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Evaluating Salt-Tolerant Wheat Genotypes in Seedlings Exposed to Diverse Salinity Stress Levels

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ABSTRACT An excellent source of nutrients and a staple food crop is wheat. However, its growth, development, and yield are primarily limited by salt stress. The salt tolerance level of 40 wheat genotypes was investigated using a complete randomized design (CRD) in 250 mL disposable cups. Diverse genotypes were screened and characterized for their salt tolerance at the seedling stage against three treatment levels (control, 4 dSm^{-1}, 8 dSm^{-1}). The analysis of variance mentioned that all the studied attributes have highly significant differences among the genotypes. Genotypes G27, G5, and G32 performed well in the most studied indices and were considered as salt-tolerant genotypes while G6, G19, and G25 were poor performers in most of attributes and regarded as salt-sensitive genotypes under all treatments. Future wheat breeding initiatives could make use of the genotypes with the potential for salt tolerant to create high-yielding, salt-tolerant cultivars.

Keywords: *Morphological traits; Spider graph; Salinity; Wheat screening; Salt-tolerant*

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INTRODUCTION Large tracts of bread wheat (*Triticum aestivum* L.), a vital cereal crop, are planted. It is grown everywhere in the world, and 33% of people who live there depend upon it due to its high nutritional value and long-term storage ability. Wheat accounts for a large proportion of daily caloric and protein consumption globally (Kizilgeci et al., 2021). The total production of wheat in 2021 was 777.9 million metric tons, harvested from 223.36 million hectares (mha) (FAO, 2021). In 2021, wheat was grown on 9.2 million hectares in Pakistan and the annual production was 27.3 million metric tons.

Among the several types of environmental stress, salinity is one that adversely impacts worldwide wheat production. In Pakistan's 79.6 million hectares of land, 22.05 million are cultivated, while 6.28 million are affected by salt damage. Out of which, nearly half are under irrigated agriculture. The major abiotic stress of soil salinity affects more than 800 mha of agricultural land worldwide harming a plant's germination, growth, and development. A significant imbalance exists between the amounts of salt that enter and leave the soil (EL Sabagh et al., 2020). After soil erosion, soil salinity is a significant element that contributes to land deterioration and reduced the agricultural productivity (Shahid et al., 2018). Soil salinity is difficult to control because it requires huge efforts in term of cost and time to make it fertile again. The only solution is the development of salt-tolerant varieties of wheat that can be grown better on salt-affected soil and produce high yields. Many methods have been used to increase wheat's salt tolerance, such as the development of genotypes of salt-tolerant wheat with a high potential yield through conventional (Ashraf and O'leary, 1996), marker-assisted (Lindsay et al., 2004) genetic engineering and breeding techniques (Abebe et al., 2003; Sawahel and Hassan, 2002).

Wheat, a field crop, is particularly susceptible to salinity, which inhibits plant growth and development. Under extreme saline conditions, this results in low crop productivity or even crop failure. The selection and breeding process benefits from understanding how plants tolerate stress based on their physiological attributes. Thus, understanding the mechanisms conferring salt tolerance and the effect of different physio-morphological traits on the wheat response to saline conditions is crucial for wheat breeding. Wheat genotypes must be developed or screened for salinity stress to ensure increased productivity for sustainable food security. To investigate the impact of salinity on wheat seedlings, researchers can use wheat screening based on physio-morphological traits such as germination percentage (GP), shoot length (SHL), root length (RL), shoot fresh weight (SFW), root fresh weight (RFW), shoot dry weight (SDW), root dry weight (RDW), germination index (GI), vigor index (VI), chlorophyll content (CC), stomatal conductance (SC), and relative water content (RWC). Thus, these characteristics can serve as selection criteria to protect various genotypes of wheat from salt. The amount of chlorophyll in leaves is a measure of how well plant tissues can photosynthesize. In saline conditions, the quantity of chlorophyll pigments fluctuates. The seedling stage is when plants are most vulnerable to salt, followed by the blooming and grain-filling stages (Gerona et al., 2019). The soil salinity reduces the plant growth rate at the seedling stage (Sallaku et al., 2019). Mature-stage plants are less susceptible to stress than seedlings because, at the seedling stage, plants are closer to the dynamic environment of the soil surface. A vigorous seedling also a reliable indicator to predicts the yield of a plant in a short period of time (Dodd and Donovan, 1999).

