Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

Advances in Applied Science Research, 2012, 3 (2):1117-1121

Pelagia Research Library
ISSN: 0976-8610
CODEN (USA): AASRFC

Assessment of salinity tolerance of different promising lines of bread wheat (*Triticum aestivum* L.)

Maryam Asadi[1], G. Mohammadi-Nejad[2], P. Golkar[2]*, H. Naghavi[3] and B. Nakhoda[4]

[1]*Dep. of Agronomy, Islamic Azad University of Jiroft Branch, Jiroft-Iran*
[2]*Dep. of Agronomy and Plant Breeding, Shahid Bahonar University of Kerman, Kerman, Iran*
[3]*Agricultural Research Institute of Kerman, Kerman, Iran*
[4]*Agricultural Biotechnology Research Institute of Iran, Iran*

ABSTRACT

Evaluation of 342 synthetic lines of bread wheat with three ones of control (Arg, Bam, Kavir) at salinity and normal conditions was carried out during the 2009-2010 in Iran. Salt tolerance indices including: Stress Tolerance Index (STI), Stress Susceptibility Index (SSI), Tolerance Index (TOL), Mean Productivity (MP) and Geometric Mean Productivity (GMP) were calculated. Result of tolerance indices showed that GMP and STI indices were appropriate indices to identify tolerant lines in salinity stress. On the basis of these indices, 12 lines including (10, 32, 74, 86, 92, 98,114, 191,188, 297, 300, 326) were identified as the most tolerance lines. There were significant differences among evaluated lines and control lines for seed yield. The highest values for seed yield were observed in Arg and lines number of 5, 10, 32, 74, 95, 86, 98,115,117, 120, 118, 143,147,149,152, 176, 216,223, 225, 301,313 and 358 in saline condition. This study showed that salinity stress had significant effect on seed yield reduction of some genotypes. Therefore, selection of salt tolerance genotypes with consideration of their indices (e.g. GMP and STI) could be a good strategy for improvement of salt tolerance genotypes in bread wheat. It could be resulted that synthetic lines of 10, 32, 74, 86, 92,98, 114,188, 191, 297,300, 326 that had more seed yield than control varieties of Arg, Bam and Kavir, were identified as the promising lines for wheat breeding programs.

Keywords: indices, salinity tolerance, wheat, yield.

INTRODUCTION

Breeding for salinity tolerance of two staple crops in the world including wheat and rice is an important goal, especially for FAO [1]. Urban spread has reduced the area of prime available land for agriculture, so productivity must be increased to maintain global food supply. Food production is limited by saline soils in arid and semi-arid regions of the world [2]. More than 800 million hectares of the land are salt-affected in the world that equating to more than 6% of the world's total land area [3]. For example, Iran, Pakistan, Egypt, and Argentina are salt affected regions that about 23.8, 10, 8.7, and 33.1 million hectares of their total lands are salty, respectively [3].The development of salt tolerant crop has a significant importance on agricultural and economical aspects [4]. Wheat (*Triticum aestivum* L.) is a main cereal that has an important role for people nutrition in Iran.

Evaluations the effects of salinity stress on wheat yield have an important necessity for wheat breeding in arid regions. It is now realized that sustainability as well as productivity could be essential for wheat breeding. Stress indices have been used for screening stress-tolerant genotypes [5]. These indices could measure stress intensity based on yield loss under stress conditions in comparison to normal. These indices are either based on stress resistance or susceptibility of genotypes [6]. Rosielle and Hamblin [7] defined stress tolerance (TOL) as the differences in yield between the stress and irrigated environments and mean productivity (MP) as the average yield of yield of genotypes under irrigated (Yi) and rain fed (Yr) conditions. Fischer and Maurer [8] suggested the stress susceptibility index (SSI) for measurement of yield stability that apprehended the changes in both potential and actual yields in variable environments. Fernandez [6] defined a new advanced index, the stress tolerance index (STI), which can be used to identify genotypes that produce high yield under both stressed and non-stressed conditions. Other yield-based estimates of stress resistance are mean productivity (MP) and TOL. Clarke et al. [9] used SSI to evaluate drought tolerance in wheat genotypes and found year-to-year variation in SSI for genotypes. Guttieri et al. [10] suggested that genotypes with larger SSI values than had susceptibility to drought stress in wheat genotypes. Golabadi et al. [11] and Sio-Se Mardeh et al. [12] suggested that selection for drought tolerance in wheat could be conducted by high values of MP, GMP and STI under stressed and non-stressed environments. SSI indice and seed yield were used as stability parameters for identification of drought resistant genotypes in wheat [13].

The aims of the present study were to evaluate best salinity tolerance wheat lines from a broad germplasm of wheat cultivars and effective screen for identification of salt tolerance lines in bread wheat.

