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Plant species differ in their salt tolerance depending on their genetic makeup ranging from high to low levels of salts in the soil. Higher salinity level retards seed germination and root emergence due to osmotic effect, which is deleterious and prevents the plant in maintaining their proper nutritional requirements necessary for their healthy growth (Hamid *et al*., 2008). Plant growth is detrimentally affected by salinity as a result of the disruption of certain physiological processes that lead to reductions in yield quality. Growth, yield, and quality reduction may occur through a decrease in the ability of plants to take up water from the soil solution and the destruction of soil structure due to the presence of Na^+ (Krishnamurthy *et al*., 2007). Some elements, such as Na and Cl have specific toxic effects on plants. Salinity also causes ion toxicity, osmotic stress, mineral deficiencies which adversely affect photosynthetic, physiological and biochemical processes limiting crop yield and production to various levels (Krishnamurthy *et al*., 2007; Hamid *et al*., 2008). Salinity effects are the results of complex interactions among morphological, physiological, and biochemical processes including seed germination, plant growth, and water and nutrient uptake (Singh *et al*., 2013).

Tef is the major Ethiopian cereal and serving as staple food grain. The major constraints in (((((ivity (national average about 9=6 =(qt ha^{-1}) and susceptibility to lodging. Tef is also a resilient crop adapted to diverse agro-ecologies with reasonable tolerance to both low (especially terminal drought) and high (waterlogging) moisture stresses. Tef therefore, is useful as a low-risk crop to farmers due to its high potential of adaption to climate change and fluctuating environmental conditions (CSA, 2015). Tef is the dominant crop next to sorghum in the cultivated lands of the district (IPMS-ILRI, 2005)

Germination and emergence stages might be useful criteria to evaluate the effect of salinity (Krishnamurthy *et al*., 2007). However, laboratory experiments may not be always an efficient approach under saline conditions because field salinity is present spots (Ashraf *et al*., 2006). In contrast, Ashraf *et al*., (2005) found a significant relationship between field and laboratory experiments. In fact, the variation of whole plant growth response is the best source to provide information to identify the salinity tolerant genotypes (Khan & Ashraf, 1990). The objectives of this study were to evaluate and identify salinity stress tolerant tef varieties/lines and to determine the effect of salinity on tef varieties/lines at different levels [redacted] NaCl.

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The study was conducted in [redacted] strict is located at 600 km [redacted] between 9: : = ((9: [redacted] longitudes with an elevation of 1520 meter above sea level (REST, 1998). The landform of the district is largely level plain where Vertisols and Fluvisols are the dominant and found extensively in farmlands (Amanuel *et al.*, 2015). The district has a bimodal rainfall pattern, though diminishing from time to time. The annual rainfall (mm), minimum and maximum temperatures (O_C) collected from National Meteorology Service Agency show that it is 663.12, 14.70 and 28.17, respectively (REST, 1996).

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Tef varieties/lines were collected from available sources and screened under saline environment for their salinity tolerance. The activity involves screening at germination, seedling and finally at actual field condition as detailed below:

> **Ec ec a cc e** initially, adequate number of seeds (20 seeds/Petri plates) of each Tef varieties/lines were placed at 0 and 15 dS m^{-1} of NaCl level to screened 42 varieties/lines of Tef. On the basis of their performance for total germination percentage and germination stress index, 7 better performing varieties/lines were selected in the first stage of germination and advanced to second germination stage of screening. Accordingly, three treatments; control (0 dS m^{-1}) and two salinity levels (10 and 15 dS m^{-1}) of saline solutions were prepared and arranged in completely randomized design (CRD) with three replications.

Total germination percentage (TGP) was calculated based on the equation; GP = (total germinated seed/ total number of seed)*100 (Ashraf and Foolad, 2005). Mean germination time (MGT) was calculated according to Ellis and Roberts (1981) (((((7((here, (n) is the number of seeds germinated on day d, and d is the number of days counted from the beginning of germination. Germination stress tolerance index (Ashraf *et al.*, 2008) was calculated as; GSTI = (germination of stressed seeds / germination of control seeds)* 100.

cc e ec a cc e seedling stage screening was conducted under small lath house condition. Treatments include two factors; Tef varieties/lines and NaCl levels. Bulk surface soil (non -saline and non -alkaline) was collected and packed into pot. The amount of NaCl to be added in to dry soil was calculated using the formula (Tekalign *et al*., 1996):