Therefore, such cultivars must be developed or screened for crop improvement from locally adapted varieties that can perform well in saline conditions and give better yield. The current study focuses on evaluating these cultivars that were least affected by salinity. Thus, the purpose of this study was to assess how various wheat cultivars responded to salinity stress during the germination or seedling stage. Forty genotypes of wheat were subjected to three different salinity levels, 4 dSm-1 (ST1), 8 dSm-1 (ST2) with a control group (N), to check the effect of salinity. Keeping the above-mentioned objective in mind, an experiment was designed to collect information and analyze data. In order to quantify the degree of link between two variables or factors, correlation coefficients were also developed. This is helpful for plant breeding since it can forecast associations that may be used practically and provides information on the connections between the numbers of desired characters. This can help the plant breeders to select the cultivars with the necessary characteristics. Georg von Mayr created the radar plot in 1877, and it can be seen as a connected line graph, which reduces the plot's size (Mamen et al., 2020). Radar is a statistical analysis tool that is used to visually represent data on several attributes on a single graph. A two-dimensional radar chart is a visual way to display multivariate data with three or more quantitative variables. RADAR-graphs, which illustrate mean values relative to a central point for investigated attributes, were created from mean values using Excel-Stat (Ahmed et al., 2020).

The goals of this investigations were to: I) Screening of germplasm for disorders involving salt stress. II) Identifying the genotypes that were vulnerable to and tolerant of salt. III) Checking the response of physio-morphological traits against salt stress conditions in wheat. IV) Assessing the effect of salt stress in different wheat cultivars by assessing seedling and germination properties. Wheat breeders can use the results from this experiment to select or screen salt-tolerant cultivars and develop a higher-yielding cultivar in salt stress conditions through a wheat breeding program for sustainable food security.

MATERIAL AND METHODS

Using a Complete Randomized Design (CRD), 40 different wheat genotypes were cultivated in this experiment for some physio-morphological traits-based analysis against tolerance to salt in seedlings. Five seeds of each genotype were grown in 250-mL plastic cups filled with the sand mixture (Fan et al., 2015). After watering upon sowing, the genotypes were subjected to the first dose of three different salinity treatments, ST1, ST2, which equated to 4 dSm-1, 8 dSm-1 respectively, along with a control (N). In addition, 20 mL Hoagland solution (Hoagland and Arnon, 1950) was applied to all treatments to boost the germination of seedlings. The saline solution was prepared using AR-grade sodium chloride (MW: 58.44) in a given ratio, i.e., (TDS (g/L) = 0.6 x EC (dSm-1)); through this calculation, salt solutions were prepared in 1000-mL batches. The desired amount of NaCl was added to distilled water to make the desired amount of solution (Xu et al., 2012). Fifteen days after sowing, a saline solution treatment was initiated, consisting of three doses of 40 mL each, administrated at five-day interval Following germination, data on the percentage of germination were acquired, and one plant per cup underwent thinning.

The data were recorded when the plants reached the stage of 3–4 leaves, or seedlings, after 30 days. A ruler was used to measure the shoot length (SL) and root length (RL). A leaf porometer (model SC-1, Decagon Devices, Inc., USA) was used to quantify the stomatal conductance (SC) in mmol m-2s-1, and a SPAD meter model CL-01 (Hansatech Instruments, Pentney King's Lynn, United Kingdom) was used to determine the relative chlorophyll concentration.

The relative water content was measured (Ahmed et al., 2019):

Statistical Analysis

GenStat (v10) software was used to analyze the collected data using the analysis of variance (ANOVA) approach to check for significant differences in the studied genotypes. For highly significant effects, the significance threshold was set at 0.01; for only significant effects, it was set at 0.05. The characteristics that showed the most significant differences in the studied genotypes were subjected to a further to evaluate the relationship between characteristics and genotypes under both normal and salinity stress conditions using Pearson correlation. A spider analysis was also used to depict the data for the attributes under study (Ahmed et al., 2020). XLSTAT (Baskauf, et al., 2016) (Vanderbilt University, Nashville, TN, USA) was used to generate the spider graphs, which display values for plots of observable qualities in relation to a central point.

