the salt tolerance and sensitiveness. % decrease at S_1over S_2 was the lowest showed the most salt tolerance as mentioned in the data that Galaxy wheat variety showed the maximum salt tolerance among these varieties or lines. Studies indicated that rice is more resistant at reproductive and grain filling than at germination and vegetative stages as well as low levels of salinity can increase the resistance of rice to higher and lethal salinity levels [40]. Grain yield of rice in salt affected soils is much lower because of its high sensitivity to salt stress [41]. Grain yield and shoots, 100 seeds weight, tiller number, root dry weight and K^+ uptake in seeds and shoot significantly decreased with increasing salinity [42].

4. Conclusion

Galaxy wheat variety received the highest position in two salinity levels. % decrease at two salinity levels showed the least among other varieties. Galaxy wheat variety showed the maximum salt tolerance.

References

[1] USDA-ARS, 2005. "George E. Brown Jr salinity laboratory, riverside, CA, USA." Available: http://www.ars.usda.gov/Services/docs.htm?docid=8908

[2] Colmer, T. D., Munns, R., and Flowers, T. J., 2005. "Improving salt tolerance of wheat and barley: future prospects." *Australian Journal of Experimental Agriculture*, vol. 45, pp. 1425–1443.

[3] Husain, S., Munns, R., and Condon, A. G., 2003. "Effect of sodium exclusion trait on chlorophyll retention and growth of durum wheat in saline soil." *Australian Journal of Agricultural Research*, vol. 54, pp. 589–597.

[4] Zhu, Kinet, J. M., and Lutts, S., 2001. "Characterization of rice (Oryza sativa L.) F3 populations selected for salt resistance. I. Physiological behaviour during vegetative growth." *Euphytica*, vol. 121, pp. 25–263.

[5] Asch, F., Dingkuhn, M., Dörffling, K., and Miezan, K., 2000. "Leaf K/Na ratio predicts salinity induced yield loss in irrigated rice." *Euphytica*, vol. 113, pp. 109–118.

[6] Husain, S., 2002. *Physiology and genetics of salt tolerance in durum wheat.A thesis submitted for the degree of Doctor of Philosophy of Australian National University*. Canberra, Australia.

[7] Almansouri, M., Kinet, J. M., and Lutts, S., 2001. "Effect of salt and osmotic stresses on germination in durum wheat Triticum durumDesf." *Plant Soil*, vol. 321, pp. 245–256.

[8] Malcolm, C. V., Lindley, V. A., O'Leary, J. W., Runciman, H. V., and Barrett-Lennard, E. G., 2003. "Germination and establishment of halophyte shrubs in saline environments." *Plant Soil*, vol. 253, pp. 171-185.

[9] Kumar, R., Singh, M. P., and Kumar, S., 2012. "Effect of salinity on germination, growth, yield and yield attributes of wheat." *International Journal of Scientific and Technology Research*, vol. 1, pp. 2277-8616.

[10] Asgari, H. R., Cornelisb, W., and Van Dammec, P., 2012. "Salt stress effect on wheat (Triticum aestivum L.) growth and leaf ion concentrations." *International Journal of Plant Production*, vol. 6, pp. 1735-8043.

[11] Munns, R., 2011. "Plant adaptations to salt and water stress, differences and commonadities." *Advances in Botanical Research*, vol. 57, pp. 1-3.

[12] Sobhaniana, H., Aghaeib, K., and Komatsuc, S., 2011. "Changes in the plant proteome resulting from salt stress towards the creation of salt-tolerant crops." *Journal of Proteomics*, vol. 74, pp. 1323-1337.

[13] Shafi, M., Bakht, J., Khan, M. J., and Khan, M. A., 2010. "Effect of salinity and ion accumulation of wheat genotypes." *Pak. J. Bot.*, vol. 42, pp. 4113-4121.

[14] Iqbal, M., Ashraf, M., Jamil, A., and Rehman, S. U., 2006. "Does Seed priming induce changes in the levels of some endogenous plant hormones in hexaploid wheat plants under salt stress." *J. Integr. Plant Biol.*, vol. 48, pp. 181-189.

[15] Zhu, 2003. "Regulation of ion homeostasis under salt stress. Curr." *Opi. Pl. Bio.*, vol. 6, pp. 441-445.