MATERIALS AND METHODS

Plant material and experimental setup

Collection of 378 lines of synthetic bread wheat was studied in this research. This experiment was carried out in two research field at Mahan (normal soil) and Ekhtiar-Abad (saline soil) in Kerman (56º58´ longitude and 30º15´, 2044 asl) in Iran at 2009-2010. After conventional operations including: field preparation, fertilizing, disking, leveling and furrowing, seeds were manually planted in two lines 2 (m) in length and 25 cm of interspacing. In each block (20 lines), control lines were grown in each line randomly. Fertilizer was applied at a rate of 200 kg ha^{-1} ammonium phosphate in planting and 250 kg ha^{-1} urea in dressing. In Tables of 1 and 2 the physical and chemical characteristics of soil is represented.

Table 1. Soil assay for physical and chemical characteristics (normal soil)

Characteristic	Soil depth (cm)	Soil texture	N(%)	EC (dS/m-1)	PH	P	K	Fe
							(ppm)	
Value	0-30	Sandy	0.22	1.11	7.7	8	112	0.98

Table 2. Soil assay for physical and chemical characteristics (saline soil)

Characteristic	Soil depth (cm)	Soil texture	N(%)	EC (dS/m-1)	PH	P	K	Fe
							(ppm)	
Value	0-30	Loamy	0.012	9	7	7	165	0.42

Measurements and data analysis

378 lines of synthetic wheat lines and check varieties (Arg, Bam and Kavir) were evaluated based on an augmented design with no replication under field conditions. The analysis of variance was performed using MSTAT-C software package. Mean comparisons were conducted using Fisher's test (P < 0.05). Two agronomical traits including plant height and grain yield were measured. 20 plants were randomly chosen from each plot.

Stress tolerance indices were calculated with the following formula:

$$SSI = \frac{1-(\frac{YS}{YP})}{SI} \quad SI = 1 - \frac{\bar{Y}_s}{\bar{Y}_p} \; [8]$$

Where Ys is the yield of lines under stress, Yp the yield of lines under normal conditions, $\overline{Y}_s$ and $\overline{Y}_p$ are the mean yields of all genotypes in stress and non-stress conditions, respectively.

TOL = Y_p-Y_s [14], $HM = \frac{2(Yp.Ys)}{Yp+Ys}$ [14], $GMP = \sqrt{Yp.Ys}$ [6], $STI = \frac{Yp.Ys}{(Yp)2}$ [6]

The data was analyzed using MSTAT-C, SPSS and EXCEL softwares for analysis of variance and mean comparisons.

RESULTS AND DISCUSSION

Analysis of variance studied traits based on augmented design is presented in Table 3. Results of analysis of variance showed that significant differences were observed between control varieties for plant height but there was not significant difference for seed yield. The effect of salinity was significant on seed yield and plant height (Table 3).

Table 3. Analysis of variance for of control varieties for evaluated traits

S.O.V.	df	Plant height	Seed yield
Stress	1	7446.75**	684235.37**
Replication ×Stress	38	61.3	1970.44
Genotype	2	1191.98**	798.09
Genotype ×Stress	2	17.16	9727.11**
Error	76	38.10	813.75
CV (%)	-	7.64	21.3

*** and * significant at P<0.01 and P<0.05 respectively, ns:non-significant*

Mean comparisons showed that the highest value for seed yield and plant height was observed in Arg and Bam varieties, respectively (Table 4). Salinity stress decreased significantly seed yield and plant height, significantly (Table 4). Shao et al. [15] and Rahnama et al. [16] reported that reduction in plant height and seed yield could be lead to a considerable decrease in plant growth, photosynthesis and canopy structure under stress condition.

Table 4, Mean comparisons of control varieties for studied traits under salinity stress

Cultivar	Plant height (cm)	Seed yield (g/m^2)
Arg	74.62^c	138.9^a
Bam	85.21^a	130.31^a
Kavir	82.22^b	132.46^a

Values followed by different superscripts (a–c) in the rows are significantly different at P < 0.05.

Seed yield and plant height at saline soil

The study of adjusted means of lines showed that 31 lines had higher seed yield than control varieties (Table 5). Also 73 lines had higher plant height than control varieties at saline soil which localized in class 1 on the basis of LSD test (Table 5). It is necessary to further study them. The other lines came to class 2.

Seed yield and plant height at normal soil

35 lines had lower plant height than control varieties at normal soil which came to class 2 (Table 5) and the other lines came to class 1 (Table 5). 114 lines had higher seed yield than control varieties at normal soil which came to class 1 and the others came to class 2.

Salt tolerance indices in control varieties

Among the stress tolerance indicators, a larger values of TOL and represent relatively more sensitivity to stress, thus a smaller values of TOL and SSI are favored. Selection based on these two criteria favors genotypes with low yield potential under non-stress conditions and high yield under stress conditions. On the other hand, selection based on STI and GMP will be resulted in genotypes higher stress tolerance and yield potential will be selected [6]. Low values of SSI and TOL and greater values of GMP and STI were belonged to Arg variety. The lowest values of GMP and STI were related to Bam, indicating that Arg had highest tolerance than Kavir and Bam (Table 6).