RESULTS AND DISCUSSION

Analysis of variance (ANOVA) results for all the attributes were presented in Table 1, which showed that there was a highly significant difference in treatment, genotypes, and (G×E) interaction. All attributes studied showed a significant difference in their mean values among all genotypes under all salinity stress levels. Performance of Studied Genotypes Determined through Spider or RADAR Analysis

The mean data recorded for germination percentage (%) in figures showed that genotype G5 had the best performance, with 93.37%, 79.84%, and 76.13%, germination in control, ST1 and ST2, respectively, while genotype G6 showed poor performance in the control (26%), ST1 (20%), and ST2 (19.56). The spider (RADAR) graph showed that genotypes were adversely affected by all saline treatments (Figures 1–3). In this graph, various axes radiate out from a single center axis. Most of the time, all the axes were regularly and evenly distributed among one another. The axes can occasionally be joined together to create various grids that make it simpler for us to plot the spider chart.

The data for the shoot length of the wheat seedlings are presented in Table 2. They clearly showed that genotype G10 had excellent performance in the control, ST1, ST2 treatments, with a shoot length of 25.3 cm, 22.7 cm, and 16.9 cm, respectively, whereas genotype G6 was the worst performer in the control, ST1, ST2 treatments, with values of 6.5 cm, 4.8 cm, 5.1 cm, respectively. The spider graph also exhibits similar behavior for genotypes G10 and G6 (Figures 1–3).

Genotype G11 had good root length—19.7 cm, 18.3 cm, and 18.2 cm in the control, ST1, and ST2 saline conditions, respectively—and so was declared the best performer, while G6 had 5.1 cm and 4.5 cm root lengths in the ST1 and ST2 conditions, respectively, and was declared the worst-performing genotype (Table 2). Figures 1–3 show the variation among genotypes for different attributes against salinity stress. The spider graph also showed that G11 weas the best and worst performers, respectively, in the studied saline conditions. Table 2 also showed that genotype G3 had a higher relative chlorophyll content (CC) in the control (4.47) and ST2 (1.84) and so was declared the best performer for chlorophyll content, while the lowest chlorophyll content was seen in G2, which had 0.6, and 0.45 in ST1, ST2 conditions, respectively. The spider graphs (Figures 1–3) also mentioned a decreasing trend in chlorophyll content against saline conditions.

Genotype G33 had the maximum stomatal conductance (SC) in the control, while in ST2, G36 (18.6) had maximum mean value, respectively, while the minimum SC was seen in genotype G4 for the control (6.2), ST2, (5.7) conditions, and so these were declared the best and worst performers, respectively, for SC. The spider graphs in Figure 1–3 also show a decreasing trend of SC in saline conditions.

Genotype G27 had a higher vigor index in the control (32.36), ST1 (24.19), and ST2 (23.87) conditions, while genotype G6 had the lowest vigor index of 5.23, and 1.18 in the control, and ST2 conditions, respectively. There was a decreasing trend in vigor index among all saline treatments as compared to control conditions. The VI was decreased, which can also be seen in the spider graph. The spider graphs (Figures 1–3) showed that, in normal conditions, VI showed maximum values, while in treatments it decreased.

Genotype G27 also had the maximum germination index (GI) for the control (110.5), ST1 (85.7), and ST2 (84.99) treatments, while the minimum germination index was seen in genotype G6: 59.15, 45.5, and 50.4 for the control, ST1, and ST2 treatments, respectively. Genotypes G27 and G6 were declared the best and worst performers for GI, respectively. The spider graphs (Figures 1–3) also show significant differences among the genotypes in terms of the germination index.