[16] Sharma, S. K., Joshi, Y. C., and Bal, A. R., 2005. "Osmotic and ionic effects in salt sensitive and resistant wheat varieties." *Indi. J. Plant. Physiol.*, vol. 27, pp. 153-158.

[17] Shafi, M., Bakht, J., Raziuddin., and Zhang, G., 2009. "Effect of Cadmium and Salinity stresses on growth and antioxidant enzymes activity of wheat genotypes." *Bull. Environ. contaim. Toxicol.*, vol. 82, pp. 772-776.

[18] Tester, M. and Davenport, R., 2003. "Na+ tolerance and Na+ transport in higher plants." *Ann. Bot.*, vol. 9, pp. 503-527.

[19] Bakht, J., Shafi, M., and Jamal, Y., 2011. "Response of maize (Zea mays L.) to seed priming with NaCl and salinity stresses. Spanish." *J. Agric. Res.*, vol. 9, pp. 252-261.

[20] Bhatti, M. A., Ali, Z., Baksh, A., Razaq, A., and Jamal, A. R., 2004. "Screening of wheat lines for salinity tolerance." *Int. J. Agri. Biol.*, vol. 6, pp. 627-628.

[21] Ashley, M. K., Grant, M., and Grabov, A., 2006. "Plant responses to potassium deficiencies: a role for potassium transport proteins." *J. Exp. Bot.*, vol. 57, pp. 425-436.

[22] Afzal, I., Rauf, S., Basra, S. M. A., and Murtaza, G., 2008. "Halopriming improves vigor, metabolism of reserves and ionic contents in wheat seedlings under salt stress." *Plant Soil Envir.*, vol. 54, pp. 382-388.

[23] Shafi, M., Bakht, J., Raziuddin, and Zhang, G., 2011. "The genotypic difference in inhibition of photosynthesis and chlorophyll fluorescence by salinity and cadmium stresses in wheat." *Salinity J. Plant Nutrition*, vol. 34, pp. 315-323.

[24] Naseem, M., Qureshi, R. H., Akhtar, J., and Masood, M. A., 2000. "Screening of wheat (Triticum aestivum L.) genotypes against salinity in solution culture." *Pak. J. Agri. Sci.*, vol. 37, pp. 1-2.

[25] Tahir, M. A., Rahmatullah, Aziz, T., Ashraf, M., Kanwal, S., and Maqsood, M. A., 2006. "Beneficial effects of silicon in wheat (Triticum aestivum L.) under salinity stress." *Pak. J. Bot.*, vol. 38, pp. 1715-1722.

[26] Munns, R. and James, R. A., 2003. "Screening methods for salinity tolerance: a case study with tetraploid wheat." *Plant Soil*, vol. 253, pp. 201-218.

[27] Farhoudi, R. and Sharifzadeh, F., 2006. "The effects of NaCl priming on salt tolerance in canola (Brassica napus L.) seedlings grown under saline conditions." *Int. J. Cr. Sci.*, vol. 1, pp. 74-78.

[28] Flowers, T. J. and Hajibagheri, M. A., 2001. "Salinity tolerance in Hordeum vulgare: ion concentrations in root cells of cultivars differing in salt tolerance." *Plant Soil*, vol. 23, pp. 1-9.

[29] Ali, Y., Islam, Z., Ashraf, M. Y., and Tahir, G. R., 2004. "Effect of salinity on chlorophyll concentration, leaf area, yield and yield components of rice genotypes grown under saline environment." *Int. J. Environ. Sci. Technol.*, vol. 1, pp. 221-225.

[30] Gurmani, A. R., Bano, A., Din, J., Khan, S. U., and Hussain, I., 2009. "Effect of phytohormones on growth and ion accumulation of wheat under salinity stress." *Afr. J. Biotech.*, vol. 8, pp. 1887-1894.

[31] Montgomery, D. C., 2001. *Design and analysis of experiments*. 5th Ed ed. New York, USA: John Willey and Sons. pp. 64-65.

[32] Ashraf, M. and Akram, N. A., 2009. "Improving salinity tolerance of plants through conventional breeding and genetic engineering: An analytical comparison." *Biotechnol Adv.*, vol. 27, pp. 744–752.

[33] Gupta, B. and Huang, B., 2014. "Mechanism of salinity tolerance in plants: Physiological, biochemical, and molecular characterization." *Int. J. Genom*, vol. 2014, pp. 1-18.