Gram salt per 100 gm dry soil= (0.064 dS m^{-1} *X* water saturation%)/ 100%

Accordingly, two salinity levels (10 and 15 dS m^{-1}) were prepared from a salt of NaCl by weighing 14.80 and 21.59 gm of NaCl respectively and mixing into 6 kg soil packed per pot to obtain 10, and 15 dS m^{-1} salinity treatments. Treatments were arranged in completely randomized design with three replications. Seven Tef seeds of each selected varieties/lines were planted per pot. Then prepared saline solutions was added to each pot sown with seeds of Tef varieties while maintaining the soil moisture at field capacity. Once saline treatments are added, non-saline water was used for subsequent irrigations and was applied at 5 day interval maintaining to a field capacity. Emerged seedlings were counted at 5, 7 and 9 days after planting. After the last count has been made, only 4 seedlings were maintained per pot. After 40 days of the experiment, shoot and root dry and fresh weights were calculated after dried at 70^{o}c for 24 hours.

Dc c c c : Screening for salt tolerance and evaluation for yield and yield component performance at field condition was undertaken at 6.18, 8.53, 20.16 % and 13.7 in ECe, pHe, ESP and SAR respectively of the district. A plot size of 3 m X 3 m with Latin square design was used. At field experiment screening stage, selected sorghum varieties were sown over two consecutive cropping seasons.

The collected data were subjected to the analysis of variance (ANOVA) using SAS computer package. Mean separation was carried out using least significance difference (LSD) test at 5% probability level.

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Total germination percentage (TGP) of Tef varieties were significantly reduced by the application of levels of saline solution. Abida *et al*,. 2012, also reported that, TGP of varieties were significantly affected by the application of levels of salinity.

The analysis result also showed that, all Tef varieties were decreased in TGP with increasing salt stresses levels. However, there is no significant difference between the varieties/lines in salinity levels of NaCl (Table 1).

Table 1. Total germination percentage of Tef varieties.

Tef varieties	NaCl salt levels (dS m^{-1})						
	0	10	15	Means	LSD ($p \leq 0.05$)	CV (%)	Ranking
Qunco	78.24	60.35	52.28	63.62	3.56	9.78	3
Magna	75.15	62.23	50.50	62.63	4.12	11.85	4
Kora	80.86	68.41	55.69	68.32	5.32	10.21	1
DZ-01-974	81.87	65.79	53.12	66.93	0.94	6.53	2
DZ-Cr-44	70.84	57.67	48.36	58.96			5
Zezew	68.32	52.97	50.13	57.14			6
Asgori	70.57	52.00	48.27	56.95			7
Means	75.12	59.92	51.19	NS	5.94	15.62	

At columns NS= not significantly different (varieties*varieties) at P<0.05 and at rows significantly different (varieties*treatments) at p<0.05, LSD= least significant difference; CV= Coefficient of variation.

The maximum TGP at the highest level of NaCl (15 dS m^{-1}) was observed in Kora (55.69%), DZ-01-974 (53.12%), Quncho (52.28%) and Magna (50.50%) respectively. Accordingly, the overall ranking of Tef varieties on the basis of TGP indicated that, Kora, DZ-01-974, Quncho and Magna respectively were medium tolerant, whereas, the other Tef varieties were sensitive to saline environment.

Ec c c ac c the two ways of ANOVA for both varieties and levels of NaCl with respect to GSTI was found to be significant at (p<0.05).This indicated that, GSTI was significantly affected by the application of levels of NaCl and varied between Tef varieties under different salinity levels. The reduction was observed particularly at the highest level of salt stress (15 dS m^{-1}). The maximum GSTI at the maximum level of Nacl was recorded in Kora, DZ-01-974, Quncho and Magna respectively. The highest GSTI under all salinity levels was noted for Kora, which was closely followed by DZ-01-974, Quncho and Magna Tef varieties (Table 2).

Table 2. Germination Stress Tolerance Index of Tef varieties

Tef	NaCl salt levels (dS m^{-1})					
Varieties	10	15	Means	LSD ($p \leq 0.05$)	CV (%)	Ranking
Qunco	70.50	60.68	65.59	2.56	19.01	3
Magna	65.36	52.70	59.03	4.86	10.85	4
Kora	81.85	68.52	75.19	5.32	12.54	1
DZ-01-974	74.59	63.12	68.86	3.45	7.59	2
DZ-Cr-44	63.65	47.89	55.77			5
Zezew	57.62	45.36	51.49			6
Asgori	53.24	41.95	47.60			7
Means	66.69	54.32		6.34	12.62	