The maximum relative water content (RWC) were present in genotype G27 (82.2), ST1 (51), and ST2 (50.2) had best performance, respectively—whereas genotype G6 had the minimum RWC of 12.2, 19.1, and 18.5 in the control, ST1 and ST2 saline conditions, respectively. The relative water content increased with the increasing level of NaCl among all genotypes, as seen in the spider graph (Figures 1–3).

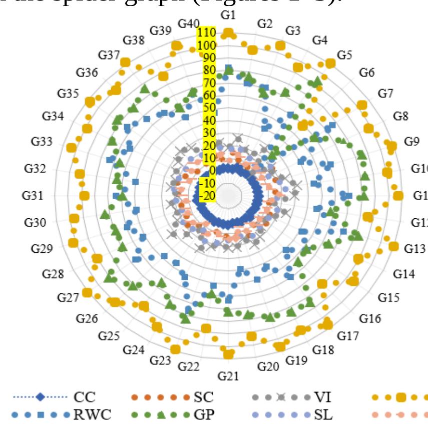

Figure 1. The control group's spider graph displays the following data: relative water content (RWC), germination percentage (GP), vigor index (VI), germination index (GI), stomatal conductance (SC), shoot length (SL), and root length (RL).

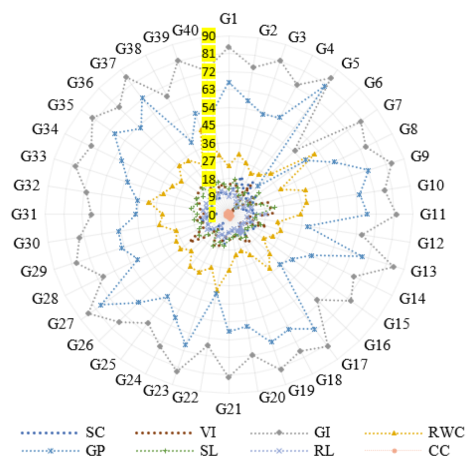

Figure 2. The spider graph displays the following data for salinity level 1. (ST1)

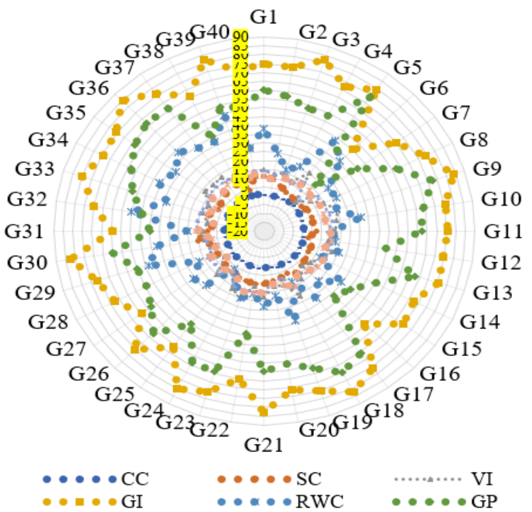

Figure 3. The spider graph displays the data in Salinity treatment ST2.

Correlation Analysis

The correlations between the examined attributes in the control conditions and at all studied salinity levels were presented in Table 3. In this study, shoot length was highly significant and had a positive correlation with germination index (GI), root length (RL), relative water content (RWC), while there was a non-significant and negative association with chlorophyll content (CC). Germination percentage (GP) was highly significant and correlated positively with germination index. As GP increased, the germination index as well as CC increased. Significant correlations were found between the relative water content and the attributes under investigation.

The stomatal conductance among ST2 treatment had a positive association with RL. A highly significant and positive correlation with shoot length was seen in RL (Table 3). Among all treatments, the germination index had a positive but non-significant relationship with chlorophyll content. As presented in Table 3, an increasing salt level reduced the chlorophyll content of the plant, which was damaging to chloroplast; With the exception of CC and SC, all attributes exhibited a positive and substantial connection with the vigor index. Features like SL, GP, and SC are helpful indices for assessing characteristics early in the wheat genotype response to salt.