[34] Hakim, M. A., Juraimi, A. S., Begum, M., Hanafi, M. M., Ismail, M. R., and Selamat, A., 2010. "Effect of salt stress on germination and early seedling growth of rice Oryza sativa L." *Afr. J. Biotechnol*, vol. 9, pp. 1911–1918.

[35] Lauchli, A. and Grattan, S. R., 2007. *Plant growth and development under salinity stress. In: Jenks M A, Hasegawa P M, Jain S M. Advances in molecular breeding toward drought and salt tolerant crops*. Dordrecht, the Netherlands: Springer. pp. 1–32.

[36] Moradi, F. and Ismail, A. M., 2007. "Responses of photosynthesis, chlorophyll fluorescence and ROS-scavenging systems to salt stress during seedling and reproductive stages in rice." *Ann. Bot.*, vol. 99, pp. 1161–1173.

[37] Zeng, L. H. and Shannon, M. C., 2000. "Salinity effects on seedling growth and yield components of rice. Crop Sci, 40(4): 996–1003. (Red) rice: an emerging constraint to global rice production. Chapter Three-Weedy (Red) Rice: An Emerging Constraint to Global Rice Production." *Advances in Agronomy*, vol. 129, pp. 181-228.

[38] Verslues, P. E., Agarwal, M., Katiyar-Agarwal, S., Zhu, J. H., and Zhu, J. K., 2006. "Methods and concepts in quantifying resistance to drought, salt and freezing, abiotic stresses that affect plant water status." *Plant J.*, vol. 45, pp. 523–539.

[39] Eynard, A., Lal, R., and Wiebe, K., 2005. "Crop response in salt-affected soils." *J. Sustain Agric.*, vol. 27, pp. 5–50.

[40] Djanaguiraman, M., Sheeba, J. A., Shanker, A. K., Durga, D. D., and Bangarusamy, U., 2006. "Rice can acclimate to lethal level of salinity by pretreatment with subletal level of salinity through osmotic adjustment." *Plant Soil*, vol. 284, pp. 363-373.

[41] Gao, J. P., Chao, D. Y., and Lin, H. X., 2007. "Understanding abiotic stress tolerance mechanisms: recent studies on stress response in rice." *J. Integr. Plant Biol.*, vol. 49, pp. 742–750.

[42] Mohiti, M., Ardalan, M. M., Mohammadi, T. A., and Shokri, V. H., 2011. "The efficiency of potassium fertilization methods on the growth of rice (Oryza sativa L.) under salinity stress." *African J. Biotech.*, vol. 10, pp. 15946-15952.

Table-1. Impact of salinity cum sodicity on growth and yield of Wheat

Varieties /lines	**Plant Height (cm)**		**Chlorophyll Contents (%)**		**50% Days to Flowering**		**# of grains spikelet^{-1}**		**Grain yield (tha^{-1})**		
	S_1	**S_2**	**S_1**	**S_2**	**S_1**	**S_2**	**S_1**	**S_2**	**S_1**	**S_2**	**% decrease at S_1over S_2**
Galaxy	98a	94a	57a	56a	86a	84	68a	61a	3.85a	1.64a	57
Punjab-2011	47d	43cd	41b	33cd	89a	86	44cd	38d	3.51ab	1. 34ab	61
Inqlab-91	66bc	65bc	55a	54a	85a	82	48c	41bc	3.62a	1.50a	58
SARC-1	68bc	65 bc	59a	56a	87a	84	59ab	53b	3.60a	1.10bc	69
Punjab-85	51d	47cd	39bc	37bc	88a	86	39d	33c	3.44ab	1.11bc	67
Pak-81	50d	47cd	47ab	45ab	92a	88	57ab	52ab	3.61a	1.20b	66
LU26S	57bc	52c	55a	51a	90a	85	48c	43bc	3.44ab	1.08c	68
Auqab-2000	68ab	63bc	42b	38bc	87a	83	63a	58ab	4.29a	1.35ab	68
Kh-65	81a	78ab	51a	47ab	83a	79	66a	62a	3.78a	1.41ab	62
KRL-19	94a	86a	55a	51a	87a	81	69a	64a	3.65a	1.47a	59
LSD	17	14	8	7	NS	NS	7	6	1.41	0.23	--------

S_1= ECe=3.33 dSm^{-1} SAR=13.44 (mmol L^{-1})$^{1/2}$ S_2= ECe=16.05 dSm^{-1} SAR=40.25 (mmol L^{-1})$^{1/2}$