At columns (varieties*varieties) and rows (varieties*treatments) significantly different at p<0.05, LSD= least significant difference; CV= Coefficient of variation

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The analysis results of mean germination time (MGT) revealed that, increased salinity levels of Nacl significantly delayed mean germination time in all varieties. The two ways ANOVA implied that, varieties to levels of NaCl with respect to MGT was found to be significant at ($p<0.05$). However, there is no significant difference between the varieties with respect to MGT in NaCl levels. The highest MGT (9.27 days) of Tef varieties was observed at 15 dS m^{-1} of NaCl while, the lowest (5.56 days) was recorded at 0 dS m^{-1} of NaCl (Table 3). This revealed that, more saline environment MGT of Tef varieties. This is supported by Abida *et al,*. (2012), who reported MGT of varieties were significantly affected by the application of increased levels of salinity.

Table 3. Mean Germination Time (in days) of Tef varieties

Tef Varieties	NaCl salt levels (dS m^{-1}) 0	10	15	Means	LSD ($p \leq 0.05$)	CV (%)	Ranking
Qunco	6.24	6.74	8.28	7.09	5.66	11.08	3
Magna	6.38	7.53	8.72	7.54	4.82	9.85	4
Kora	5.56	6.52	7.07	6.38	8.02	10.84	1
DZ-01-974	5.87	6.79	7.59	6.75	2.84	8.53	2
DZ-Cr-44	6.74	7.80	8.83	7.79			5
Zezew	6.51	7.97	9.07	7.85			6
Asgori	6.57	8.00	9.27	7.95			7
Means	6.27	7.34	8.40		9.04	15.05	

At columns NS= not significantly different from each other (varieties*varieties) at P<0.05 and at rows significantly different (varieties*treatments) at p<0.05, LSD= least significant difference; CV= Coefficient of variation.

Based on the analysis result of TGP, GSTI and MGT of the Tef varieties evaluated at the second germination stage screening, five (5) better performing varieties; Kora, DZ-01-974 3, Quncho, Magna and DZ-Cr-44 respectively were selected and advanced to seedling stage screening.

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The analysis results revealed that, increasing salinity levels of Nacl significantly decreased in plant height and shoot fresh weight of all Tef varieties. Similarly, there is significant difference between the varieties in plant height and shoot fresh weight whereas, there is no significant difference between varieties and the increased levels of NaCl with respect to shoot dry weight (Table 4). The maximum values for plant height, shoot fresh and dry weight of all Tef varieties was recorded at control (0 dS m^{-1}) and the minimum values was recorded at the maximum value (15 dSm^{-1}) of salt concentration. Accordingly, the overall ranking of Tef varieties on the basis of plant height, shoot fresh and dry weight of Tef varieties, Kora, DZ-01-974, Quncho and Magna respectively were medium tolerant whereas, the others were sensitive to saline environment.

Table 4. The effects of NaCl on plant height, shoot fresh and dry weight of Tef varieties.

Means TETQq271.85 195.57 42.68 15.6 43 n/ /I1 9 Tf1 0 0 1 177.73 206.14 200 g[( )] TETQQ EMC q174.01 213.56 42.67 15.6 43 n/P <</MCID 1448 BDC q364.01 325.57 42 n26 43 n/ /I1 9 Tf1 0 0 1

Parameters	Tef varieties	NaCl salt level			Means	LSD ($p \leq 0.05$)	CV (%)	Ranking
		0 dS m^{-1}	10 dS m^{-1}	15 dS m^{-1}				
Plant height (Cm)	Quncho	33.64	27.15	15.82	25.54	3.19	13.35	4
	Magna	34.78	28.81	17.38	26.99	11.54	16.38	3
	Kora	40.60	32.30	23.05	31.98			1
	[redacted]		30.77	19.00	29.36	6.95	9.98	2
			18.12	12.39	19.24			5
	Means	34.91	27.43	17.53		8.07	10.54	
Shoot fresh weight (gm/pot)	Quncho	25.01	24.20	21.51	23.57	5.15	12.47	3
	Magna	24.80	22.23	21.84	22.96	4.89	18.10	4
	Kora	32.73	27.03	23.98	27.91			1
	DZ-01-974	27.10	24.00	20.81	23.97	8.55	16.30	2
	DZ-Cr-44	22.70	20.12	19.65	20.82	2.19	21.75	5
	Means	26.47	23.52	21.56		7.75	12.86	
Shoot dry weight (gm/pot)	Quncho	12.50	12.20	11.80	12.17	NS	25.18	4
	Magna	12.82	12.26	12.00	12.36		12.77	
					12.66			

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Although there is no significant difference in rows (varieties*treatments) and columns (varieties*varieties), maximum reduction of root fresh and dry matter of Tef varieties were observed at the maximum level of NaCl. The highest fresh and dry weight of root were observed in Kora, DZ-01-974, Quncho and Magna whereas, the lowest ones was at DZ-Cr-44. Accordingly, Tef varieties with the maximum value of fresh and dry weight of root were selected and advanced to actual field experiment screening.