Salt stress is a major abiotic stress that had a drastic effect on plant health (Elshafei et al., 2019). In salt stress conditions, wheat genotypes showed diverse responses. Under saline conditions, the germination percentage was reduced in the present study. In salt stress conditions, the seed requires a large amount of water for uptake due to the accumulation of soluble salts around the seed, which causes an increase in osmotic pressure (Iqbal et al., 2020). This results in a high uptake of those ions that cause toxicity in the plant, ultimately reducing the potential water gradient in the external environment and root emergence (Yan, Shah, Zhao, & Liu, 2020). The shoot of the wheat seedling is an important characteristic used to study the effects of salt conditions; their length decreases with increasing levels of salt stress (Kiremit et al., 2022). Saline conditions reduced the shoot length (Moradi et al., 2019). Experimental findings (Alom et al., 2016) also stated that, under 4 dSm-1 and 8 dSm-1 saline stress conditions, the wheat shoot length was significantly affected by salinity stress.

Root morphology is a very important trait when selecting salt-tolerant genotypes. In salt stress, the root length of wheat decreased (Kiremit et al., 2022), as observed in this study. There was some variation in root length. Under high salt stress, plants that survive may have an increased root length. The authors (Iqra et al., 2020) also reported similar findings, that Galaxy-13 and Shafaq-06 reduced the root length, while FSD-08 and Anaj-17 increased the root length. The shoot fresh weight of wheat showed significant variation in saline conditions and decreased with increasing levels of NaCl (Quan et al., 2021). There was a 58% decrease in shoot fresh weight under saline conditions. For this attribute, the characterization of wheat plants against salinity stress was done by two sets of researchers, who obtained similar results.

The green area of a plant has a major effect on the plant yield, as well as the physiological, morphological, and genetic status (Singh et al., 2016). The level of chlorophyll in leaves is an indicator of a plant's photosynthetic potential (Ahmed et al., 2019). The saline conditions led to a highly significant decrease in CC as compared to the control conditions. Stomata play an important role as controllers of gas exchange on the surface area of leaves. The stomata are closed due to the increased concentration of CO_2 and NaCl, which affect the guard cells and stomatal size. Carbon dioxide diffusion into plants during salinity stress was the main cause of stomatal closure, and stomatal conductance was decreased. The plant closes its stomata in saline conditions to maintain its water status, which ultimately results in decreased stomatal conductance. Our findings for SC were supported by several scientists. They reported a 20–30% decrease in stomatal conductance under saline conditions. It decreases under saline conditions due to the degradation of chlorophyll molecules caused by an overproduction of reactive oxygen species (ROS). The vigor index decreased with an increasing level of salinity. Similar findings were reported by several scientists (Mirza, 2021) and (Jovović et al.,2017) for the vigor index. The germination index is a measure of the speed of germination with respect to the number of sowing days. The germination index decreased with an increasing level of salinity. The same experiment was previously performed on GI by the authors (Kandil et al., 2012), who proved that it decreases in increasingly saline conditions. They found that the highest GI was obtained in the control (100%), while in the 4 dSm-1 and 6 dSm-1 treatments it was 97.93% and 93.93%, respectively.

The salinity reduces the root and shoot lengths of wheat plants (Khan et al., 2017). The growth of the plant is reduced by a modified cell wall that is due to the rigid cell walls induced by salt stress conditions. The rigidity of the cell wall and reduced production of new cell cause a reduction in the length of the roots and shoots (Khan et al., 2017). The chlorophyll content also decreased in saline conditions due to the change in cell anatomy. An increase in saline conditions causes a change in the leaf dimensions, which reduces the surface area, making the leaves

smaller than in normal conditions, which ultimately decreases the CC (Munns; Tester, 2008).
The link between two variables is defined by the correlation coefficient. This is useful in plant breeding because it gives a predictive link that can be used as evidence for the association of many traits (Ahmed et al., 2019). The susceptibility and tolerance indices are effective tools for genotype screening in the presence of abiotic stress. Evidence from this experiment demonstrating the relationship between seedling parameters under stress and non-stress conditions may be used to develop sophisticated methods for choosing the required types within the targeted criteria. In our study, a non-significant and negative association with chlorophyll content was seen for other traits; similar results were also observed by wheat scientists (Ahmed et al., 2019) under normal conditions. In saline conditions, these traits also correlate with shoot length. Similar results were also seen by several scientists in saline conditions (Mansour et al., 2020). They found that root dry weight was significantly and positively correlated with CC, GI, and GP in wheat seedlings when salt stress was applied. The authors of (Pour-Aboughadareh et al., 2021) observed similar results in terms of the correlations. SC conductance showed a positive association with RL. Germination index was non-significantly positively correlated with chlorophyll content as when CC increases, GI also increases (Aflaki et al., 2017). Similar results were observed in wheat seedlings under different environmental conditions using the studied attributes. An increasing salt level may reduce the chlorophyll content of the plant by damaging the chloroplasts of plant cells, as reported in our study. The vigor index also has a positive and significant correlation with all traits except CC and SC (Khanzada et al., 2020).