Indices of salinity tolerance in wheat lines

Greater values of GMP were related to lines number of: 5, 10, 74, 86, 92, 98, 114, 117, 142, 172, 188, 191, 222, 224, 240, 250, 269, 273, 297, 300, 312, 326, 339 and 369 (data not shown). Higher values of STI were obtained from lines number of: 326, 300, 297, 196, 191, 188, 148, 129, 117, 114, 98, 95, 92, and 86,74,32,10 (data not shown). Lowest values of SSI were belonged to lines number of : 3, 32, 10, 74, 142, 148, 154, 172,175, 203, 215,224,240,250, 278, 293, 313 and the lowest values of TOL were related to lines number of : 3, 24, 34, 36, 35, 131, 144, 154, 164, 278, 287, 291, 293, 310, 313, 318, 328, 353, 358 (data not shown).

Table 5. Adjusted means of wheat lines for seed yield and plant height under salinity and normal conditions

			Salt soil				Normal soil		
		Class 1			Class 2			Class 1	
plane height	plane height	plane height	grain yield	grain yield	plane height	plane height	grain yield	grain yield	grain yield
232	1	155	3	274	3	314	1	167	303
234	5	161	10	294	7	319	11	170	307
244	15	168	32	301	19	329	12	173	310
245	16	169	74	313	26	331	14	176	317
259	21	184	78	314	32	332	16	190	321
264	22	191	86	333	36		19	194	323
267	28	192	95	358	53		21	195	324
269	35	206	115	368	67		29	201	325
271	41	213	117	369	90		30	204	327
285	42	214	118		92		31	212	336
292	55	215	120		94		33	214	337
302	58	220	143		114		38	216	338
303	64	374	151		185		42	218	340
304	65	333	173		192		44	224	345
307	71	335	192		195		45	225	346
311	82	339	204		212		48	231	347
316	84	346	216		225		51	232	348
321	85	361	223		231		52	234	358
323	99	362	224		241		53	235	359
325	100	366	225		276		58	238	361
326	101	372	241		280		60	243	374
327	102	120	251		288		66	244	375
150	132	121			289		70	246	376
129	139				299		73	247	122
	131				309		82	249	127
							86	253	128
							92	256	129
							94	259	133
							98	260	135
							99	264	143
							105	265	152
							106	267	153
							107	271	160
							109	278	162
							110	280	165
							111	287	166
							114	294	120
							115	300	121
							117		

Table 6. Salt tolerance indices of control varieties and their seed under salinity and normal conditions

	SSI	T0L	GMP	STI	Yp	Ys
Arg	0.44	116.21	126.16	0.36	197.01	80.8
Bam	0.73	176.41	95.93	0.2	218.53	42.1
Kavir	0.65	160.44	105.40	0.25	212.68	52.2

REFERENCES

[1] FAO. **2010**. FAO Land and Plant Nutrition Management Service. http://www.fao.org
[2] Rengasamy P. Soil processes affecting crop production in salt affected soils. *Functional Plant Biology*, **2010**, 37, 255–263.
[3]FAO. FAO land and plant nutrition management service. Available online at::/[/www.fao.org/ag/agl/agll/spush/](http://www.fao.org/ag/agl/agll/spush/). Accessed 25 April **2008**; **2008**.
[4] S Dulai, L Molnar, Molnar- Lang M. *Acta Biologica Szegediensis*, **2011,** 55 (1), 73-75.
[5] J Mitra. *Curr Sci.,* **2001**, 80, 758-762.
[6] GCJ Fernandez. Effective selection criteria for assessing plant stress tolerance. In Proceedings of a Symposium. Taiwan, **1992**, 13-16 Aug. pp.257-270.
[7] AA Rosielle, Hamblin J. *Crop Sci*., **1981**, 21, 943-946
[8] RA Fischer, Maurer R. *Australian J of Agric Res*., **1978,** 29, 897-912.
[9] JM Clarke, RM De Pauw, Townley-Smith TM. *Crop Sci.,* **1992**, 32, 728-732.
[10] MJ Guttieri, JC Stark, K Brien, Souza E. *Crop Sci*., **2001**, 41, 327-335.
[11]M Golabadi, A Arzani, Maibody SAM. *Afr J Agric Res*., **2006**, 5, 162-171.
[12] A Sio-Se Mardeh, A Ahmadi, K Poustini, Mohammadi V. *Field Crop Res*., **2006**, 98, 222-229.
[13] KC Bansal, Sinha SK. *Euphytica*, **1991**, 56, 7-14.
[14] ABS Hossain, AG Sears, TS Cox , *Crop Sci*., **1990**, 30: 622-627.
[15] HB Shao, LY Chu, C Abdul Jaleel, Zhao CX. *C. R. Biologies*, **2008**, 331, 215–225.
[16] A Rahnama, K poustini, R Tavakkol-Afshari, Tavakoli A. *Word Academy of Science, Engineering and Technology*, **2010**, 71, 14-19.