Table 5. The effects of NaCl salinity on root fresh and dry weight of Tef varieties.

Parameters	Tef varieties	NaCl Salt Level			Means	LSD (p ≤ 0.05)	CV (%)	Ranking
		0 dS m^{-1}	10 dS m^{-1}	15 dS m^{-1}				
Root fresh weight (gm/pot)	Quncho	10.01	8.58	7.96	8.85	NS	10.54	3
	Magna	9.80	8.28	7.37	8.48	NS	12.88	4
	Kora	12.93	10.08	8.75	10.59	NS	3.94	1
	DZ-01-974	11.10	9.00	8.07	9.39	NS	8.17	2
	DZ-Cr-44	8.70	8.04	7.29	8.01	NS		5
	Means	10.50	8.80	7.79		NS		
Root dry weight (gm/pot)	Quncho	6.85	6.20	5.51	6.19	NS	13.45	2
	Magna	5.42	4.23	4.02	4.56	NS	5.87	4
	Kora	7.45	6.31	6.12	6.63	NS	12.36	1
	DZ-01-974	6.10	5.08	4.81	5.33	NS	18.30	3
	DZ-Cr-44	5.16	4.12	3.84	4.37	NS		5
	Means	6.20	5.19	4.86	[redacted]	[redacted]S	22.34	

At columns (varieties*varieties) and rows (varieties*treatments) NS= n[redacted]ifferent at p<0.05, LSD= leas[redacted] significant difference; CV= Coefficient of variation

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The two years combi[redacted] results of Tef varieti[redacted] there is non-s[redacted]ence at (p ≤ 0.0[redacted] though[redacted]eld were fo[redacted]th re[redacted]eties sh[redacted]st and second year of cropping season an[redacted]olerate saline environment. Therefo[redacted] varieties were recommended for yield and yield component maximization in Raya Alamata district.

Table 6. Combined mean values of yield and yield components of Tef varieties.

Tef varieties	DE(50%)	HD(50%)	MD(50%)	Ph(cm)	Nt	Pl (cm)	By (qt/ha)	Gy (qt/ha)
Qunco	5.17	49.27	81.21	87.00	6.28	30	58.31	19.31
Magna	5.84	50.05	82.16	83.27	5.25	29	55.85	16.88
Kora	6.31	49.19	81.52	94.41	7.34	32	64.63	22.77
DZ-01-974	6.21	49.24	82.24	86.35	6.31	29	60.00	20.13
LSD ($p \leq 0.05$)	NS	NS	NS	0.87	NS	NS	7.54**	2.07**
CV (%)	9.03	1.85	2.52	2.41	8.48	6.39	6.75	2.25

DE(50%) = Days to 50% Emergency; HD (50%)= Days to heading; MD(510%)= Days to maturity; Ph= Plant height; Nt= Number of tillers; Pl= Panicle length; By= biomass yield; Gy= Grain yield; LSD= Least significant difference; NS= non-significant; CV= coefficient of variance

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Soil salinity is an increasing problem in the world and main obstacle to agricultural productivity. The increasing distribution of salt affected soil in all continents minimizes the productivity of soil resources. Therefore, developing a strategy for salt tolerant crops under saline soil condition to attain [redacted] self-sufficiency and reverse ecological degradation for agric[redacted]sector is mandatory. Accordingly, for the last three years; screeni[redacted]ties/lines for salt tolerance were conducted at three growth [redacted]dling and actual field experiment at laboratory, lat[redacted]pectively through exposing to salt stress c[redacted] come up with consistent and conclu[redacted]

It is concl[redacted]y weights of [redacted]ed to increasing levels of NaCl. 4([redacted] ((((4(([redacted] (((yield and yield attributes(([redacted] (((6((((-8 [redacted] ((09=6 =((-9 1(([redacted] ((6 ([redacted] (varieties were selected as promising [redacted] environment particularly for the study area. The[redacted] varieties were recommended for yield and yield component maximization.

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