Table 1. ANOVA for all studied attributes under control and stress conditions.

SOV	DF	GP	SL	RL	CC	SC	VI	GI	RWC
Treatment	2	15,581.8**	528.6**	45.87**	50.51**	730.64**	1631.47**	19523.3**	24633.99**
Genotype	39	1,810.64**	88.6**	42.99**	0.75**	32.43**	229.64**	410.2**	517.93**
G*T	78	50.95**	8.25**	16.22**	0.43**	33.21**	17.62**	76.56**	229.85**
Error	320	371.39	3.84	4.02	0.25**	5.72**	3.9**	150.96**	60.44**
Total	479								

**Significant (0.05); **highly significant (0.01)" to p < 0.05 and p < 0.01 consequently*

Table 2. Best- and worst-performing genotypes under control and salt stress conditions.

Traits	level	Genotypes that perform best with mean values	Genotypes that perform worst with mean values
GP	**N**	G5 (93.37), followed by G27 (91.06) and G37 (85.86)	G6 (26), followed by G15 (52) and G16 (53.8)
	ST1	G5 (79.84), followed by G27 (77.57) and G37 (72.37)	G6 (20), followed by G16 (35.53) and G15 (38.51)
	ST2	G27 (77.57), followed by G5 (76.13) and G9 (71.84)	G6 (19.56), followed by G16 (34.66) and G25 (37.50)
SL	**N**	G10 (25.3), followed by G32 (21.4) and G36 (21.3)	G6 (6.5), followed by G25 (12) and G19 (13)
	ST1	G10 (22.7), followed by G32 (18.9) and G36 (18.5)	G6 (4.8), followed by G25 (10.3) and G19 (10.4)
	ST2	G10 (16.9), followed by G32 (16.6) and G36 (16.6)	G6 (5.1), followed by G25 (8.4) and G19 (8.5)
RL	**N**	G11 (19.7), followed by G36 (16.93) and G32 (15.83)	G19 (6.5), followed by G25 (7.3) and G1 (7.5)
	ST1	G11 (18.13), followed by G27 (13.1) and G32 (13)	G6 (5.1), followed by G25 (6.8) and G4 (7.5)
	ST2	G11 (18.2), followed by G7 (14.7) and G27 (14.6)	G6 (4.5), followed by G25 (6.1) and G4 (7.1)
CC	**N**	G3(4.47), followed by G16 (3.49) and G30 (3.22)	G15 (1.26), followed by G4 (1.4) and G25 (1.56)
	ST1	G19 (2.21), followed by G27 (1.76) and G15 (1.774)	G5 (0.55), followed by G29 (0.58) and G2 (0.6)
	ST2	G3 (1.84), followed by G30 (1.70) and G5 (1.67)	G2 (0.45), followed by G28 (0.46) and G33 (0.69)
SC	**N**	G33 (21.2), followed by G27 (20.3) and G7 (19.3)	G4 (6.2), followed by G3 (7.2) and G36 (8.4)
	ST1	G3 (20.2), followed by G22 (19.9) and G24 (16.1)	G25 (5.3), followed by G31 (5.8) and G9 (6.8)
	ST2	G36 (18.6), followed by G7 (18) and G26 (17.7)	G38 (4.2), followed by G4 (5.6) and G8 (5.7)
VI	**N**	G27 (32.36), followed by G10 (32.11), G36 (30.59)	G6 (5.23), followed by G15 (12.06) and G25 (12.53)
	ST1	G27 (24.19), followed by G11 (21.62), G10 (20.93)	G16 (6.56), followed by G16 (6.56) and G15 (7.41)
	ST2	G27 (23.87), followed by G11 (21.86), G36 (20.61)	G6 (1.18), followed by G16 (6.02) and G15 (20.57)
GI	**N**	G27 (111.4), followed by G5 (110.5) and G37 (110.4)	G6 (59.15), followed by G16 (79.29), G12 (85.97)
	ST1	G27 (85.7), followed by G27 (84.99) and G5 (84.90)	G6 (45.50), followed by G16 (60.98), G12 (66.13)
	ST2	G27 (84.99), followed by G36 (84.31) and G9 (83.63)	G6 (50.40), followed by G16 (60.49), G31 (65.12)
RWC	**N**	G27 (82.2), followed by G23 (76.5) and G7 (76.4)	G6 (12.2), followed by G20 (38.7) and G4 (40.1)

	ST1	G27 (52), followed by G39 (44.9) and G32 (39.9)	G6 (19.1), followed by G20 (20.6) and G15 (20.8)
	ST2	G27 (50.2), followed by G34 (41.0) and G1 (38.4)	G6 (18.5), followed by G25 (18.8) and G6 (19.1)

Table 3. Correlation analysis for all studies traits in normal and salt stress conditions.

Traits		**CC**	**GI**	**GP**	**RL**	**RWC**	**SC**	**SL**
GI	N	0.044ns						
	ST1	0.136ns						
	ST2	0.111ns						
GP	N	0.012ns	0.8343**					
	ST1	0.078ns	0.8721**					
	ST2	-0.0218ns	0.8788**					
RL	N	0.3408*	0.074ns	0.1327ns				
	ST1	0.0996ns	0.425**	0.317*				
	ST2	-0.1868ns	0.4871**	0.3621*				
RWC	N	0.154ns	0.751**	0.4624**	0.1938ns			
	ST1	-0.013ns	0.0838ns	-0.0571ns	0.5432**			
	ST2	-0.2028ns	0.3689*	0.3691*	0.6729**			
SC	N	-0.2416ns	0.053ns	-0.0662ns	-0.0151ns	0.1383ns		
	ST1	-0.057ns	0.106ns	-0.0079ns	0.0407ns	0.0391ns		
	ST2	-0.0068ns	0.3187*	0.2607ns	0.4128**	0.2852ns		
SL	N	0.1565ns	0.400**	0.4095**	0.4293**	0.489**	0.264ns	
	ST1	0.1291ns	0.3955**	0.3037ns	0.7228**	0.5869**	0.0551ns	
	ST2	-0.2932ns	0.527**	0.429**	0.8847**	0.676**	0.3523*	
VI	N	0.174ns	0.631**	0.7739**	0.6392**	0.4837**	0.0441ns	0.7634**
	ST1	0.1102ns	0.7616**	0.8207**	0.7294**	0.3337*	0.0159ns	0.7221**
	ST2	-0.166ns	0.7914**	0.8177**	0.7879**	0.6656**	0.3996**	0.8332**

** Significant (0.05); ns Non-significant; ** Highly significant (0.01)*

CONCLUSION

Total forty wheat genotypes were tested in this study using a complete randomized design against salinity stress. Significant differences were found in treatment, genotypes, and the G×E interaction, according to the analysis of variance. A correlation analysis showed the positive association of SL with GI, GP, RL, and RWC. The SC also showed a positive association with and RL. From the spider analysis results, we know that genotypes that performed better are considered stress-tolerant, and those that had lower performance were susceptible to salinity stress. The genotypes G27, G5, and G32 were considered as salt tolerant due to their performance under saline condition. Three genotypes were considered as susceptible to salinity stress (G6, G19, and G25) due to their having the worst performance. The present study showed a clear differentiation between the genotypes and selection criteria for desirable traits. In order to meet the demand for wheat and achieve long-term food security, future wheat breeding efforts can make use of the best-performing genotypes to develop cultivars that can withstand saline stress.

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